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PROCEEDINGS OF SOCIETIES.

THE UNVEILING OF THE STATUE OF PROF. JOSEPH HENRY AT WASHINGTON.

On Thursday, April 19th, the ceremonies attendant upon the unveiling of the statue of Prof. Henry were performed by the National Academy of Sciences. We find the following account of them in the *National Republican* of the 20th *ultimo:*

Just at the left of the statue, which was closely wrapped, effectually preventing any glimpse of its actual appearance, was a raised platform covered with a handsome Persian rug on which were three chairs. These were for the Chief Justice, the orator, and the chaplain. The marine band was stationed immediately back of this stage, while the chorus was arranged on either side of the band.

Precisely at 4 o'clock, the hour appointed, the strains of the band were heard, and to the music of a grand march, "The Transit of Venus," the long procession of dignitaries marched from the museum to the platform.

Chief-Justice Waite, President Noah Porter, and Rev. A. A. Hodge then ascended the stage and took their seats, and without any delay Mr. Sousa, the leader of the marine band, waved his baton, and the grand Hallelujah chorus from Handel's "Messiah" was performed in superb style. The Chief Justice then announced that the Rev. Dr. Hodge would make the prayer, and nearly the entire assemblage rose to their feet, the men standing with uncovered heads while the reverend gentleman invoked the divine blessing.

"Eternal and almighty God, who from Thy throne in heaven dost look down upon Thy children in love, we thank Thee for the opportunity of meeting here on this occasion. We bless Thee that when Thou didst create this world Thou didst give unto Thy creatures the power of discernment of Thy law. We thank Thee that as thou didst send forth Thy prophets, so didst Thou also send Thy spirit unto Thy children that they might know and interpret the laws of this temporal life even as thy servants of old have shown us the way of the life to come. We bless Thee that Thou hast given unto us so much of an appreciation of the merits of our fellow man, that so many of us are gathered here to do honor to the memory of the man whose statute we are now to unveil. And we ask Thee, our Father, that as he has served his race and loved his God, his memory may live for all generations, teaching posterity that those who serve their Creator best, serve also His creatures best. We bless Thee for all Thy mercies with us and ascribe unto Thee all honor, glory, dominion, and power, forever, amen."

At the conclusion of the prayer Chief Justice Waite, chancellor of the Smithsonian Institution, delivered the following address:

"On the first of June, 1880, at the instance of Mr. Morrill, of Vermont, in the Senate, and of Mr. Clymer, of Pennsylvania, in the house of representatives, congress authorized the regents of the Smithsonian institution to contract with Mr W. W. Story "for a statue in bronze of Joseph Henry, late secretary of the Smithsonian institution;" and, availing themselves of the presence in Washington of the members of the National Academy of Sciences, with which Prof. Henry was so prominently and honorably connected for many years, the regents have asked you here to-day to witness the presentation to the public of the result of what has been done under this authority.

On the tenth of August, 1846, congress established the Smithsonian Institution to take the property which had been given to the United States by the will of James Smithson, of England, to found an establishment of that name "for the increase and diffusion of knowledge among men."

The business of the Institution was to be managed by a board of regents, and they were required to elect some suitable person as Secretary of the Institution.

On the third of December, 1846, the board met to perform that duty, and before entering on the election, adopted the following resolution:

Resolved, That it is essential for the advancement of the proper interests of the trust that the Secretary of the Smithsonian Institution be a man possessing weight of character and a high grade of talent; and that it is further desirable that he possess eminent scientific and general acquirements; that he be a man capable of advancing science and promoting letters by original research and effort, well qualified to act as a respected channel of communication between the Institution and scientific and literary individuals and societies in this and foreign countries; and, in a word, a man worthy to represent before the world of science and letters the Institution over which this board presides.

Immediately on the adoption of the resolution the board proceeded to the election, and the first ballot resulted in the choice of Professor Henry, then occupying the chair of Natural Philosophy in Princeton college. Experience has shown that the world possessed no better man for such a place. He was all the resolution required and more; and from the day of his election until now, the wish has never been expressed that another had been chosen in his stead.

He accepted the appointment on the seventh of December, and on the next day, the eighth, finished and sent to the regents an elaborate paper, giving his views of the will of Smithson, and presenting a plan for the organization of the institution. He entered on the discharge of his duties on the twenty-first of December, and from that day until his death, lamented by all, on the thirteenth of May, 1878—almost one third of a century—he was engaged in making the Smithsonian Institution what its munificent founder desired—an active and efficient instrument for the increase and diffusion of knowledge.

He was faithful to every duty, active in every work, and during his long official service lost no opportunity of making his trust what it was intended to be.

The statue which will now be unveiled has been erected by the United States as a token of gratitude for the labors of his useful life and for his faithful administration of the important public trust so long in his keeping."

Just as the Chief Justice finished speaking the lanyards were pulled, the covering fell away, and the statue of Joseph Henry was exposed to the view of the vast multitude, who greeted it with loud applause. The shapely head looked to the south and the far reaching eye bent its gaze, as on some distant object, beyond mortal reach. The sun, so long obscured, had at last pierced the cloud mantle that enveloped it, and as the veil of the statue dropped the sunshine fell on the well known head, gilding its bronze features with a golden glory. In the bright sunlight of accumulating truths had the great philosopher lived, and the first view of his statue in the open air was wrapped in the sunshine still.

Hardly had the applause subsided when the grand chorus, accompanied by the full marine band, sung "The Heavens are Telling," from Hayden's "Creation," under the leadership of Prof. R. C. Bernays, with a volume of harmony rarely heard, and never before listened to in the open air in this city.

When the last chord had died away the Chief Justice introduced Rev. Dr. Noah Porter, President of Yale College, who had been selected as the orator of the occasion. Dr. Porter said:

"We are assembled to complete the long series of public honors to the late Joseph Henry as we unveil the statue which has been erected to his memory. These honors have been manifold, but all have been well deserved and most cordially bestowed. His funeral obsequies were attended by the President of the United States and other officials of the Government which he had so faithfully served, by representatives from many learned and scientific societies of which he was a conspicuous member and ornament, and by a large following of those who honored and mourned him as a friend. Subsequently a more formal commemoration of his scientific and public services was held at the Capitol, at which were present the Executive of the Nation, the Judiciary, the Senate and House of Representatives. On this occasion a discriminating and sympathizing sketch of his personal and public life was given by one who had known him long, and was singularly qualified to do him justice in every particular. This was followed by other warm and eloquent tributes to his genius as a philosopher and his excellence as a man. Memorable among these were the ringing words of the noble Rogers, whose own sudden euthanasia was like the translation of a prophet, and the warm-hearted eulogy of the generous and glowing Garfield, whose noble life was slowly wasted that it might measure the intensity of the Nation's sorrow. Many if not all of the institutions of the country with which Prof. Henry had a more or less intimate connection, have honored him by records and estimates of his services to science, education, and philosophy. The tributes to his honor from other countries have also been hearty and numerous.

Last of all, the two houses of congress, with the approval of the President, have ordered that a statue in bronze should be erected within the grounds of the institution which was the creation of his genius and industry, as a permanent memorial of his services and worth. This statue is now completed and has this moment been unveiled to public view. We are assembled to receive the first impressions of this enduring monument, which we trust will stand for many generations and declare the fame and attest the manifold excellences of this eminent servant of science and benefactor of the American people."

Dr. Porter then proceeded to sketch the boyish life and initial investigations of Henry. His portrait of the sensitive and dreamy boy, "who found enough in the common earth and air and the play of common scenes to stimulate his creative powers and to furnish material for his long day dreams, as he lay on the sunny hillside and looked into the glowing sky," was striking and graphic. The economies of the boy's household were straitened, but not ignoble. The brief space of time in which he cultivated the imaginative was gracefully touched on. and the awakening to the inducements of science was also beautifully portrayed. His calm, gradual, but sure progress onward was described, until he became a professor in the Albany academy.

"At the age of twenty-eight we find him a professor in the academy at Albany, of which he had been a graduate, tasked with the work of teaching several hours every day, and tasking himself with burning zeal over every possible inquiry in chemistry and physics. As we have said already, it was in the brilliant dawn of modern chemistry. As the new science steadily rose above the horizon, one new discovery after another flashed its light toward the zenith and indicated its upward path of triumph. In its train appeared those new and mysterious agencies which were then just beginning to fix the attention and to task the analysis of the oldest and newest discoverer. To those novel phenomena the young Professor Henry devoted his special attention and soon astonished the world by achievements which first awakened the excitement of bewildered wonder to convert it into the homage of amazed conviction. There was nothing to be said when as the plunger went down into its bath the impotent bar of iron became possessed of a giant's strength and could pick up and hold a weight of more than a solid ton, and as the same plunger was lifted this gigantic energy vanished as at the word of an enchanter. The speaker well remembers the excitement which this discovery occasioned when the first experiment was tried at Yale College in the presence of a few spectators who casually met at the call of Professor Silliman, who was glowing with animation and delight. The ponderous platform was loaded with pig iron and other heavy weights, with a few slight additions of living freight. Among the last was the speaker, being the lightest of all and, therefore, convenient to serve on the sliding scale. It is more than fifty years ago, but the scene is as vivid as the event of yesterday."

Briefly noting the successive discoveries of the daring young scientist in the same field until they made assured the telegraph and the telephone, with their wonders of written language and audible speech, the orator continued:

"From Albany, in the year 1832, Professor Henry was transferred to Princeton through the wise sagacity of our honored associate, Rev. President John Maclean, and the generous and cordial recommendations of some of the most honored leaders of American science. The step was a bold one, and might seem almost rash, to transfer to a college a man who had himself lacked the breadth of early culture and the discipline and variety of scientific thought which the college curriculum is supposed to give. His insight into nature's secrets might seem to be magical; but for this very reason could he share this secret with his pupils? Would not the very swiftness of his own processes of thought disqualify him from imparting them to others? Would not the lightning rapidity with which, as a discoverer, he had leaped from indication to theory and combined probabilities into evidence hinder him from discerning that there were any steps in the process or any articulation in the proofs? Whatever misgivings of this sort there might have been—and the failures in teaching of many eminent scientists have proved that they were not without reason—were all set aside by his acknowledged skill as an instructor at Albany and his prominent success at Princton. Not only did he give himself to instruction with exemplary zeal and painstaking, but he studied the theory of teaching as he studied electro-magnetism, by reflecting upon its conditions and laws, and using wise experiments in concrete applications. He did more. He used his special studies as examples of general philosophical inquiry, whatever might be the subject matter, and sought by means of these to introduce his pupils to the theory of inductive research and the nature of scientific evidence, however they should be applied. This was a subject which he had ever at heart, the discipline of the mind to a true philosophic method as the best preparation and security for sound science, clear insight, strong convictions, and practical wisdom.

This active and fruitful life continued for fourteen years, when, at the age of forty-eight, in the year 1846, he was called to Washington as the first secretary of the Smithsonian Institution.

At first it might seem that a situation like this would be attractive to any man, but on second thought many reasons would suggest themselves why, to a man like Professor Henry, interested as he was in teaching, devoted to research and with the scientific world watching eagerly his experiments, the attractions of the place should be scanty and feeble. It is only when we learn how he regarded the possibilities and demands of the place, and his own capacity and purpose to meet them, that we can explain the readiness with which he responded to this call. The secretary was to initiate and control the policy of a novel institution, with a handsome but not extravagant endowment given to the United States for the increase and diffusion of knowledge among men. Loosely interpreted, the terms of the gift might admit any application of popular usefulness. But when read in the light of the known tastes of the giver and the previous bequest of the estate to a society which was severely scientific in its functions, and especially when interpreted by the eminent need and certain usefulness of a special application, it was clear to Professor Henry that it should be used exclusively in the interests of the increase and diffusion of scientific knowledge. He foresaw and foretold that his theory would at first encounter active dissent and opposition. He was equally confident that it would finally become popular and attractive. Before he entered upon his duties the institution had been partially committed to another policy. It was not until after eight years of discussion and reports in committees and in both houses of congress, in which some of the ablest and most brilliant members were conspicuous, that the policy of Professor Henry at last prevailed, and has ever since justified itself to the approval of the nation. It was not that Professor Henry despised literature that he did not favor the attempt to found a splendid library, for few men were more sensitive to its charms or appreciative of its powers; much less that he did not understand the value of a museum to an ardent interest in which he was pledged by his fondness for natural history and his curious zeal in ethnology and archæology, but because he saw a need and opportunity for an institution that should be limited to the increase and diffusion of scientific knowledge. *Finis coronat opus.* The experiment has justified the theory. Not only have the workings of the Smithsonian Institution vindicated the wisdom of his anticipations, but it is itself a monument to his strong convictions and his unyielding tenacity, tempered as these were by singular simplicity, patience, and unselfishness. Had it not been for these characteristics the Smithsonian Institution as we know it would never have existed at all. Were it not for the modesty of the man we would hear this statue speak as it surveys the scene of his life work, "*Si monumentum quæris, circumspice.*"

Then showing that the library, the museum, and the art collection had thrived better than if Professor Henry's policy had failed, the orator continued:

"It would not have been surprising if his scientific ardor had thereby been cooled, his invention had been limited, and his many-sidedness had been curtailed. This does not seem to have been true. From the beginning to the end of these more than thirty years he was almost as inventive, ingenious, alert, and wide-minded as when he achieved the triumphs of his early manhood. Though many of his discoveries and inventions were in the line of his official responsibilities, they all bore the stamp of scientific genius. During all this period it should be remembered the sciences of nature were making a progress such as the world had never witnessed before—progress in every form, from the severest mathematical analysis, through ever-ascending steps of adventurous speculation, up to the most gorgeous cloudlands of theory. Experiment, too, had never made such daring ventures, whether in the form of applications to art, or the determination of problems purely scientific. With every one of these onward movements, whether of theory or experiment, Professor Henry was in active sympathy. In many of the most important he was the leader of thought and act, as witness his place in the very first anticipation of the doctrine of correlation of forces; his prophetic experiments and suggestions in respect to the use of the telegraph in meteorological observations and the reports of astronomical discovery; his devices to render available the reports and essays, scattered over the scientific world, by systematized bibliography; the long-continued researches in respect to light and sound, which were incidental to his official experiments as a member of the light-house board; his comprehensive experiments in respect to the sustaining capacity of building stone, and his never-ceasing study of acoustics in every possible production, prolongation, and disturbance of sound, whether in his own parlor, in solitary walks, in fog or sunshine, or in travel by land or sea."

Briefly alluding to the dark days of the war and the lofty bearing of Henry during that period, which lifted him above personal bitterness from any man, the orator dwelt on the singleness of purpose actuating the Secretary of the institution. That singleness of purpose lifted him above jealousy, envy, and even the idea of a reasonable compensation for his labors. He never directly or indirectly sought for place or honor, nor even asked for increase of pay. Continuing, the orator said:

"In the wars of theory against theory he was recognized as an upright mediator, who thoroughly understood the criteria by which scientific truth can be established, and would impartially apply them. If political, or ethical, or theological traditions seemed to conflict with established scientific principles or facts, he calmly awaited the issue, and insisted that science must have its rights, whatever might be the consequence to any received ethical or theological interpretations. Though his own faith was fixed and fervent in respect to the leading Christian verities, he scorned, with all the energy of scientific integrity, to apply these convictions as a test to any question that was properly scientific. It would have been strange in a man who was always learning something new, had he not modified his views of objective and practical Christian truth with the progress of his mind and his manhood, but he would never acknowledge any base compromise of sentimentalism, or mysticism, or one-eyed dogmatism, with the processes or conclusions of his scientific thoughts. Within the domain of science proper he was a clear-eyed, impersonal, and uncompromising arbiter and judge. Theorists might complain, dogmatists might rage, zealots might bemoan, but not one of them would dare accuse the judge of an ignorant or partisan decision.

For all these high and varied functions, in his high position, Professor Henry had one supreme advantage, in that he had not only studied and mastered so many of the sciences of nature, but that he made science itself, in its principles and processes, the subject of his profoundest reflection. We have abundant evidence that from the time when he made his earliest ciscoveries his mind was not content to search after the secrets of nature without, but was equally curious to discover the secret of the processes by which man interprets the forces and laws which nature hides with such studious reserve. From the time when he began at Princeton till the end of his life, this was prominently and avowedly the theme of his constant meditation. In making this a study he was not singular among eminent scientists, but only in that from the beginning to the end this seemed to haunt him as the most wonderful problem of all. This habit forced him to contemplate all the sciences of nature as an organic whole, having intimate relations that are broader and deeper than those which are limited to any single class of phenomena. It forced him to study and question most closely the process of knowledge, the sublimest and most fundamental phenomenon in nature, that he might know how far to trust its products, and by what criteria to test its conclusions. We find evidence of this habit of mind in the questions which he suggests in his earlier essays, and in the partial solutions which he gives in his miscellaneous writings. Such a habit would insensibly train him to exalt the human intellect in its higher functions, with its principles and laws, its axioms and institutions, its theories and anticipations, its forecasting questionings, its creative hypotheses, its tentative theories, and its decisive experiments, and to assure himself that an agent or agency such as this could have no affinity with matter and own no allegiance with physical laws. Even the suggestion that the thinking agency which interprets the universe by authoritative question and answer could once have slumbered in a fiery cloud, or could have been evolved from any material mind-stuff by any series of physical processes, however daintily phrased, seems never to have been entertained by him for an instant as having the semblance of scientific probability. And yet there is abundant evidence from his writings, both early and late, that he was in no sense behind the times, or ignorant of the fascinating plausibilities of the newest and most fantastic of theories. While he was almost the earliest in the field to formulate and defend the doctrine of the correlation of forces, and to concede that it might be applied to all the processes that are properly physiological, he was equally sharp and positive in the assertion tha mental agencies of every kind cannot be the correlate of any physical agency but are simply directive. He insisted, with equal positiveness, that the so-called vital force cannot be the product of any mechanical or chemical activity, single or in combination, but must be a directive or constructive agent of itself. Later in life he recognized the manifold indications of the presence of a law of progressive variation in the history of animal and vegetable life, and so far accepted evolution as a working hypothesis. But had he been asked at any time whether evolution as a force, or evolution as a law, one or both, apart or together, could explain the origin of life or living men with intellect and will, and the capacity for science and faith in science, I think he would have regarded the question somewhat as though he had been asked whether he believed in the vortices of Descartes, or Kepler's directing angels. Had this doctrine been defended in a scientific association, either in the soaring gyrations of winged speech, or the dry assertions of dogmatic positiveness, I am confident he would have remanded its champions at once to the blackboard, and have begged them first to explain whether evolution were an agent, a force, or a law, and desired them to identify it if it were a force, or to formulate it if it were a law. Large as was the sphere which he assigned to the imagination, and important as the role which he allowed to hypothesis, he would bring every theory, however brilliant and plausible, to the triple test of coherence, sufficiency, and experiment.

Forward and hopeful as he had been all his life long to follow the fruitful suggestions of analogy, he never would allow this winged steed to traverse the chasms of scientific theory with any flying leaps, without insisting that it should fold and pack its pinions and then carefully retrace its steps over that hard pathway of fact and law which alone can carry us safely from a scientific hypothesis to a scientific truth. The science of America owes somewhat to his example and authority in this regard, that its brilliant promises and solid achievements have been so far kept free from the speculative audacities and the physiological cosmogonies from which the science of England and Germany has not been wholly exempt.

This, be it observed, was his position within the domains of pure science. For the region beyond, whether it is called the domain of philosophy or the domain of faith, let it suffice to say that he had too positive a respect for his own mind to doubt for an instant that this intellect was the reflex of that supreme intellect which sustains and controls the universe which the scientist interprets. The existence of a personal God was accepted by him as a well-nigh self-evident truth, as necessary to our confidence in scientific study as to our hopes for man's social and moral well being. The moral and spiritual capacities and destiny of man were regarded as dominant facts and chief ends of the universe made up of spirit and matter, facts and ends so important and so pressing as to create the need and establish the truth of the Christian's faith and hope. He believed, moreover, in no inherent law of progress in human nature or human society as such. On the contrary, he asserted often that our supreme hope of such progress, even in scientific culture and achievement, must rest on moral integrity and culture as the supreme conditions."

The orator then dwelt on Henry's fixed idea that immorality is incompatible with the exercise of great mental power in scientific research. He had proposed to prepare a paper for the Philosophical Society on the relations of religion and science, and also upon the true import of prayer. This, however, he was not permitted to do. But he believed in and found joy in prayer. Almost his last words were: "Upon Jesus Christ, the one who for God affiliates himself with men, I rest my faith and hope!" He concluded with the following peroration:

"For more than fifty years, the most memorable and critical which the sciences of nature have ever seen, he has been indeed a guiding star to their devotees in all this land, ever shining with a severe yet commanding light.

During the critical years of its young and buoyant life American science has found much of the guidance and inspiration which it needed in his childlike yet kindly spirit. And now as it rejoices in the security of its position, and its ever increasing honors, it is most fitting that its assembled representatives should here gratefully acknowledge their obligations to their eminent benefactor and distinguished leader, and cordially welcome this statue, which by its commanding presence gives new dignity to the grounds so long honored by his presence and associated with his name. Long may it stand to express to them and to other generations the sturdy self-confidence, the keen insight, the benignant spirit, the soaring yet docile genius, the self-relying yet devout temper which made him a leader and commander in their conquering hosts. And as here by day and by night, in sunshine and in storm, our honored friend shall ever, as in his lifetime, keep watch and guard over the scene of his cares and labors, of his conflicts and triumphs, so may his memory be kept in fresh and grateful recollection by the coming generations. And as this Institution, so eminently the creation of his mind, shall become more and more busy in its activities, and more and more conspicuous in its usefulness and its fame, may the spirit of its eminent originator continue to inspire its aims, and direct its counsels to the strength and glory of the nation and the well-being of man.

"To the well-being of man." For let us never forget that science knows no nationality; least of all in this place, and in this institution, which was the gift from the mother to the daughter land, whose sacred trust and solemn duty has ever been, as it ever should be, to promote "the increase and diffusion of knowledge among men."

President Porter was frequently interrupted by applause as he eloquently depicted the life and character of the distinguished scientist. At the conclusion of his address he was greeted and congratulated by Chief Justice Waite and a number of other eminent men, among whom were the General of the army, the Commissioner of agriculture, Secretaries Teller and Lincoln, Representatives Kasson and Pettibone, the Civil Service commissioners, and many others.

During the congratulations the marine band executed "Schiller," a grand triumphal march by Meyerbeer, and the exercises were concluded.

EDUCATION.

NATURE STUDIES FOR THE YOUNG.

PROF. S. H. TROWBRIDGE, GLASGOW, MO.

One of the peculiarities of the Yankee character is its fondness for whittling. Having a sufficiency of Yankee blood in my veins, I yield to its natural tendency and attempt to whittle out a tooth-pick. I take two square pieces of pine board and a sharp jack-knife, and begin. I saw off five thin slips from the end of one piece and carefully essay to whittle it to a point. I find, in spite of my best efforts, that, just as soon as it begins to approach a point, it breaks square off and, instead of the desired acuteness, nothing but a blunt end appears. I try another and another with the same result till the whole block is used up and, after all, have failed to make a single sharp point, and, of course, have no tooth-picks. Undaunted, I take the other block and split it *with the grain* into just as many strips as I sawed off before. Now, with much less care in working and in much less time, I have made five neat, uniformly tapering, sharp, symmetrical, effective tooth-picks. Why, now, did I succeed with the last lot and signally fail with the first? The answer, obvious and conclusive, is that in the first case I went the wrong way to work; I tried to sharpen the sticks across the grain.

If I understand the teacher's work, it is primarily to sharpen and make effective for the future use the minds of his pupils. And according to the best of my observation and experience, most have, in the main, gone the wrong way to work. They have tried to work the material across the grain. Now, obviously, the first thing to consider in making the tooth-picks was the best way of working the pine. Equally obvious is it that the first consideration of the intellect sharpener is to know something of the material with and upon which he has to work. What is the bent of mind he has to sharpen? What is the natural order of mental development? What are the first things that attract the attention of the opening mind? Are they definitions, rules, principles; or are they facts? There is clearly but one answer. As facts, are they conceived or perceived? Are they presented to the mind from within or from without? Do they affect his consciousness or his senses? When does a child's education begin?

The first things that attract the attention of children are the objects and events of nature which they see everywhere about them. And their first inquiries are for information concerning the *what*, the *how* and the *why* of those phenomena which affect their five senses. Every child is born a naturalist; and, if his laudable curiosity is encouraged and his questions receive clear and helpful answers, he will soon become delightfully interested in his original investigations, which, in all his life, will be an inexhaustible source of pleasure and profit. By thus habitually using his eyes and thinking of what his sight reveals, he will be continually learning, and *without a conscious effort*, the facts of nature, then their relations to one another, and, in time, the laws which regulate them, and, even before he realizes it, he will be doing valuable scientific work. An excellent educator, Prof. E. S. Morse, says: "To collect in the field, to make a cabinet, and then to examine and study the specimens collected, are the three stages that naturalists, with few exceptions, have passed through in their boyhood." At the same time he will be finding enjoyment richer, purer and more exalting than mere amusement, and will be attracted from much of the mischief Satan finds for idle hands. If much of the money and time spent in procuring toys and games for *amusing* the young were employed in teaching them to enjoy the objects of nature many of which are always present and cost nothing, it would result in present and life-long advantage to the child, and would relieve the fond parent of many an imploring and perplexing cry—"Mamma, what can I do now?" and much of the sleepless anxiety over wayward children in later years. "As the twig is bent, the tree's inclined."

A most pressing need of every child, as his opening mind begins to inquire into the mysteries of nature, is some one at hand to encourage his inquiring spirit by judicious and well-directed assistance, and to stimulate his mind to an activity which will increase and strengthen through life. Those who know enough of nature to teach it properly to the young, and to encourage them to *acquire the habit of observation*, are justly said to be a desperate need of the present age. But how soon are their childish inquiries on these points rebuked,—often with the command to cease their troublesome questions,—and thus their innate curiosity, which is only a thirst for knowledge, is checked, their youthful ardor with its mental stimulus changed to indifference and often to *stupidity*, because those who should give the help needed are unable to do so. The real and only practicable remedy is in the ability of the parent to give the child the help he craves. In the absence of this, his next best recourse for assistance is to his teacher. But how or where is either parent or teacher to acquire the ability? If not at home, then certainly at school, if at all. And educational institutions of all kinds which do not supply this lack are manifestly remiss in a most essential line of work.

Does a child's education commence when he first begins to learn from books? According to the present method of reversing the order of nature, it is far more likely to *end* there, and to be henceforth nothing but a servile acceptance, for absolute and unquestioned truth, of the statements and opinions of text book and teacher. Every teacher who has honestly endeavored to *educate* his pupils, in the proper sense of the term, has been painfully impressed with the fact that the first, and usually the last and only, effort of nine-tenths if not of ninety-nine hundredths of his pupils, to whom he has given a question requiring independent thought and the use ot *their own* eyes and minds, is to seek help from the printed page; this failing, the parent or teacher, the big brother or sister, is implored to impart the needed information. If these fail the pupil is sure he has exhausted every conceivable resource, and confidently gives the all-conclusive reply: "I can't answer that question because I couldn't find it in the book, and mamma didn't know." Or if he propounds a question requiring individual study to an adult Bible-class, the first response, if not the only one, is likely to be: "What do *you* think about it?" or "I will look it up in the commentary."

The bane of the education system of to day is its obsequious subserviency to authority. The popular craving to be imposed upon is an attractive demand which many hasten to supply; and the rich abundance of both supply and demand react upon each other and both to an alarming extent are thereby increased. And I lay largely at the door of the common method of exclusive text-book and lecture instruction in various branches, and especially in the natural sciences, with its servility to the words and opinions of the author, without personal investigation or inquiry, and the cramming of undigested and indigestible statements into the young mind, the fact that the popular world to-day is overwhelmed with a deluge, vaster and more universal than Noah's, of crude suppositions and wild theories which are turning the world upside down. And it can never be set right till young and old have learned to be fully persuaded in *their own* minds—not in another's, and to prove all things by individual, independent thought.

Now how can this independence of mind be best acquired? This question suggests a consideration of the relative value of studies usually pursued. Did space permit, it would not be difficult to show that, while all are valuable and none can be entirely dispensed with, the best results in furtherance of *every* legitimate design of school instruction are to be looked for in the realm of nature studies; and that these ought to have, through the whole course of school and college instruction, and especially in the early part of each, *at least* as much time and attention as any other branch of study.

The time one can devote to educational pursuits—which during the time are unproductive—is, at best, but short. And, if we accept the statements of those who ought to know, its brevity is increasing. In other words, the "ratio of graduates to our population is continually diminishing." This decline, which is a sad one for the educational interests of our land, is attributable to the fact that the education of to-day does not keep pace with the demands of practical life. If we would have our people receive a thorough education, we must establish a closer relationship between the studies of the schools and the pursuits of every-day life. This has been forcibly urged by such educators as Winchell, Youmans, Dawson, Spencer, and others; and there is still need of the continual rubbing that shall at length wear away the ruts in which educational methods have run from primeval times.

Of course, the shorter the time one can spend for his education the more imperative the demand for such studies from the start as will be of most advantage to him in after life. But we hear on every hand the statement that every pupil *must have* reading, spelling, geography, grammar, arithmetic, history, some ancient and modern languages, a little music and art, and with these indispensables they have no time for such such superfluities as scientific studies. Is this system based upon the soundest reason from our present stand-point of observation? If it was best in times long past this does not prove it the best now; but rather, if the times have changed the probabilities are that the *demands* of the times have changed also.

Passing over other points of inquiry respecting the benefits of nature studies, let us spend a few minutes upon the two questions most prominent in ideas of education: (1) as to their value for strengthening and sharpening the intellect and (2) their practical use, as compared with other studies.

As a means of intellectual culture science has no superior. The first requisite to success in any line of effort is *interest* in it. The attractiveness of natural objects and the peculiar fascination in the study of nature, to all who have learned to *see* these things, afford a degree of interest and mental quickening which is found in no other studies. Ancient classics and mathematics *have been* considered superior to all other means in mental discipline. Advocates of the Greek and Latin languages "claim that their disciplinal value is in the ratio of the naked retentive power which they call into exercise." Without detracting in the least from these, we simply ask what can be a greater tax upon the memory than to retain the names, classification, structure, and habits of the hundreds of thousands of animals and plants upon the earth? It is also claimed that language disciplines memory and strengthens judgment by a study of its grammatical structure. But does it require more of the mental effort that promotes these than does the determination of minerals, the analysis of complex chemical substances, or the determination of the proper position in the scale of life to which any animal or plant belongs, or the exact horizon of a disputed stratum of rocks? The study of mathematics has the credit, and justly too, of giving great power to the reasoning faculties. But whether it is superior in this regard to what is called moral reasoning, admits of question. What can require greater depth of thought or strength of reason than to study out the plan of God in forming and controlling the material universe? The study of nature has for its object the solution of this great problem with all its corollaries. What problem or problems in mathematics can require more profound research? Mathematics is generally regarded as dealing with facts upon which the mind can rest; but scientific reasoning is more a balancing of probabilities. The latter requires constant exercise of reason and judgment to see that the opinion held has a preponderance of probabilities in its favor; while the former demands less mental exertion and hence affords less intellectual power.

Again, the notion is manifestly prevalent that geography, grammar, reading, spelling, the classics, and especially mathematics, are of more practical use than science to the majority of mankind. That they are of use to all, and in more and higher ways than is commonly supposed, and that science is one of the largest beneficiaries, is gratefully admitted. But in the ordinary acceptation of their use in common life, we beg in all candor to know and challenge a satisfactory answer, what real use ninety-nine in every hundred have for any more of mathematics than the four fundamental rules of arithmetic, or of classics than can be obtained from an unabridged English dictionary and a literal translation; and what real use nine hundred and ninety-nine in every thousand have for more of mathematics than can be found in an intermediate arithmetic, or of ancient classics than can be acquired in a single year; also how much *real proficiency* any one attains in geography, grammar, history, reading, spelling, and the like till after he has left school and finds a need of a thorough knowledge of these things in the practical affairs of life? Who, except those who have never tested it, has any reasonable expectation of obtaining a satisfactory solution of a question requiring independent thought, or even the correct statement of a fact, on any of these subjects, from those yet in school, who have there glibly recited the principles involved over and over again?

The growing popularity of natural science, at least among those who give any adequate consideration to its claims, its increasing value and demand in all walks of practical life, and the long array of questions of deep, and many of vital, importance which it has to solve, sufficiently demonstrate its importance to every thoughtful mind.

Many of the blessings of science are so common that we forget to be thankful to any source of good for them. To make us fully appreciate the value of a simple pine stick with sulphur and phosphorus on its end, we need to go back to the days of the tinder-box, to lose the last match in a vain endeavor to start fire in a far-off camp, or to be compelled, as was its inventor, to suffer the "gravest inconvenience from his tedious efforts to obtain a light from flint and steel" while preparing chemical lectures at four o'clock on winter mornings. Before we can realize how much we owe to science, we need to lose, for a time, the benefits of chimneys, pumps, time-keepers, glass and earthen-ware, coins and other alloys, bleaching, illuminating gas, all kinds of machines, from the pin to the steam-engine, applied science in arts and manufactures, and other indispensables without number which science has given us. Most of the inventions which are now gaining wealth for the inventors and the public are made by application of the principles of physical science to the varied and rapidly increasing wants of man. And those who fully understand these principles are the ones to whom we reasonably look for the discoveries and inventions which are to benefit, enrich and bless mankind.

A critical inspection of the later and somewhat less popularly understood benefits derived from each branch of natural science, might add to the strength of this discussion, especially those in the line of electricity, of mining and agriculture, and particularly in relation to the ravages of insects upon crops, and their remedies; but space forbids.

But it may be said that science studies in schools have not shown the good results that are claimed for them. This is true, and the reasons for it are clearly seen. In the first place they have not had a fair chance. They have had far less time and attention than other studies. As a rule school boards, teachers, parents and pupils have a lower appreiation of nature studies, and less interest in them than their importance demands. On looking at the facts in the case, this is not at all surprising. One's interest in any subject is just in proportion to what he knows of it and does for it. The chances are against a fair acquaintance with science from the simple fact that so few schools, comparatively, teach it by the only method by which it can be learned. Again, if a teacher has been so fortunate as to have learned as much of these as of other studies, and enough to see somewhat of their rare attractiveness and value, he will find few positions in schools of any grade, especially in the West and South, in which he will not be expected to teach more or less of all branches of study in the school course; and, if he is sufficiently interested in any one study to thoroughly master it, he will have neither time nor inclination to master others. Or, briefly stated, the chances are against his choosing science as a specialty, and if he does he will be practically forbidden to give it special prominence. Science in schools must, therefore, be an underling till teachers of science refuse to waste their own time and that of their pupils in attempting to teach what they have no time or taste to thoroughly understand. All education must suffer till a judicious division of mental labor will neither require nor allow one to teach these topics for which he has not himself sufficient enthusiasm to inspire his pupils.

Another reason for the too prevalent notion that what is in reality the most charming line of study is the most dry and void of interest, is that these subjects are taken up so late in the course of study that the pupil never acquires the scientific method. He is set to learning definitions, laws and principles before he has been allowed to see any basis in fact and reason for them; compelled to accept the conclusion before he has considered the premises; and to crowd the memory with long lists of hard names relating to objects of which he has no intelligent conception, because he has never seen or carefully examined them.

Again, when science *has been* accorded its fair share of opportunities, these have, for the most part, been practically wasted by *wrong methods*. It is a sad mistake, though I believe a ruinously common one, to think the teacher's work is to impart information. The teacher ought not so much to be a good conductor as a good exciter or electric. The parent does not best serve his child when he hands from his own purse whatever the boy wants; but rather he who with holds every possible cent which the boy can earn for himself, and bestows the most precious gift when he teaches him to earn his own money. The history of great men is of those whom some circumstance—usually poverty—had compelled to help themselves. And I believe the best teacher is the one who imparts only the least possible information that will inspire and foster thought, and only helps his pupil to think and acquire for himself. A stuffed turkey is not remarkable for intellectual power, but is about as much so as a stuffed boy, and certainly far more agreeable to a cultivated taste. A porker once chewed up for a friend of mine a leather purse containing $300.00 in bills of his own hard earnings. It made just about as much fat on the hog's ribs as 300 thoroughly digested and well-put statements from a teacher would benefit an ordinary school boy. That which costs one nothing is no more a good to him than the funds which others have earned serve to enrich a cashier who receives without appropriating them.

One can progress more rapidly to carry a child than to teach it to walk. To answer a question or solve a problem for a pupil is easier than to lead him on to his own solution. But the quicker and easier way only weakens the child by fostering the spirit and practice of dependence. Again there is a strong temptation ever besetting a self-conscious teacher,—and it might well be called his easily besetting sin,—to exhibit on every occasion his own superior knowledge, by putting forth his own views before his pupils are given a moment's time to reach a conclusion for themselves. By thus robbing them of the opportunity to form an opinion of their own, he does his pupils an irrepairable wrong. All honor and praise are due to the rare virtue of an instructor with a self-forgetful devotion to the best interests of his pupils which allows them to think by with holding his own thoughts.

The best educators of to-day are thoroughly convinced that a knowledge of science never was and never will be acquired from books alone. The *only* way to become acquainted with nature is to study *nature herself.* I would as soon expect to fall in love with a character in a yellow-backed novel, from reading it, as with nature by reading what others have seen and thought about her. What sort of an idea would you get of a gorgeous sunset, a magnificent landscape, or a soul-inspiring orchestra from a finely written description of it? A blind man was once asked to give his idea of how the sun looked. He replied: "I think it must look like the sound of a very large bell." And his idea, obtained from the descriptions of others, was about as correct as one forms of nature who has never learned to see her with his own eyes.

Now compare this, by an illustration or two, with the method of teaching in other lines of study. To teach arithmetic as science is usually taught, you would have to do away with blackboard and crayon, slate, paper, pencils, cubes, spheres, and every appliance now used to give the pupil a sense-perception of the principles he studies. You would allow the student to waste no time in illustrating the rules by working problems, or money for slate and pencil. If as many school officials were liberal enough to furnish a blackboard in the class-room and time to use it as now furnish apparatus for chemistry and natural philosophy, the *teacher* in these few favored schools might work out a few problems *for the class*, but they must not prove or demonstrate a single rule for themselves. It would cost too much. Now, if you apply the cost, small as it is, of slates, scratch-books, pencils, boards, crayons, etc., used by an arithmetic class in a single year, to procuring apparatus and specimens for a class in science, you would see a wide difference in the appreciation and interest given to science, and by attempting to teach arithmetic a year without illustration, would be better able to see the relative disadvantage under which science is compelled to labor.

Take another illustration, perhaps less appropriate, but more striking, in the case of music. Imagine a music teacher pleading with the school authorities for an instrument to illustrate the musical sounds he explains to his class, even begging the boon of a tuning fork, and the students acquiring a "*thorough knowledge*" of music without either, and you may gain some idea of the attempt to teach science "*thoroughly*" with no illustrations; and abundant explanation of the low esteem in which nature studies are held in so many schools. Fancy for a moment a music teacher attempting to interest and perfect a large class of pupils (he usually teaches one at a time) in instrumental music, with only the music book and oral instruction! He would proceed somewhat thus: These marks, called notes, indicate different sounds. You must learn their names first, do, ra, mi, &c. This note is higher than that, this higher still, the next still higher, and so on, and this eighth note is an octave higher than the first. This note is twice as long as that, half as long as the next, quarter as long as the other. This scale is divided into feet or measures and there are four beats to the measure. This tune begins on a different note from that, which makes it in a different key, and that makes it sound diffierently from the other. Now you must learn to read these all correctly, call them by their proper names, tell how much each note is higher than the others and how long time each one must take. When you can do this for every tune in this book you can finish it and go through a higher book in the same way. But one bright pupil says:

I don't see any sense in it at all. I don't understand what you mean by higher and longer notes, an octave, the scale, the beats, and the measure, and don't see how I can remember the names and kinds of so many different characters. The teacher says:

Oh! it is a most delightful study. When these tunes are played they make most heavenly music, and it is worth a great deal to you.

Student.—I wish I could hear some of them played.

Teacher.—Yes, it would be better if you could.

S.—Why can't I?

T.—We would need a piano for that.

S.—Can I ever understand music without one?

T.—Not very well, but they cost a good deal of money and the school can't afford to buy one.

S.—Then I will go to a school that can afford one.

She goes; and finds the teacher with a good instrument. She now understands that there *is* something quite interesting in the notes and tunes when the teacher illustrates them by playing on the instrument. She, being an exceptionally thoughtful and aspiring person, thinks she would like to know how to play for herself. The teacher raises his hands in holy horror with the astonished exclamation that she would get the piano out of tune, break the strings and the keys, injure the pedal, and positively declares this is only for the teacher to use.

But says she: Can I ever understand music to do me any good unless I earn to play myself? Did you learn without a piano to use?

Teacher.—No I didn't, and you can't, but the school has made no provision for practical exercises by the pupils themselves. All you can get here is the privilege of hearing me play and of having the principles taught you.

Her desire to secure some satisfactory benefit from her expenditure of money, time and effort, determines her to seek a school in which she can have a piano for her own practice. She succeeds; and soon learns that, to become at all proficient, she must have a piano of her own to which she can have access at all times.

This is what it costs to gain proficiency in music, and no plea of want of funds would for a moment excuse any school for attempting to teach music without the necessary outlay. To place science on an equal footing with this accomplishment, each pupil should have his own set of apparatus, illustrative series of specimens and preparations a good cabinet, microscopes and other essentials to his work, in his own home and at his own disposal. This would make in the aggregate a considerable outlay of money; but probably not so much as is expended for excellence in instrumental music, and this is retained only at the additional expense of constant practice. Yet science, in nine schools out of ten, must be taught with hardly a dollar of expenditure, and the teacher who is not willing to teach it in this way is promptly replaced by one who is. Is it at all strange, under these circumstances, that science is not appreciated?

Fortunately, however, one does not need an immense outlay of funds to possess respectable facilities for teaching nature. The material is to be found everywhere and costs little beside the effort to bring it together, *and*—an important consideration—the ability to see instruction in it and to arrange it for the instruction of others. The text-book too is always open to all who can "interpret the mystical hand-writing there," and no book-dealer has a monopoly on it or can shut it from your view. In the face of these facts, it seems strange indeed that so few public or private schools are at all adequately supplied with preparations, systematic collections, and the like, for teaching nature in the only way those who know it best say it can be learned. True, some schools have a few appliances for illustrating natural philosophy, and a smaller number, for chemistry; but ruinously few facilities are to be found for teaching any strictly natural history studies, though these are most easily obtained and their acquaintance more sadly needed than any others.

THE PUBLIC SCHOOL PROBLEM.

E. R. KNOWLES.

In this country all discussions of problems relating to government education have unfortunately been heretofore participated in either by politicians desirous of turning the bigotry and ignorant prejudices of some of their fellow citizens into political capital for themselves, or by persons whose narrow sectarianism and absurd fears have led them into a one-sided view of their theme and caused them to flee blindly from some imaginary evil into the presence of a real danger, rather than considered in a truly liberal, intelligent manner with a desire to ascertain that solution of the problem which will be the most conducive to the welfare of the American people, as a whole, and which shall be founded on the basis of equal justice to all.

As republicans, the citizens of the United States will not allow the public servants to infringe upon their rights. This is one of those recognized American principles that will never allow our people to tolerate a sectarian public school system. Our people seek "equal rights for all, favors for none." The liberty of conscience of Catholic, Protestant, Jew, free-thinker and infidel must, under the national constitution, be equally respected. Though among the "reserved" State powers is that of dealing with religion and the religious liberties of the people in such manner as each State shall think most expedient; yet we find the doctrine fully expressed in the Constitution of thirty-five States, and implied in the Constitution of two others, that the consciences of all shall stand on the same footing, and that religious liberty must be secured for all the people.

It is alike impossible for the upholders of religious liberty to consistently require the children of our States to attend, and the tax-payers to support, schools where the Protestant Bible, which is regarded by Roman Catholics, Jews, and others as a sectarian book, is read, or where the tenets of the Catholic, Jewish, or any other faith are taught. Therefore, if we have any public school fund, and it is not distributed in part among the religious bodies to be used by them for the support of their own denominational schools, the State should rigidly confine its system of popular education to the secular sphere of knowledge.

But a secularist public school system does injustice to all who have any Christian convictions, and tends to sap the foundations of public morality. The consciences of all citizens have an equal, natural, and constitutional right to be respected, and a secularist public school system which is thus an outrage to millions of American consciences, not merely because it excludes religious teaching altogether, but because it produces a vicious, immoral, thriftless, and superficially educated class of citizens, with an education sufficient to do them harm, but not complete enough to do them any good, is a violation of right and a disgrace to the country. It is a violation of right that any person having any Christian convictions should be compelled to pay taxes for the support of such schools.

A very large number of the children who now attend our public schools are so situated that all the improvement and instruction they get must come only from their attendance at school, and, as Washington said, "Reason and experience forbid us to expect that national morality can prevail in exclusion of religious principle." This class of children cannot be expected to become men and women of good moral character. As to the rest of those who attend these schools, it is useless to say that their religious education can be secured by exertions in the Sunday-school and at home. The evil influence of the secularist public schools will thwart and nullify the efforts of good parents toward this end. Even those who inveigh against the opponents of a public school system are seldom willing, when they can afford to pay the charges of a private school, or can avail themselves of the privileges of a parochial school, to risk the danger of having the breeding and morals of their children contaminated by their mingling with children from the most rude and immoral quarters of society in schools where not even the first principles of Christianity and morality are taught. Such Godless schools ought to be abolished on account of their pernicious influence.

The term Godless, applied to the secularist public schools, here means the same as anti-religious, immoral, and hostile to true religion; and such the public school must be, unless it makes religious teaching one of its functions; not because true religion will not stand the test of popular enlightenment (if that were the case the sooner the world got rid of it the better); but because, as I have already urged, morality cannot prevail in exclusion of religious principle, and the indifference to and ignorance of religion among those who are trained in these schools, and especially the bad examples and influences there met with, lead to immorality and every sort of corruption.

A system which excludes altogether religious ideas from its instruction gives to the children of its schools the practical example of "religious indifferentism," which is sure to bear, sooner or later, its usual fruit of infidelity, knavery, and debauchery.

Can these evils of a public school system be remedied by the distribution of the public money, either the whole or a part of it, among the religious bodies, to be used by them for the support of their own schools? If this plan were adopted the expense of supporting the public schools would become greater even than that of supporting a secularist public school system, because this plan requires an unnecessary increase of "machinery;" and if the number of children taught by each denomination respectively was in the same proportion to the total number of children taught in the public schools, as the tax paid by such denomination to the entire amount raised by taxation for the support of the public school system, it would amount to the same thing in the result as the voluntary plan of popular education, except that it would be far more expensive. But when the number of children taught by the several denominations respectively and their respective taxes are greatly disproportionate, the State, through its taxing power becomes the supporter of religious sectarianism, compelling the people to pay the expenses thereof. The State can support sectarianism in the public schools without paying money for the religious instruction given in them. The State, therefore, should have nothing to do with popular education. Among those of any religious belief, complete education and religion are inseparably connected, and when a State, whose citizens comprise chiefly adherents of various creeds, attempts to give the former it necessarily gives instruction in the latter, and does injustice to some or all of the religious bodies among its people.

It is objected that this plan would entirely withdraw educational advantages from a large number of the poorer classes, and would be practically equivalent to a plan for lessening general intelligence. If the Catholics of this country, laboring under great disadvantages and with insufficient means, while at the same time taxed to support sectarian or secularist public schools which they totally disregard, have voluntarily taxed themselves to support parochial schools for the benefit of their children and of all the poor children whom they can gather under their charge, there is certainly nothing to prevent those of other schools of thought from following their example in maintaining their own schools and charitable institutions. And if other religious bodies exert themselves one-half as much as the Catholic Church in the interests of popular education on this voluntary plan, the abolition of the State public school will, at least, not *lessen* general intelligence.

Public schools, therefore, *as State institutions*, should be abolished, and every religious body should have and support its own free schools; where at least good breeding, morality, and the love and fear of God will be imparted, as well as secular learning; this plan being the only solution of the troublesome public school problem, founded on the basis of equal justice to all.

ZOOLOGY.

NOTES ON THE DISTRIBUTION OF SHELLS.—NO. IV.

F. A. SAMPSON, SEDALIA, MO.

A co backward spring made all vegetation unusually late for the date of my trip, and when I left Sedalia on the 12th day of March, 1883, everything here was still almost in winter dress, and showed very slight effects of the returning of spring. A few birds had come, the blue-jay being the first, on the 24th day of January; the blue-birds came on the 20th day of February, though a single one was seen two weeks earlier; and the robins arrived in flocks on the 3d day of March.

My first stop was at Lamar, in Barton County, Missouri, where I had some six hours to wait for a train, and I decided on putting in the time collecting shells, and at once started for the woods. I found, however, that the soil was so sandy as to make land shells scarce. In the bottom along the north fork of Spring River, I found the following:

1. *Zonites arboreus*, Say.
2. *Z. minusculus*, Binn.
3. *Conulus fulvus*, Dr.
4. *Stenotrema leaii*, Ward.
5. *Strobila labyrintkica*, Say.
6. *Pupa contracta*, Say.
7. *P.* ——— ——— (?)
8. *Succinea ovalis*, Gld.
9. *Carychium exiguum*, Say.

Also the following water shells:

10. *Physa gyrina*, Say.
11. *Planorbis trivolvis*, Say.
12. *P. bicarinatus*, Say.
13. *Amnicola porata*, Say.
14. *Sphæreum striatinum*, Lam.
15. *S. transversum*, Say.

I got but three species of *Unios*, though from the shells I saw in some yards in the town, there are other kinds in the streams there.

In a small branch stream, by sifting the mud, I obtained considerable numbers of

16. *Sphæreum* ——— (?)

Of beetles I saw not more than a half dozen species; two or three kinds of butterflies were on the wing; and turtles were out lazily sunning themselves on logs.

The next day I promised myself fine success around Springfield. I knew of a *Goniobasis* and several rare land shells having been found there, and knowing that there were many springs about the town, I supposed I would find the former in abundance. I first walked to a fine spring near town which had a small fish pond attached to it, but I found less than a half dozen *Physa gyrina*, and no other shells. I then went to some timber on the higher ground, and although there were places suitable for shells hibernating, if there were any, I found none. Afterward Mr. J. R. Milner drove me to various points around the town, but none of the springs visited showed any *Goniobases*, and some of them no other species.

At one, the *Physa gyrina* were fine and very large with no small ones; at another they were quite plenty, of different sizes, the largest seeming to be mature, though not more than one-half to two-thirds the size of the others. In James' Fork of White River, a few miles from the town, *Unios* are said to be plenty.

On a rocky bluff south of the town I expected some success with land shells, but they were very scarce. Under one stone there were a dozen *Stenotrema labrosa*, Bld.; they were 8 mm. in diameter, those from Eureka Springs, Ark., being 11 mm.

The following are all I found there:

1. *Physa gyrina*, Say.
2. *Limnophysa humilis*, Say.
3. *Mesodon clausa*, Say.
4. *Stenotrema labrosa*, Bld.
5. *Pupa armifera*, Say.
6. *P. Contracta*, Say.
7. *P. fallax*, Say.
8. *Zonites arboreus*, Say.
9. *Succinea ovalis*, Gld.

Of beetles I obtained perhaps twenty species.

The crows winter in and around Springfield in large numbers, but before time to build nests they go further north. It is said that there is a narrow strip of country running southwest in Arkansas, in which strip the crows winter, and out of which they are seldom seen during the winter time.

Arriving at Eureka Springs at noon of the 15th, I commenced the same day my conchological pursuits. With Mr. C. C. Allen I first went to a side ravine near the Johnson Spring, where I found the *Polygyra jacksoni* in considerable numbers, they being scattered among the gravel and small stones, and under such circumstances I found them at the different places where collected, while the next species was always found under large stones or logs. There was also a difference in the lay of the ground where the two species were found, the latter being almost the only shell on hill sides having south or west exposures, while the *jacksoni* and other species were found on north and east exposures.

At different points having south and west exposures I found *Polygyra sampsoni*, Wetherby, but they were most abundant on a hill near King's River, where I got fifteen or more under each of five stones. This species varies in size, the larger ones having a much wider umbilicus and being 9 mm. in diameter, while the smaller were not 7 mm. in diameter.

In June and July, 1881, *Physa gyrina* were very plenty near the springs along West Leatherwood Creek, but I now saw but few of them.

At the previous visit a branch stream had *Ancylus tardus* and *Pisidium compressum* (?), in abundance but I could not now find a single one of either. The reason probably is that the bed of the stream is used to some extent for a wagon road.

In 1881 this stream had great numbers of the interesting shell-shaped pupa case of the *Helicopsyche armifera*, Lea, but now scarcely any were seen, while another kind similarly made of grains of sand, but straight, one sided, and affixed to the under side of stones were plenty.

Lizards, as might be expected, were abundant, though I found only one snake during the four days collecting. Under one stone I counted sixteen scorpions.

In King's River I obtained fine large *Pleurocera subulare* and *Goniobasis pallidula*, both of which I got in White River in 1881, but they were quite small in comparison with the King's River specimens.

In the REVIEW for January, 1882, I gave a list of shells found in and around Eureka Springs, and I now give the list as corrected and added to since that time by Mr. C. C. Allen and myself.

1. *Mesodon albolabris*, Say.
2. *M. albolabris, var. alleni*, Wetherby.
3. *M. exoleta, var. minor.*
4. *M. thyroides, var. bucculeuta*, Gld.
5. *M. divesta*, Gld.
6. *M. clausa*, Say.
7. *M. elevata*, Say.
8. *Patula alternata*, Say.
9. *P. solitaria*, Say.
10. *P. perspectiva*, Say.
11. *Stenotrema labrosa*, Bld.
12. *S. leaii*, Ward.
13. *Polygyra jacksoni*, Bld.
14. *P. sampsoni*, Wetherby.
15. *Triodopsis inflecta*, Say.
16. *T. oppressa, var.* Major.
17. *T. fallax, var.* Minor.
18. *Strobila labyrinthica*, Say.
19. *Zonites arboreus*, Say.
20. *Z. fuliginosa*, Griff.

21. *Macrocyclis concava*, Say.
22. *Pupa armifcra*, Say.
23. *P. fallax*, Say.
24. *P. contracta*, Say.
25. *Succinea ovalis*, Gld.
26. *S. verrilli*, Bld. (?).
27. *Bulimulus dealbatus*, Say.
28. *Helicina orbiculata*, Say.
29. *Pomatiopsis lapidaria*, Say.
30. *Tebennophorus carobuensis*, Bosc.
31. *Limax campestris*, Binn.
32. *Physa gyrina*, Say.
33. *P. heterostrophe*, Say.
34. *Limnæa humilis*, Say.
35. *Planorbis bicarinatus*, Say.
36. *P. trivolvis*, Say.
37. *Ancylus tardus*, Say.
38. *Melantho integra*, Say.
39. *Pleurocera subulare*, Lea.
40. *Goniobasis pallidula*, Anth.
41. *Sphæreum transversum*, Say.
42. *Pisidium compressum* (?), Prim.

GEOLOGY.

AGE OF THE MISSOURI RIVER.

E. P. WEST.

(*A Paper read before the Kansas City Institute.*)

Mr. President and Gentlemen:—The Missouri, one of the grandest rivers of the world, washes the northern limit of Kansas City. We witness its annual floods, garnered by the vast accumulations of winter's snows in the far-off elevations of the Rocky Mountains. We see, year by year, the devastations caused by its wild waste of waters. We observe it, in its gentler moods, freighted with the products of many nations, destined to swell the commerce and add to the convenience and comfort of the enlightened and happy people occupying the environments of its picturesque shores. Generation after generation, age after age, witnesses the same occurrences; and we are apt to associate this great river with the geological formations cut by its turbid waters for all past time. But, while it is one of the largest, and apparently one of the oldest of rivers, it is, in truth, one of the youngest of this continent. When the St. Lawrence, the Cumberland, the Ohio, and the Upper Mississippi had attained their full growth and supremacy over the countries now tributary to th m, the Missouri River was but in its infancy. When their systems of drainage were complete, all the vast territory now tributary to the Missouri, which lies within the limits of four great geological formations, namely, the Triassic, Jurassic, Cretaceous, and Tertiary, embracing a part of Iowa, the most of the States of Kansas and Nebraska, all of Colorado, and the Territories of Wyoming, Dakota, and Montana, were covered by an ocean. The Missouri River was then but little more than four hundred miles in length, and its drainage covered less than half of Missouri and Iowa, and but a small part of the eastern portions of Kansas and Nebraska, its headwaters being not remote from Omaha, Nebraska. Then great reptiles, from forty to ninety feet in length, sported in this vast expanse of ocean, which, with some interspersed islands, extended westward over the western plains and Rocky Mountain regions, covering the entire country now drained by the Missouri River westward and northwestward of Omaha. The eastern borders of Kansas and Nebraska formed a part of the ocean's eastern shore line, and it was nowhere at a greater distance than two hundred miles from the eastern boundary of these States, the greatest distance being along the Kansas border.

The Triassic and Jurassic formations were the first to emerge from this old western ocean. These formations are exposed along a narrow strip of country extending through Middle Kansas, and prolonged, perhaps, into Eastern Nebraska, but greatly widening to the south-west through the Indian Territory and Northern Texas. They added but little to the drainage of the Missouri River, and are conspicuous for the paucity of organic remains in them. Next, the Cretaceous formation emerged and became dry land. This added to the Missouri's drainage a broad belt of country extending across Kansas and Nebraska, and northward of Omaha, through Dakota Territory, increasing the river's length more than four hundred miles, and adding very materially to its western tributaries. This formation is noted for the great abundance and gigantic proportions of its fossil reptiles and numerous invertebrate forms, as well as for several varieties of fossil wood, leaves, and plants, closely approximating present living species. Lastly, the Tertiary formation rose from the water, completing the Rocky Mountain system, and the drainage of the Missouri River to its present sources. By the uprising of this formation the remainder of Kansas and Nebraska, the most of Colorado, and the Territories of Wyoming, Dakota, and Montana were made tributary to the waters of the Missouri. But we must not associate these various elevations with great catastrophes, or suppose them sudden or violent, but, on the contrary, we have reason to believe them slow and gradual, requiring long ages in their accomplishment. We must not, either, consider the Missouri, though among the youngest of rivers, so very young, counting its age by years, or comparing it, even, with man's duration upon the earth, for it has witnessed stupendous and long-continued changes since it attained its majority and was adopted, full-grown, into the family of American rivers. Though young in comparison with the other great rivers I have named, some idea of its really very great age may be formed when it is considered that the great and wide-spread mutations which gave it birth and built up our western river systems, occurred between the close of the Carboniferous age and the end of Tertiary time The upper carboniferous rocks are to be found about Kansas City, and northward along the western border of Missouri and eastern borders of Kansas and Nebraska, and the Tertiary formations about the elevations of the Rocky Mountains and over their eastern slopes.

Next in sequence followed the events alluded to as having occurred since the Missouri river was increased to the full measure of its present drainage, namely, the Glacial and Champlain epochs which occurred in Post-Tertiary time. First, the Glacial period was ushered in:

"Once the fierce Kabibonokka,
Issued from his lodge of snow-drifts,
From his home among the icebergs,
And his hair, with snow besprinkled,
Streamed behind him like a river,
Like a black and wintry river,
As he howled and hurried southward,
Over frozen lakes and moorlands."

The entire country now tributary to the Missouri River was elevated far above its present level, and vast glaciers, thousands of feet in thickness, crept down from the northward to about the parallel of Kansas City. But before the country became mantled in snow and creeping rivers of ice, the Missouri River had carved out a channel to an unknown depth, but, perhaps, five hundred feet or more below its present bed. The old channel is found to be choked up with drift-sand and boulders, borne in by glacial action, and by this means the river was partly, and perhaps entirely, diverted in some places. These facts are made apparent by the achievements of modern civil engineering in overcoming obstacles to continuous railway transit. Nine railway bridges now span the Missouri River from Omaha downward to its mouth. All of the bridges approach one or the other of the river bluffs, generally those on the south side. In sinking piers to support the superstructure, solid rock has been found only on one side, *i e.* the side touching the bluffs, although excavations for this purpose were made at all of the bridges, in the river's bed, from sixty to more than one hundred feet deep. Consequently some of the piers, in each instance those most remote from the bluffs, rest on piles driven into the loose erratic material which fills the old channel up to the river's present bed. These facts would seem to indicate that the old gorge of the river extended from bluff to bluff, and sloped, with more or less regularity, downward from the bluff on either side, toward the centre of the valley. It required a great lapse of time for the river to cut out such a channel, and long ages must have transpired between the close of the Tertiary era and the full inauguration of the Glacial epoch, between which events this work of attrition was done.

To comprehend this clearly, we must imagine a rock-bound canyon of variable width, cut through the carboniferous strata between the bluffs on either side of the river, to a depth of five hundred feet or more, below the present bed, at the bottom of which the river was dashed in wild confusion; then we must conceive of vast rivers of ice, creeping down from the north, laden with great streams of stones and sand, to be emptied into the canyon, in quantities sufficient to fill and completely dam it up in many places; but, at the same time, it must be borne in mind that at the interval the glaciers reached the Missouri River the volume of water was greatly diminished in it, in consequence of the congelation of the snow and rainfall over all the country north of the 40° of north latitude.

The Glacial period is distinguished by its wide-spread distribution of eratic rocks over all of the country north of the 40° of north latitude. It has but few fossil remains, and those, mostly of life which preceded it.

The Champlain epoch next followed, and was, in every way, in strong contrast with the Glacial period.

Most of the country along the Missouri River, which, during the Glacial time, had been elevated above the present level, in the Champlain era was sunk below it. Instead of intense cold, the climate was warmer than we now enjoy. Instead of vast fields of moving ice, still lakes prevailed along the Missouri River, co extensive with the Loess formation now bordering it. Instead of an arctic waste, life teemed in the water and upon the land. The lakes were filled with fish, and the land abounded with animals. Among the animals the elephant and the mastodon browsed among the hills and valleys. The horse, much larger than the living species the ox, and the bison grazed on the plains. A gigantic beaver, and animals of the sloth tribe, much larger than the moderns, prevailed. Among the carnivores there were bears, lions, and a species of raccoon; and last, though not least, we have a glimpse of man playing a part for supremacy in this remote era. The remains of several of these animals have been found imbedded in the Loess deposits about Kansas City. This era is distinguished for its great deposits of brick clay, or Loess, its terrace formations, its gigantic mammals which have become extinct, and for the great number of its mollusks, which are identical with living species. Next, the era of mind was ushered in, and is still slowly fulfilling its promise of a higher destiny.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, April 10, 1883.

Dr. Delaunay publishes a very remarkable work on "Medicine as Practised by Animals." There is less sickness among the latter than with man, and much of the difference may be attributed to the instinct of animals in prescribing for themselves when unwell. Instinct in the case of man, frequently leads to his ruin; thus the stomach impels him to eat when the interests of good health counsel him to moderation or abstinence. Animals select instinctively the food which suits them; man, though not devoid of this instinct, rather disregards it. The doctors it seems devote no attention to the tastes of individuals, but which is not the less an invaluable guide. Women feel more keenly the want of food than men, and further, they do not like the same aliments. However, in the various hospices, both sexes are subjected to exactly a common regime. The same fact reigns almost everywhere. Again, children hardly weaned, are placed on adult dietary, strong meat and wine, which are not only unsuitable, but that they dislike.

Dr. Delaunay from the result of inquiries lays down that a child only likes meat when about five years old. He recommends to allow salt, vinegar, etc., to those who prefer such condiments. Taste is the best of guides. Instinct aids animals also in a sanitary point of view; they free themselves from parasites by rolling in dust, mud, etc. The swallow, when one of its young is attacked by vermin, ejects it from the nest to save the rest. When a dog fails in appetite, it eats couch grass, which is at once an emetic and a purge. Cats also eat certain plants for medicinal ends, and so do sheep and cows. Dogs and horses suffering from constipation, will consume fatty substances with avidity, and an animal attacked with chronic rheumatism endeavors to lie always in the sunshine.

Latreille relates that having cut off the antennæ of an ant, its comrades arrived and covered the wound with a liquid secreted from their mouths; the chimpanzee when wounded staunches the bleeding with leaves or grass; an animal with a shattered leg or paw, amputates it with its teeth. Dr. Fredet had a dog stung in the nose by a viper; for several days in succession the dog constantly plunged its head in a stream till cured. Another dog, crushed by a vehicle, remained three weeks in a current of water, where it recovered, food being duly supplied. Cats also, according to Dr. Delaunay, adopt the cold water cure; one has been known to remain during 48 hours under a jet of water. Instinct may thus teach us many lessons.

Sensations have been measured. We know the time which elapses between the moment when the skin is touched and the subject feels that pressure. The transmission of visual and auditory impressions can also be ascertained. Until now it was unknown how long it took for an odor to be perceived. Professor Beaunis, and Dr. Buccola, of Turin, confirms his calculations, affirms that the time which separates the excitation from the sensation of a perfume is in hundredth parts of a second—for ammonia, 37; vinegar, 46; camphor, 50; chloro form, 56; mint, 63; and carbolic acid, 67. The exact moment of perception for musk could not be ascertained. It results, that the perception of odors travels less rapidly than the sensations of hearing and seeing, and somewhat shorter than those of touch.

By the process known as synthesis, chemistry has been able to re-constitute nearly all the substances fabricated by the animal and vegetable organism; thus have been artificially prepared urea, formic acid, madder and the odoriferous principles of the tonka bean and vanilla. M. Fischer has just obtained two substances which enter so largely into the composition of tea and coffee, theobromine and caffeine. And from what matter does he extract them? From xanthine, a product derived from urine and guano.

Professor Dubois, of the Sorbonne, makes known a new process for the preservation of meat and fruits. It entails neither injections, immersions, nor kindred preliminaries. The aliment is simply enclosed in vapors of ether, or chloroform, or wood alcohol. It is thus the professor has exhibited fruits, meats, and even entire animals conserved during months under bell glasses saturated with ether vapor. On the cessation of the experiment not the slightest trace of putrefaction was observable; there was a notable loss of water, and the latter which escaped was colored red. Even blood, similarly preserved indicated no change, only the globules were contracted. Fruit diminished in weight and presented the color of faded leaves.

M. Moser has discovered a simple and ingenious plan for strengthening and augmenting the tension of an electric telephonic current. He has applied it to the transmission, along a single wire, of music and speech. At the Electrical Exhibition one wire connected the building in the Champs Elysees with the Opera, and served eight receivers. M. Moser has, by means of a single wire laid between the Hippodrome and the place Vendome, a distance of one and one-half miles, fed one hundred receivers with music from that circus. The energy of transmission has thus been extensively augmented This result opens up the question of transmission of electric force. To obtain in the transmission of sound a maximum of strength, currents of high tension must be employed, and the more the current will possess of electro-motive power the more the intensity of the sound will be increased. But in transmission this intensity diminishes through the leakage of the electricity, and each apparatus, each distance, each communicating wire has its characteristic tension and quantity. M. Moser's discovery enables currents of tension and intensity to be selected, and so renders the sounds received more distinct. It is thus that a very audible conversation has been held between Paris and Nancy, a distance of 220 miles.

M. Gaudry reviews the present state of paleontology. Before the Cambrian epoch, we know nothing about the animal life on our planet; it is in the Silurian epoch that the earliest forms of animal life are accessible to our studies; then the trilobites and similar "kings of the sea" seemed organized for defense and preservation rather than for attack. The Devonian epoch corresponds to the development of vertebrate animals; in the carboniferous reptiles multiply, and they swarm also in the secondary strata; in the tertiary birds and mammiferæ develop them selves, while in the quartenary man appears. Such are the general traits of the progress of animal life across the immensity of geologic ages. Respecting the details of this progress it must not be concluded that each cycle of life has been developed with precision, in one and the same epoch and strata. Investigations prove that such and such a type runs into another over several epochs. There are, furthermore, great inequalities in the duration and prolongation of these types and the "struggle for life" does not receive entire corroboration, since the strongest and the most perfect types are precisely those which have had the shortest destinies. In a word, the paleontologist can distinguish in this grand history of animal existence, types which correspond to epochs, similarly as we allude to the age of Pericles or that of Louis XIV. There appear to be persistent or cosmopolitan types that play the role of permanent reservoirs.

Lead salts enter very largely and against our will into our daily food, drink, and even raiment. Dr. Galippe announces that sulphate of copper is another metal that can be found in our daily bread and vegetables. But blue vitriol it is now believed is not poisonous; that is to say, taken in moderation, such as it exists in wheats and vegetables grown in France. As revealed by the analysis of Dr. Galippe, there is a very respectable "trace" of blue vitriol in these products; from whence does it come? From the soil; the latter has received it from the practice of French farmers since years steeping their *seed* grain in solutions of blue vitriol to kill weevil and similar vermin.

The astronomer Herschel introduced us to lunar men. M. Zaborouski directs our attention to the case of two conscripts, medically examined in 1880. They had caudal appendices, one three-quarters of an inch in length, the other two and a quarter inches. When the latter was raised it fell down of its own accord. Both were malformations. Max Hortels gives a list of nineteen analogous cases. This does not indicate that a man with a tail is a reality; but that a man with an appendix is a phenomenon. Other *lusus naturæ;* in the Yellowstone mountains of America, *male* hares, or what are designated such, suckle their young very frequently. In 1872, M. Courty drew the attention of scientists to a man at Montpellier, whose right breast secreted milk, and that might put a first class wet-nurse into the shade.

M. Manouvrier has conducted some curious experiments to test the relative power of hand-pressure. Men, not belonging to the laboring classes, and aged between 25 and 45, pressed respectively upon an instrument, a kind of dynanometer; the minimum pressure was 84 pounds, and the maximum 187 pounds; there was always a mean difference in favor of the right over the left hand of 22 pounds; while 6½ pounds was the difference between big and little men. The maximum hand-force of women was 97 pounds; the minimum 35 pounds. Small women had invariably stronger hands than large women. Every-day life confirms that.

ARCHÆOLOGY.

EXPLORATION OF ALTAR MOUNDS IN OHIO.

PROF. F. W. PUTNAM.

The group of mounds about which I will speak to-day is situated in Anderson township, Ohio, near the little Miami River, about twenty miles from Cincinnati.

One of the mounds in this group is the center of a circular embankment placed on a small hill. Across the hill, outside the embankment, two wide trenches had been cut to the level of the bottom of the hill, and the earth from the cuts had been used to form a graded way from the top of the hills to the lowlands. From this graded way a low embankment extends, forming a circle over half a mile in diameter, in which were eleven mounds and a large earth circle. Near the earth circle, but outside the large enclosure upon the bank of the river, was another mound, making in all thirteen mounds belonging to this interesting group. In May last, with the assistance of Dr. C. L. Metz and a number of reliable workmen, I began the exploration of this important group of earthworks After I was obliged to leave the field, the work of exploration was carried on by Dr. Metz, who has been a most conscientious and faithful agent of the museum, and to him we are principally indebted for the important results that have come from the field work, which has extended over a period of several months. To Mr. Turner, the proprietor of the land upon which the group is mainly situated, the museum is indebted for the exclusive right of exploration.

The mound on the hill was five feet high and fifty two feet in diameter. Beneath the sod and two feet of clay was found, in the central portion, a pavement of flat stones, covering a circular enclosure about twenty-five feet in diameter, surrounded by a stone wall two feet ten inches high and about two feet wide. This stone wall enclosed a central tumulus two feet four inches high and twelve feet in diameter, made up of stratified earth and clay, and the space remaining between the tumulus and the stone wall was packed with a mass of gravel. Under the tumulus was found an elongated bed of puddled clay, sunk in the ground, and having a central excavation, which was filled with sand and covered by an altar made of clay, carefully shaped into a basin about four feet in diameter, and burnt hard and red. This altar did not contain any relics. Upon the stone wall enclosing the inner tumulus were two skeletons, one extended, the other having the bones out of the regular order, as if buried in a bundle or re-interred here. In the clay outside the wall several skeletons were found, one of which lay upon a platform of stones. With the skeletons were found copper ornaments, a copper implement, shell beads, and two large sea shells which had been cut to form vessels.

Another mound contained a sort of refuse pile on one side, and under the centre a bed of burnt clay and ashes, containing the fragments of four pottery vessels and several flint knives. The pottery vessels have since been restored, and one proves to be richly ornamented by incised markings forming squares. No sign of the use of the mound for burial was found.

The largest mound of the group was fourteen feet high and fifty feet in diameter, and proved to be one of the most interesting, from the numerous layers composing it, and the rich character of the offerings upon its altar. Beneath the mound, a little to one side of the centre, was an ash-pit six feet deep. This ash-pit is the first ever found beneath a mound. Its contents were similar in character to those in the Madisonville Cemetery, except that it contained fewer implements. The mouth of the ash-pit and the surface of the ground about it were covered with ashes and animal remains. At the other side of the centre of the mound was found the altar of burnt clay. Its base was sunk a little in the ground, and from its top ran off, over the ashes and animal remains, a thin layer of burnt clay.

The altar was about four feet across, and shaped like a basin. On it were a great number of ornaments and three large sheets of mica. The contents of the altar were covered over by a layer of flat stones, and this by layers successively of sand and ashes, sand and loam, gravel, ashes, burnt limestone and clay, clay and charcoal, flat stones, clay, and lastly, the sod covering the surface.

Another mound, nine feet high, covered eighteen ash-pits and contained two altars near together, seeming to have been erected over a large altar. One of these altars contained in its basin many interesting ornaments of shell, mica, and copper, fragments of carved stone and terra cotta images. Partly covering these objects was a layer of pieces of coal (bituminous), and over all this altar was a layer of flat stones, covered by a layer of sand, this extending also across the other altar, upon which only ashes were found. The layer of sand was completely covered by a layer of flat stones, over which were successive layers of ashes and sand, ashes, clay, ashes and charcoal, clay and sod.

Several of the other mounds were also erected in layers and covered altars. The mound on the river bank was of especial interest, from the fact that it was found to be completely covered with stones, carefully laid just below the sod.

The specimens collected from this group of mounds show the high attainments of the mound-builders in the treatment of metals, and also a distinct order of potter's art, higher than has been known heretofore from the mounds. In contact with the mica and other material in the large mounds, small masses of iron were found, which at first sight might lead to the inference that the mound-builders were acquainted with the use of iron, or that the mound was erected after contact with the whites; but on careful examination this proved to be bog iron, which had formed upon the altar since the erection of the mound. Upon two of these masses on either side will be seen the layers of mica between which the iron was found. Much of the mound over the altar was formed of ferruginous clay, and water in percolating through this clay would become impregnated with iron, which would be retained in the cavities formed in the material upon the altar over the hard-burnt clay. Bog iron might also be derived from the bituminous coal, clinkers and ashes from the fire upon the altar. This explanation accounts to me for the supposed rusted iron sword found in the Marietta mound in 1819 by Dr. Hildreth, which has been a puzzle to archæologists ever since. The silver-plated bosses, supposed by Dr. Hildreth to have been ornaments of the sword scabbard, are also fully accounted for by similar silver-plated objects from this mound.

Numerous mica ornaments were found in two of the mounds. They were cut from thin sheets of mica in various designs, conspicuously some like the head of some animal, one like a serpent, and one like a human head caricatured with a big nose and open mouth. The mica from which these ornaments were cut was probably North Carolina mica, which is known to have been mined before the settlement by the whites.

Besides one copper implement, copper occurred in great abundance in these mounds. Two of the mounds contained masses of native copper, and several contained many ornaments of various designs, cut from hammered copper. Many spool-shaped ornaments occurred with pendants, bracelets, rosettes, and scrolls. Several large sheets of copper, full of round holes cut at regular intervals, were found upon the altar of the large mound. A few copper ornaments were plated with a thin layer of hammered silver, neatly and closely applied to their surface by hammering. A bracelet and several of the spool-shaped ornaments were plated in this way. It is to these silver-plated spool-shaped ornaments that I refer the so-called bosses on the sword scabbard described by Dr. Hildreth. The copper objects were all made from the native metal, which, while it may have been picked up in masses from the glacial drift, was more probably mined at Lake Superior, and the small quantity of native silver used in plating a few of the ornaments leads to the belief that the copper and silver were brought from Lake Superior. Besides ornaments of mica and copper, there was obtained, for the first time from a mound, an ornament made of buffalo horn.

There were found implements made of flint, and arrow points of quartz, of chalcedony, and of obsidian. Obsidian is not found to-day in this region, nor nearer to it than the volcanic regions of the Rocky Mountains, where the Indians still use it for making arrow-heads. Spearhead-shaped ornaments were made from a mica schist, by a peculiar method of working the stone, such as I have never before seen.

Several stone images were elaborately carved and grooved on the under side. These were more or less fractured by the great heat to which they had been subjected. In this small tray are what might be termed the gems of North American pottery. The little figures represent in clay the dress of the people, with the peculiar head-dress over the forehead, the large ear ornaments and the peculiar form of sandal. Altogether, there is a resemblance in these little images to the character of Egyptian art which is very remarkable.

Besides the larger objects enumerated were a number of fossil shells, selected quartz pebbles, an immense number of shell and pearl beads of various sizes and shapes, and small sea shells which had been perforated. These were found on the altars mixed with ashes, charcoal, bits of mica, and fragments of pottery. All these objects had been subjected to a high heat, of which they still bear marks. From the altar in the great mound more than two bushels of such material was removed, and from an altar in another mound about one bushel.

There seems to be no other theory which will account for so much property having been given to the flames except that of sacrifice during important religious rites.—*Boston Transcript.*

ARCHÆOLOGICAL DISCOVERY IN CENTRAL AMERICA.

Of the fact of there being ruins of ancient cities, hitherto shrouded in mystery, scattered over that large tract of country which separates North from South America most persons are now aware. But their nature, age, or relation to the early history of the world has remained till quite recently a matter of which comparatively nothing has been known. It has, however, been for some time recognized that among the most interesting of these archæological remains are some in Yucatan—a peninsula dividing the Gulf of Mexico from that of Honduras, situated between 17° 30′ and 21° 51′ N. lat., and at no great distance from Cuba.

Determined to explore these ruins and learn the lessons they might teach, a scientific investigator, Dr. Augustus Le Plongeon, accompanied by his wife, set out on a mission of discovery to Yucatan in August, 1873, from which he recently returned. Ten years previous to this he had determined the task of writing an account of prehistoric America, and having dedicated himself to this work, had found, after having explored the ruins of antiquity found in Peru and Bolivia since 1862, that in Yucatan were situated the most valuable materials for such work; and a residence of nine years constantly engaged in explorations both of a super- and subterranean nature, has made him familiar with many of the Yucatan ruins. Both he and his wife being skillful practical amateur photographers, they have secured numerous negatives of the ruins, embracing many detailed portions. They have also obtained by means of a plastic material similar to what is used in French stereotyping, upward of two hundred casts from the more important sculptures and mural decorations, several of which are being reproduced in plaster, thus showing the work in fac simile.

Attention was concentrated upon the cities of Uxmal, Chichenitza, Ake and Mayapan. There are other cities as large as these, but they are in the possession of the hostile Indians. Still other cities exist which are fraught with interest in an exceptional degree, for they have been inhabited by a race of dwarfs, compared with whom the dwarfs of popular exhibitions are almost giants The diminutive stature of the inhabitants is shown by the buildings, the doorways of which, Dr. and Mrs. Le Plongeon assured us, are thirty-six inches high by eighteen inches in width. One of the largest temples in these dwarf cities is twelve feet long by nine feet wide, everything else about them being in the same ratio of dimensions. The names of some of these cities are Meka, Nicte, and Cankun. These are situated on the east coast of Yucatan, opposite the islands of Mugeres and Cozumel. They are at present very difficult of exploration, owing to the frequent visits made by parties of hostile Indians, who are well armed, and in skirmishes with whom no quarter is either expected or given.

In Uxmal there are several ruins in a state of excellent preservation. These prove in an incontestible manner that in early ages a high degree of civilization existed. The date of the erection of several of these edifices is believed to be not less than six thousand years ago, although Dr. Le Plongeon is of opinion that there is much that points to an antiquity of ten thousand years. It being of the greatest importance that the antiquity of these remains of a former civilization should be determined, we here present a few of the reasons given by which this is sought to be established.

In one temple, which is richly decorated both with marble and other stone, portions are profusely covered over with inscriptions and writings in the Maya language, in writing of an ancient nature hitherto unknown, but the key to which has been discovered by Dr. and Mrs. Le Plongeon, by dint of much perseverance. With this new alphabet they have been enabled to decipher many of these records of ages of the long ago. The age of these erections is discoverable, first from the Katuns found in the city of Ake, mentioned by the chroniclers, who tell us that at the time of the Spanish Conquest such Katuns were still being used. These consist of columns of stone, eight in a column. One is placed every twenty years. On the top of the seventh, and at each corner, is placed another stone, these corner stones being laid at intervals of four years, and on the completion of the twenty years represented by them a large stone is placed over all, thus completing the column, or Ahau-Katun, which thus marks a period of one hundred and sixty years. Now, in one building were found thirty-six of these columns, which represents at least six thousand years as the time that had elapsed from the erection of that temple to that at which the last stone was laid on these time columns; and the time that intervened between the completing of these records and the Conquest is not known in this case.

Another guide to the discovery of the antiquity of these erections is the worship of Deity in the form of the mastodon's head. Now, as this animal has been extinct for ten thousand years, it follows that either the builders of these temples or their fathers were familiar with it, for had they not known the mastodon they could not have made an image or picture of it, and all of the buildings throughout the peninsula are ornamented with the mastodon's head, and some of the sculptures represent human figures in the act of worshiping it.

The buildings in most cases are formed of a white limestone, the stones being all cut to nearly one size and very closely fitted together. The outsides are square, but they are cut in a pyramidal form. The ceiling of the buildings form a triangular arch; the rooms are generally long and narrow, but very lofty, the walls and floors being cemented with concrete. At Uxmal is a building called Monjas, which consists of a hundred and twenty rooms, all arranged in pairs, each pair communicating with one another by a doorway, but with none of the others, except through the court yard. There are no interior sculptures, all being on the outside, and in these a certain local style or order has been observed, for while at Uxmal the ornaments are all found above the doorways and facades, at Chichenitza they reach down to the ground. One edifice, known as the Governor's House is 293 feet in length. They are mostly erected on artificial terraces composed of stones laid on the top of each other, one of these being similar in style to the "hanging gardens" of Babylon.

The great question of popular interest regarding these archæological remains is, What do they teach us? Apart from the history of the family affairs of the contemporary kings, which can now be read with comparative plainness by the explorers, it has been discovered that there is an almost absolute identity between the language, the manners and customs of these prehistoric Yucatanese and those of Chaldæa, Egypt, Hindostan, Persia, Burmah, and Siam, and that an early and cultivated civilization, imagined to be of a higher type than any other, existed in Yucatan. It has also been discovered and established beyond cavil that Freemasonry existed in these prehistoric times with the same Masonic symbols as are now in use, proofs of this being found in the photographs and casts; and that what is now known as mesmerism existed six thousand years ago in very much the same form as it does at present, as shown by the decorations on the frescoed walls. Among the customs common to the Yucatanese, are to be found some also common to the inhabitants of Hindostan, such as the manner of carrying children astride on the hip. The making of an impression of the hand in red pigment on the walls of certain sacred edifices was common in former times both to Yucatan, to Elephanta and other places in India, and even in caves in Australia and others of the South Sea Islands. There is scarcely a monument in Yucatan upon which is not to be found the impression of a red hand, this being the record of a vow made to the Gods. Fire worship, phallic and mastodon worship, together with gods having elephants' heads, flourished in Yucatan in these early periods.

The Maya language, still spoken in Yucatan, was also known in many parts of the East. The last words of Jesus of Nazareth, *Eloi*, *Eloi*, *lama sabachthani*, are said to be pure Maya words, and to mean, "Now, now, I sink, darkness comes over my face." From the narrative it would seem that none of those standing within hearing understood the language made use of, as they imagined he was calling upon Elias to aid him. Enough has here been said to indicate the great interest that attaches to Yucatan.—*Scientific American.*

ANCIENT MAN—A RE-CONSTRUCTION.

An effort has been made recently to represent "primitive man" upon such a basis as the fossil skull-cap, found in the Neanderthal, in 1857, is alleged by some archæologists to offer. The result of the effort is a bust of which the head and trunk at once suggest the gorilla, so much of brutal ferocity are impressed upon the facial lines, while attitude and cranial development approximate those of the fierce quadrumane. This ideal restoration has been on view at this office, together with a plaster cast of the fossil skull-cap, and so many inquiries have been made concerning our opinion of it, that the editor deems it suitable to occupy a little space in these columns in answering the oft-repeated question: "What do you think of it?"

First. We are not satisfied with the manner of the restoration, as we think that the fossil relic has not received full justice at the hand of the restorer. Taking the plaster cast as it has been furnished us, we are struck at once by its size; and by several peculiarities of structure which indicate an alliance to existing races whose crania are of the long or dolicocephalic type. If this skull-cap be a faithful relic of a "primitive man," then "primitive" men possessed heads and brains fully as large as modern man, as we find him represented in races of low class, as a whole, and as represented by individuals belonging to the civilized races.

The interior or brain space of the cast measures 6½ inches in length, 4½ inches in breadth at the ear openings, 2½ inches in vertical depth at the centre, 2¼ inches in depth in the frontal space, 1½ inches back from the nasal root, while the breadth in the same region is 3¾ inches.

Now taking from the collection of the Institute a skull of average capacity as found in white civilization, we measure its calvarium or skull-cap space interiorly, as we have just measured the cast of the Neanderthal, and find it to be 6½ inches long, 5 inches wide, 3 inches deep at the median region, 2½ inches in the frontal space, and 3⅞ in frontal breadth. This skull, it should be mentioned, is of the broad type, while the fossil belongs to the narrow. A critical comparison of the Neanderthal with a like part of an average negro skull from the Western or Southern Coast of Africa, or with a Patagonian or Australian skull, would not result unfavorably for the "primitive man" as regards brain volume. Mr. Huxley allows its capacity to be 75 cubic inches.

Second. Considerable stress is laid upon the projection of the supra-orbitar ridges by those who would find in this fossil some confirmation of their hypothesis of man's derivation from the lower animals. They point to them, and then to the great bony eminences over the eye-sockets in the gorilla head, and claim a direct relationship between the two organizations; apparently forgetting the great difference in general structure between them, that whereas the ridges of the gorilla are widely separated from the brain-pan, spread out laterally in a wide border of plate-like process, an inch or more, in the mature animal, beyond the brain case, and rise considerably above its superior plane, while a strong ridge at the median line of the cranium unites anteriorly with two smaller ridges, one proceeding from the outer angle of one supra-orbitar prominence, and the other from the outer angle of the other. There are also other great bony processes coursing over the occipital portion of the animal's skull and around its base, intimations of the powerful muscular development of its jaws and neck. The ancient relic is smooth and entirely like the modern human skull in its general structure, none of those coronal, occipital, or lateral ridges being suggested by even a salience upon which a Huxleyite could rest an eye-glass. It must be remembered, too, that in producing this fossil, nature has replaced the original salient ridges with earthy matter, which by its accumulation to so great a thickness has probably much increased the apparent extent of the ridges; and consequently a fair estimate of them must take into consideration this tendency of the thickening process, as well as the relation which the inner plate of a skull bears to the outer at the supra-orbitar region.

The projection of these ridges is due, of course, to the breadth of the frontal sinuses, which are generally large in the males of savage races, the American Indian offering a good illustration of the fact. Mr. Huxley quotes Dr. Fuhlrott's language, that "a probe may be introduced to the depth of an inch" in the sinuses of the Neanderthal frontal bone. We have seen specimens of modern skulls, in which the separation of the inner and outer tables over the orbits extended fully an inch upward. Mr. Huxley alludes to the large circumference of this ancient skull, 23 inches, due, to be sure, to the great development of the supraciliary ridges, "though the perimeter of the brain case itself is not small." These ridges, he adds justly, "give the forehead a far more retreating appearance than its internal contour would bear out."

A writer in *Longman's Magazine*, in reply to a naturalist who has placed much stress on the supra-orbitar ridges or "bosses" of the Neanderthal fossil, as significant of its "bestial type," says: "What is posed as the 'Neanderthal skull,' is the roof of the brain case, or 'calvarium' of the anatomist, including the pent-house overhanging the eye-holes or 'orbits.' There is no other part of the fragment which can be supposed to be meant by the large 'bosses' of the above quotation. And in this assumption I have to state that the supra-orbital ridge in the calvarium in question is but little more prominent than in certain human skulls of both higher and lower races, and of both the existing and cave dwelling periods. It is a variable cranial character by no means indicative of race, but rather of sex."

It is in the structure and development of the brain that we should look for points of difference and relation. Open a gorilla skull, and immediately the great difference which separates it in form and volume of brain from man is evident. The gorilla, possessing the largest brain of the quadrumana—the highest in the scale of brutes—is thus seen to be after all but a brute. Quoting again from the writer above—"I have found that a vertical longitudinal section brings to light in greatest number and of truest value the differential characters between the lowest *Homo* and the highest *Simia*."

To realize the character of the man who once thought and lived in the ancient Neanderthal skull, we must consider its interior capacity; and only by considering that, can we realize that he was a man very much like men we meet to-day in the walks of civilization. The artist may claim to use his skull-cap as a model, and build up a mass of plaster representing a brute-man with giant trunk and semi-hairy back and breast, with grinning savage jaws, and forehead low, in which the "bosses" are brought out into special prominence—and with a crown rising to a cone, unlike enough to the fossil—which is rounded in the coronal region—on which short grizzly hair exaggerates the brutish aspect, but cannot persuade us, who have had one glimpse into that fossil, that his work is aithful.—*Phrenological Journal.*

BOTANY.

CONDITIONS MOST FAVORABLE FOR VEGETABLE ACTIVITY.

PROFESSOR GOODALE.

The assimilative activity of plants is measured by the amount of carbonic acid consumed and oxygen given off. Respiratory activity is measured by the amount of oxygen consumed and carbonic acid given off. For most rapid assimilation the amount of carbonic acid must not exceed a definite amount for each sort of plant. Some people argue that if a teaspoonful of medicine is good, a whole bottleful at a dose would be better. But apply this to plants, and we soon find that if we increase the carbonic acid beyond a certain amount, the plant suffers from it. Geologists will then question how it was in the coal period. It has been concluded that there was really less carbonic acid in the atmosphere at that time than has been supposed. Moreover, we find that the equisetacea, and other descendants of the plants of that age, need more carbonic acid than do others. The amount generally found in the atmosphere seems best for plants at this time. For vegetable activity there is a maximum, minimum and optimum temperature. Let a plant grow where the conditions of moisture, heat, etc., can be *regulated*, and we find that, when the temperature rises above a certain limit, the plant dies, as does its individual cells; or let the temperature fall below a certain limit and the same thing occurs. These limits vary very much in different plants. Between these points lies the optimum temperature for each plant, which varies, of course, with the others. The optimum temperature for corn, e. g., is much higher than that of barley, and this fact has a very important bearing on the distribution of plants. From 110° to 120° is the maximum for ordinary greenhouse plants.

For others it does not exceed 70°. In a miscellaneous collection, some, of course, would suffer. Vegetable activity may be measured also by growth and movements. A description of apparatus devised by Dr. Wilson was given, and a picture of the same thrown upon the screen. It consisted essentially of a generator whence gases could be fed to a receptacle containing plants or germinating seeds, and an aspirator for withdrawing from this the products of growth through liquids which would attract and detain certain elements, as carbonic acid. Thus a stream of hydrogen could be fed to germinating seeds. Carbonic acid was found to be a product of the growth, and as no oxygen was given the plant, it must have come from the tearing asunder of the molecules composing the seeds. This was first tried in Professor Sach's laboratory. Apparatus to measure growth was then explained. A delicately weighted lever attached to the growing tip of a plant rested at the end against a cylinder of blackened paper turned by clock-work. As the plant elongated in growth the end of the lever would descend and indicate the rapidity of growth by the lines on the paper. Leaving out of view slight diurnal oscillations of growth not yet accounted for, we find that at the optimum temperature growth is accelerated, and that light slightly retards the same. Another and perhaps better way of testing vegetable activity was by measuring movements made by plants in growing. This was illustrated by views of various plants on the screen. On the hop vine the flexible end of the stem twists about a support, and thus raises itself into light and air with a slight expenditure of woody tissue, the whole revolution made is in from two to four hours under favorable conditions. The morning-glory has a long projecting arm which sweeps around and clings to support.

The jasmine solanum twists its leaf-stalks about other plants, and so climbs upward. The passion vine was shown to have tendrils, which were modified forms of branches, moving and sensitive. Virginia creeper has tendrils with a disk at the end, which fastens itself to support. The activity of these tendrils is increased in darkness, i. e., the plant is negatively heliotropic. Another form was shown in the leaf of the nepenthes, where a tendril was found between the blade of the leaf and the pitcher. In conclusion of this part of the subject the lecturer said that the observations made prove that the most favorable conditions for vegetable activity are, (1) supply of proper amount of the gases; (2) sufficient moisture; (3) best degree of heat; (4) requisite kind and amount of food.

This last point leads to a consideration of those plants which obtain part of their nitrogen from animal food. These may be divided into two classes: First, those which have fly-catching traps, as the *drosera*, where the leaf is covered with tentacles of various lengths tipped with a viscid liquid. These are not sensitive to straw or metal, but place on them a bit of beef or albuminous substance and they will close over it, and after a few days it will have disappeared. The *dionea* has at the end of its leaf-blade two valves bearing three sensitive bristles. The edge is also fringed with hairs. If an insect tonches this the valves close, the bristles on the edge interlock loosely; if the insect be small it escapes; if large, t is retained, a glairy fluid is exuded and the fly is digested as food is digested in our stomachs. Touch these valves with the poles of an electric battery and they will close. Attach a galvanometer, cause them to close, and an electrical disturbance will be noticed. This was long held to be comparable to the electrical disturbance noted when a muscle contracts, but it has been proved that the same thing occurs if any leaf or stem be bent in the same way, and is owing to the rapid passage of fluids from one cell to another. The pitcher plants and other insect-catching plants, as the *utricularia* and *pinguicula*, were described, explained by diagrams and shown on the screen.

Whether these insects, etc., were really appropriated as *food* was next considered. Francis Darwin proved that the *drosera* fed with nitrogenous food surpassed others not so fed. In the case of the pitcher the experiment had been tried of feeding flies with saccharine matter in which was a trace of lithium. The flies were then given to the plants, and by means of the spectroscope the lithium was subsequently found to have become a part of their tissues.

POWER OF VITAL FORCE IN GERMINATING SEEDS.

During the years 1873 and 1874, a variety of experiments were made at the Massachusetts Agricultural College, with a view to determine the amount of force exerted in the growth of plants. These experiments are very fully described in two lectures by Pres. Clark, which are given in the Reports upon the Agriculture of Massachusetts for those years. Doubtless the publication of these lectures gave an impulse to the practicing of experiments in other places. Recently, the botanical faculty at Wellesley College have been experimenting upon the germination of seeds.

We are indebted to our South Natick correspondent, Mr. A. P. Cheney, for the following condensed report of two of these experiments.

Three pints of marrowfat peas were placed in a strong iron vessel, into which a cover was so fitted that while it would readily pass down inside, it would not allow any peas to pass up by it. Scales, capable of weighing something over half a ton, being prepared for the purpose, the vessel of peas was placed upon the platform, and warm water added. This was done at 7.45 A. M.

At 8.00 A. the pressure from the swelling of the peas amounted to . . . . 75 lbs.

9.00 A. M.	it had risen to	300
9.50	"	432
11.00	"	585
12.00 M.	"	687
1.05 P. M.	"	778
2.00	"	855
3.10	"	943
4.00	"	980
4.45	"	1025

6.00	"	 1080
7.40	"	 1141
9.00	"	 1175
10.00	"	 1193
10.45	"	 1195
6.45 A. M.	next day it had risen to	 1227
8.00 "	it had risen to	 1300

At this point the platform of the scales broke down, and so put an end to that trial. It will be seen that during the first quarter hour the pressure increased at the rate of five pounds per minute. From eight to nine o'clock, the record was made every five minutes, and it was found that the increase varied from five pounds down to one and four-tenths pounds per minute. Later in the day there were times when the movement nearly ceased, as during the forty-five minutes after ten o'clock, P. M., only two pounds were gained. The cause of these variations was chiefly, if not wholly, the changes of temperature.

The next experiment in this list was made with three pints of beans. This trial was commenced Monday, February 5th. When observed

At 8.00 A. M.	the pressure was	. . . . 55 lbs.
9.00	"	 375
10.00	"	 620
11.00	"	 875
12.00	"	 1165
1.00 P. M.	"	 1275
2.10	"	 1351
3.00	"	 1410
4.00	"	 1475
5.00	"	 1515
10.00	"	 1670
Tuesday:		
At 7.45 A. M.	the pressure was	. . . . 1845 lbs.
8.00	"	 1860
9.05	"	 1925
10.00	"	 1960
11.15	"	 2025

The rate of increase of pressure varied much more in this trial than in that with peas. During five minutes of the hour between eight and nine o'clock, A. M., on Monday, the increase was *eight pounds per minute*, while a period of twenty minutes, between twelve and one, P. M., the same day, showed only nine pounds increase, or less than half a pound per minute.

The relative rate of increase of the pressure of the swelling beans was much more rapid than that of the peas, for while the peas, with fully as close attention, attained to a pressure of but six hundred and eighty-seven pounds at noon of the first day, the beans showed eleven hundred and sixty-five pounds in the same length of time.

When the beans were removed from the vessel in which the trial was made, it was found that many had sprouted, or rather, that the sprouts had grown to be half an inch or more in length.

We could wish that time and space permitted a further statement of the facts in these cases, but we must stop. These experiments are conducted under the immediate supervision of Miss Susan M. Hallowell, Professor of botany at Wellesley College.—*Natick Citizen.*

ASTRONOMY.

TRUE TIME TAKEN AT KANSAS CITY BY REGULAR STELLAR OBSERVATIONS.

W. W. ALEXANDER.

In order to obtain time we must have a starting point, something must be noted, and its return or repetition again noted. To have our time perfectly equable or uniform in its increase, this event must be certain and regular. Then we can avail ourselves of some mechanical means to subdivide this interval into equal parts; this is what our watches and clocks are intended to do, but they must have something to start from and also to regulate their rate of speed; if not one will gain, another lose, or if two should agree both may be wrong, for a chronometer, no matter how well made, will after a long lapse of time show a variation in its rate of motion. For the benefit of the public I will here explain the method adopted by astronomers: It is to watch the daily rotation of the earth which presents us with a beautiful and accurate time signal, in fact it is the only regular and constant motion known; it has been watched by astronomers for centuries past and not a fraction of variation found (this regularity is of infinite value to them in determining the eccentricity of other celestial bodies), so they have adopted this rotation as the base to measure the flow of time. In order to use it some stationary point must be found outside and separate from the earth. The fixed stars filled this want, but what one to use was the next question, there being over 300,000 visible. It was finally agreed by astronomers to use the first point of Aries, or the intersection of the equator and the ecliptic at the vernal equinox for the commencement of the sidereal day. From the time a meridian leaves this point until it returns is twenty-four hours, or one day sidereal time; the hours are divided into minutes and seconds. Watching our meridian move eastward across the heavens all the stars are found to be crossed by it; the interval from the time this day began until the star is on the meridian is called the "right ascension" or sidereal time of its meridian passage. The right ascension of our 300 stars known as the "standard time stars" have been determined with all attainable precision. The greatest variation, if any, cannot exceed the tenth part of a second in time; they are distributed all the way round the circle of the heavens at intervals of about five minutes for convenience of observers who require accurate time at all hours of the night, the brightest can be observed even in daylight, so at all times they are available (if the sky be clear) without much delay. A catalogue of them is published every year by the United States naval observatory, Washington, for the use of American astronomers and navigators.

All that is necessary in order to set and regulate a time-piece is a transit instrument adjusted, collimated, or placed at a right angle with its axis, and set to swing north and south, the axis being level. The one I have in use here is a two and three-quarter inch aperture achromatic of forty-eight inches focus, magnifying seventy-five diameters; have it in fine adjustment and set in the meridian, stars observed south and north of the zenith agree in time to a fraction of a second. This proves it to be in the meridian and the time correct. The passage of the star is observed at five equidistant vertical wires, two on each side of the meridian wire on line. The instant at which the star is bisected by each wire is noted in a new chronograph, a very ingenious machine that works on the following principle: 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 a short distance above the moving disc, which simultaneously with the pressing of the spring, makes a hole in the paper and re-adjusts itself in position in less than the hundredth part of a second. At each round of the disc, 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 transit of Procyon, April 10, 1883. From the catalogue of stars I found that at 7 h., 33m. 12.17s Procyon would be on the meridian. So at about three minutes before that time I arranged and placed the disc of paper in position and started the chronograph running, went to the clock I wished to time and watched it until it indicated 7h., 31m., os. exactly, then touched the spring which marks the paper, carried it to the transit, and, simultaneously with the star's passing the first vertical wire, I again pressed the spring, and at the second, third, and so on until the five were passed, then removed the disc of paper and placed it on the reading dial, which showed by the relative position of the marks, the interval from the time of the mark made at the clock to those made at the transit. In the above observation the time noted was as follows:

	Min.	Sec.
First wire	1	46.2
Second wire	2	00.3
Meridian wire	2	14.4
Fourth wire	2	28.6

Fifth wire	2	42.6
	11	12.1
Mean of the five wires	2	14.2

The mean of all the wires correct the error in observation at the central or meridian wire. In the above 2′ 14.14″ was the observed time at the central wire, 2′ 14.42″ as the mean of all the time noted at the different wires. This was the time that had passed 7h, 31′ 00″ by the clock, add the two given 7h, 33′, 14.42″, the time by the clock at which the star was on the meridian. True time of meridian passage from catalogue, 7h, 33′, 12.17″, clock fast 2¼″, or the difference between the observed and the true time. Observations made on seven other stars all agree within 0.3″ This proves the time without doubt to be within that limit of error.

Time is something everybody should know, there is but one true mean and sidereal time to each meridian. Mean solar time, or as it is commonly called, mean time, is the one in ordinary use, the one clocks and watches are intended to keep. It is perfectly equal in its increase, and is measured by the motion of a ficticious sun called a mean sun, that is supposed to move in the celestial equator with a uniform velocity. This mean sun is supposed to keep on the average, as near the real sun as is consistent with perfect uniformity of motion, it is sometimes in advance of it, and sometimes behind it, the greatest deviation being about six minutes. This error in the time taken from the sun is called the "equation of time," and was found from the accuracy of sidereal time, which can be converted into mean time at any hour of the day. Time varies as we go east or west. In this latitude the difference is a trifle less than four seconds to the mile. So the time at the eastern limits of our city will be ten seconds faster than at the bank of the Kaw river.

The transit is placed in the rear of No. 1416 Holmes street, in West longitude 1 hour 10 minutes 08.0 seconds from Washington. The time there obtained is reduced to the meridian of Main street, at the intersection of Seventh, by subtracting 1.7 seconds. A clock indicating this time (i. e. mean solar, commonly called "city time") can be seen at No. 16 East Seventh street, where corrections will be kept as near as possible by conveying the time with a pocket chronometer. The time thus conveyed will always be reliable within one or two seconds. Persons wishing it more correct are invited to call (on any clear evening) and see observations made with transit. Time observations at Kansas City will be a regular and permanent thing, and are intended mainly for the benefit of the public.

KANSAS CITY, April 14, 1883.

THE SUN AND PLANETS FOR MAY, 1883.

W. DAWSON, SPICELAND, INDIANA.

The Sun's mean Right Ascension (mean distance from the Vernal Equinox) on May 1st is 2h. 37m., or 39°; and this increases about four minutes every day, so that on May 31st the mean Right Ascension of the Sun will be 4h. 35m, or 69°, an increase of two hours during the month. Now this Right Ascension of the Sun subtracted from the Right Ascension of any star will give the time that Star crosses the Meridian, or south. Then Regulus (the bright Star in Leo) whose Right Ascension is 10h. 2m. will south at 7:25 P. M. on the 1st, and about four minutes earlier each day afterwards. Beta of Leo, or Dembola, south's 1h. 41m. later than Regulus. An excellent way of obtaining true mean time is by observing with a transit instrument or other meridian mark the moment when a star souths.

A great eclipse of the Sun will occur at the time of New Moon, May 6th. An interesting account of this eclipse is given in the REVIEW for April. This noted phenomenon occurs about 3 o'clock in the afternoon, Kansas City time, and might be visible here if the Moon were only about its own diameter further north. An eclipse of this series will occur every eighteen years and about eleven days; and a little farther north every time. So it will likely be visible here in the distant future—probably near 200 years. The Moon comes to First Quarter May 13, about 4:30 P. M. That night—if the sky is clear, will be a good time to view the Moon through a telescope. The mountains and shadows, valleys, &c., show better near the quarter than at other phases. Jupiter graces the western sky as being the brightest star in that region. On the 16th, about 8 P. M. his four Moons will afford an interesting sight through a small telescope —being two on each side of the planet, and near together, like a double star above and another just below the planet. Saturn is near the western horizon—a few degrees southwest of the Seven Stars. It will soon be lost in the Sun's rays. Venus is the bright morning star in the southeast. In the telescope it presents a delicate half-moon shape. It and Mars will be near together about the 9th and 10th. But Mars is much dimmer than Venus, and will be north a little farther than the Moon's diameter.

THE GREAT RUSSIAN TELESCOPE.

We have seen the wonders of the starlit sky through the largest and best refracting telescope in the world; but the wonderful instrument is not destined to remain in this country. The most important part of it, the object glass, with the cell that holds it in place, will soon be on its way to the Russian Observatory of Pulkowa, located on the Pulkowa Hills, nine miles south of St. Petersburg, and commanding a fine view of the Capital. The Observatory was built and richly endowed by the Czar Nicholas in 1839, and has won high renown on astronomical annals for the work it has already accomplished under its first director, the eminent astronomer Wilhelm Struve, as well as under his son, Otto Struve, who became director in 1864, upon the death of his distinguished father, and still holds the honorable position.

The Russian Government was not satisfied with the capacity and size of the present working force of the observatory, and determined to have a new refracting telescope constructed which, in mechanism and optic power, should surpass any telescope in existence. The director (Struve) was commissioned to carry out the plan. The most perfect workmanship attainable was to be put in requisition, and Struve chose from all the world, for the execution of the difficult and delicate task, the Messrs. Alvan Clark & Sons, the famous telescope-makers of Cambridgeport, Mass.

Struve came to this country and intrusted to their skillful hands the making of the object-glass, with a diameter of thirty inches, and its cell. The mounting of the great telescope is being made in Hamburg, Germany, by Messrs. Repsold & Sons. The Pulkowa object-glass is four inches larger than that of the Washington telescope, finished in 1873, and seven inches larger than that of the similar instrument recently completed for the Princeton Observatory, both telescopes being the work of the same makers. The arrangements with Messrs. Clark were made in the summer of 1881, and the great objective was completed in October, 1882.

A temporary equatorial stand was erected in the yard of the workshop, in order to test the quality, power and perfection of the glass. It consists of a pier of solid masonry, to which a tube of sheet-iron, made in three sections, is firmly fixed, with the necessary mounting to secure its movement in the required direction. The object-glass, the eye pieces and other appurtenances being then placed in position, the great refractor was ready to show its working power and to reveal any slight imperfections in the polish or finish that required attention. The precious glass bore the testing process with triumphant success, and is pronounced by the makers to be the best that has left their hands.

But the supremacy of the Russian telescope as the largest of its kind in the world will be of short duration. The same trial mounting will be used by the Messrs. Clark for testing the thirty-six inch object-glass which they have engaged to make for the Lick Observatory of California.

The pier of the temporary structure is twenty-seven feet in height; the tube is forty-five feet in length, with an aperture of forty inches in diameter. Figures, however, give a faint idea of this giant structure. It must be seen looming up under the sky before its huge dimensions can be realized. A view of the heavens through its great eye must be taken before its wondrous light-gathering power can be imagined.

The evening of our observation is intensely cold, but the sky is undimmed by the shadow of a cloud, the atmosphere is free from a breath of moisture. The heavens present a scene of exceeding beauty as the party of observers take their places under the stars. The last lingering rays of twilight faintly suffuse the West, the new Moon, only a day old, holding the old Moon in her arms, is nearing the horizon, and the zodiacal light spreads its cone of pale gold high up among the eternal stars. Under the dark dome arching above us the brightest stars and clusters of stellar space look down with friendly eyes, and seem to hang low, as if they would hold communion with mortals. Among them thread the planets Jupiter and Saturn, whose mysterious portals we, audacious invaders, are seeking to enter this night with necromantic art. Rising from a surface of unbroken snow, and looming up with shadowy indistinctness, the huge telescope seems to pierce the skies, while the observers at its base dwindle to pigmies.

After a short time the instrument is ready for action; its open eye is turned upon the planet Saturn. The serene star, upon which a moment before we had turned our unaided eye, is suddenly transformed into a creation of surpassing beauty. A superb golden sphere, as large as the full Moon, lies before us. Saturn is softly cradled in the protecting embrace of his engirdling rings, and seven of his eight moons are visible as bright points on the dark background of the sky. Titan, the largest moon, has a perceptible disk. Every detail of the magnificent and complex Saturnian system is complete. The outer ring, with its faint line of division; the division between the outer and inner rings; the inner or second ring; the third or crepe ring, closely joined to the second, the break on the rings formed by the shadow or the planet; and the soft markings on his disk. Nothing is wanted in the minutest details, and there is but one imperfection in the picture. The definition is not good; the outlines are not clearly defined. The view does not differ greatly in dimensions from that presented by a smaller telescope, but planet and rings are flooded with light of delicious brilliancy and softness. Here lies the advantage of a great telescope. It brings to the eye all the light that enters it, so that, within certain limits, the larger the telescope the larger the amount of light it collects, the more easily visible will faint objects become, and the greater the number of objects before unseen that will be revealed.

Terrestrial colors are muddy in comparison with the celestial hues of liquid gold of the disk and rings, and the creamy tints of the belts that cross the disk with the lightness and grace of scudding cloud bands. The sphere seems almost to stand upright within the encircling rings, only a small portion of the planet being seen beneath them. We have fallen upon favorable conditions for a view of Saturn, for his rings are opening to their widest extent, his northern declination is increasing, and he is approaching perihelion.

Jupiter is the next object to test the space-annihilating power of the instrument. The Prince of Planets is superb, larger than the full Moon, though but little larger than we have seen him many times in a telescope of eight inches aperture. He is, however, much brighter, and though by no means as magnificent as Saturn, we have the pleasure of feeling that we see him on a much larger scale. He seems so near that we are impelled to put our hands behind the glass and touch him. His broad belts are delicious in coloring, now suffused with pale rose, or mottled with soft gray, while shades of purple, brown, and delicate green are interspersed. Never before did we behold the variety of tone and tint, the flood of light we see this night. Never did our giant brother seem so near, so grand in proportions, so symmetrical in equipoise. His four satellites are brightly beaming on his left, and bear testimony to the power of the telescope by presenting disks instead of points. The famous red spot is wanting in the view. We mourn its absence, for, since 1878, its well known features have become as familiar and firmly fixed as if they were a permanent feature on the planet's disk.

What shall we see next? is the question now discussed, for the extreme cold has congealed the oil, and the monster refuses to move. His eye is turned to the meridian, and no effort will make him swerve one inch to the right or left. In this emergency, a member of the party volunteered to mount to the top of the pier and lubricate with fresh oil the joints of the giant. The plan is successful, and, with many a shriek and groan, the lower end of the tube rises and the upper end falls, until the Cyclopean eye points to the great Nebula in Orion.

The little wisp of cloud haze visible to the naked eye is transformed into one of the most glorious visions that ever breaks upon the entranced eye of the observer. The most wonderful nebula the northern sky reveals lies before us, filling the whole field of view and suffused by a light that never was seen on sea or shore. Now we appreciate the power of the great telescope, the triumph of the optician's art. For definition is of little consequence in observing the shadowy nebula. Light is needed, and light comes.

The delicacy of the celestial glow that pervades the scene is beautiful beyond comparison. The central point of interest is the famous trapezium, consisting of four bright stars and two smaller ones. Around this sextuple group radiate what seem to be the head and branching horns of some huge animal, the trapezium occupying the open mouth, and surrounding a space of sky within which reigns the blackness of darkness Spiral curves of nebulous haze fill in the field of view, the radiating mass being of a delicate green tint, while dotted over the shadowy haze are many brilliant stars, throwing an element of life into the formless void and helping to light up this scene of loveliness and grandeur which no pencil may paint nor pen describe. We feel, while with reverent eyes we gaze upon the picture, that we are looking within the eternal gates, and enjoying a glimpse of the glory to be revealed, that "eye hath not seen nor ear heard"

It is said that no one can look upon the Apollo without standing erect and feeling a sense of the divinity inherent in human nature. But what is this masterpiece of Greek art, chiseled by human hands from a block of marble in comparison with this creation from Nature's fashioning hand brought near to mortal eyes by telescopic art! Where but in the heavens shall we find such an exhibition of majesty, vastness and celestial grace as is symbolized in the great Nebula of Orion, beaming with suns, peopled with ghostly shadows, and glowing with light that is hundreds of years old when it reaches us! Our earth and her brother planets will have cooled down to dead worlds, the Sun's fires will be quenched in utter darkness, when the star dust on which we are now looking will quicken with the pulse of physical life, throw off its concentric rings, and concentrate into beaming suns and systems to take the place of those whose race is run, whose mission is fulfilled.—*Scientific American.*

BOOK NOTICES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Part III, October to December, 1882; octavo, pp. 160; Philadelphia, 1883.

This Part comprises the thirty-fourth volume of the Proceedings of the Philadelphia Academy, which has had a long and useful career. Most of the leading scientific men of this and former generations of Philadelphians have been members of it, and it has put forth some notable volumes based upon original investigations and discoveries.

The present volume contains contributions by such distinguished writers and students as Professors E. D. Cope, Heilprin, Leidy, Meehan, Carvill, Rev. H. C. McCook, Dr. Harrison Allen, etc.; also full reports by the various officers, showing the institution to be in a very flourishing condition.

The officers for 1883 are Prof. Joseph Leidy, M. D., President; Thomas Meehan and Rev. H. C McCook, Vice Presidents; E. J. Nolan, M D., Recording Secretary and Librarian; George H. Horn, M. D., Corresponding Secretary, and William C. Henzey, Treasurer.

HISTORY OF THE NEGRO RACE IN AMERICA: by Geo. W. Williams; Vol. I, Octavo, pp. 481. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson.

Having referred quite fully to the general scope of this work in the April number of the REVIEW, it is unnecessary to recur to it or to repeat the favorable comments then made upon the ability and skill manifested by the author in handling his subject. The present volume is devoted to an account of the negro race in America between the years 1619 and 1800. Commencing with the unity of mankind and considering the subject in the light of philology, ethnology and Egyptology, the author proceeds to discuss primitive negro civilization, the negro kingdoms of Africa, the Ashantee Empire, African idiosyncrasies, languages, literature and religion, Sierra Leone, the Republic of Liberia, etc.

In Part II he considers the history of slavery in the Colonies of Virginia, New York, Massachusetts, Maryland, Delaware, Connecticut, Rhode Island, New Jersey, South Carolina, New Hampshire, Pennsylvania and Georgia, giving the laws regulating slavery in each and many other facts which have been collected with great pains, and carefully condensed.

Part III is devoted to an account of the services of the negroes during the Revolution, including their military employment; their legal status; the statutory prohibition against educating them; notices of Bannaker, the negro astronomer; Fuller, the mathematician, and Derham, the physician; slavery during the Revolution, as a political and legal problem.

Mr. Williams, though a very dark-skinned and pronounced negro, is a lawyer and has been a member of the Ohio Legislature. He is a vigorous writer and a hard student. In the preparation of these volumes he has consulted over 12,000 volumes, besides thousands of pamphlets, and has succeeded in producing a work which will be an authority on the subject treated until a better one is produced, which is likely to be a long time.

PROCEEDINGS OF THE DAVENPORT ACADEMY OF NATURAL SCIENCES; Vol. III, Part III, 1879–81, octavo, pp. 314; 1883.

The whole of this Volume is devoted to an account of the life and labors of Joseph Duncan Putnam, late President and life-long active member of the Davenport Academy of Natural Sciences.

Though dying at the early age of twenty-seven, Mr. Putnam had acquired an extended reputation as a scientist, especially in the field of entomology. Having been compelled on account of his health to travel largely in different portions of the United States, east and west, took occasion to pursue his studies at all times and gathered more than 25,000 specimens of insects, including many new species, several of which have been named in his honor and in recognition of his attainments in this branch of science. This volume of the Proceedings of the Academy is a grateful monument to his memory by worthy associates.

THE FORESTS OF ENGLAND: by John Croumbie Brown, LL. D.; 12mo., pp. 271. Oliver & Boyd, Tweedale Court, Edinburgh, 1883.

This volume is stated by the author, who is Professor of Botany in the South African College, Capetown, and has held several prominent positions of kindred character in England, to be a compilation of what has been published previously as contributions to the literature of Britain on subjects pertaining to Forest Science. It is to be followed by another—now in press—a translation of the famous Forest Ordinance of France of 1669, with notices of the previous treatment of forests of that country.

This work is devoted chiefly to accounts of the laws and usages concerning forests, chases, parks and warrens, with particular descriptions of ancient forests, modern woods and forests. Among these are selected for illustration Sherwood Forest, Epping Forest, Dean Forest and New Forest, with accounts of Robin Hood and his tomb, the Parliamentary Oak, the buried remains of mammoths, lions, bears, etc., in various forests.

Many historical notices are also given of Forests of which nothing now remains but the names; remains of ancient forests buried in the ground and submerged in the sea, descriptions and speculations upon petrified forests, closing with Forest Legislation, ancient and modern, and forestal literature previous to the 16th century.

It is an exceedingly instructive work to the antiquarian as well as to those interested in forests at the present day.

PROCEEDINGS OF THE BOSTON SOCIETY OF NATURAL HISTORY; Vol. XXI, Part IV, January to April, 1882; octavo, pp. 123; Boston, 1883.

The contents of this volume are as follows:

Mr. William M. Davis, On the Classification of Lake Basins (conclusion); General Meeting, February 1, 1882. Prof. H. W. Haynes, Indications of an Early Race of Men in New England. Mr. S. H. Scudder, A New and Unusually Perfect Carboniferous Cockroach from Mazon Creek, Ill. Dr. W. J. Hoffman, List of Birds Observed at Fort Berthold, D. T., in September, 1881. Mr. F. W. Putnam, Remarks on Stone-Implements from Marshfield, Mass., and Sag Harbor, N. Y. Mr. S. Garman, On Mounting Museum Specimens; and on the Nesting of the Rock-Wren. Dr. M. E. Wadsworth, Zircon-syenite from Marblehead, Mass.; General Meeting, February 16, 1882; Section of Entomology, February 22, 1882. Mr. S. H. Scudder, Occurrences of Southern Butterflies in Maine; Notes on Tertiary Neuroptera from Florrisant and Green River; General Meetings, March 1 and 15, 1882. Mr. Wm. Trelease, Structures which Favor Cross-Fertilization in Several Plants. Mr. S. S. Kingsley, On the Development of Molgula Manhattensis. Gift of Mr. Fred. Habirshaw's Collection of Diatomaceae; General Meeting, April 5, 1882. Mr. N. F. Merrill, Concerning the Lithological Collection of the Fortieth Parallel Survey; General Meeting, April 19, 1882; Section of Entomology, April 26, 1882. Index. Errata.

This is one of the oldest Societies of the kind in the Country and its work is of the highest order.

OUR CHOIR: by C. G. Bush; folio, pp. 20, copiously illustrated. G. P. Putnam's Sons, 1883. For sale by M. H. Dickinson; $1.50.

"I write of choirs, of many choirs,
Of choirs that gather weekly,
Of choirs, from those that sing in style,
To those that charm most meekly.

Of choirs in churches rich and poor,
Of choirs of ancient date
Of choirs that sing in tune, and out,
Of choirs both gay and sedate."

This brochure, to which the above is the introduction, is devoted to depict-ing, by ironical words and amusing illustrations, the comical side of church singing, and in our judgment it teaches some admirable lessons by holding an exaggerated mirror up to nature. If each church choir in the country were to procure a copy and keep it at hand for convenient reference no harm would result either to singers or congregations.

OTHER PUBLICATIONS RECEIVED.

Circular of Information from Bureau of Education, No. 4, 1882, Washington, D. C. *Christian Philosophy Quarterly*, New York; published by Anson D. Randolph. *The Electrician*, May, 1883, New York. Parish Institutions of Maryland, April, 1880; Published by John Hopkins University. John Hopkin's University Circulars, February, 1883, Baltimore; price 10c. *Knowledge*, March, 1883, London. Experiments Chiefly with Kerosene on the Insect affecting the Orange Tree and the Cotton-Plant, 1883, Washington. Reports on Rocky Locust and the Chinch-Bug, 1883, Washington. Report on Michigan Forest Fires of 1881–82, Washington. Local Government in Michigan and the Northwest, No. 3, Baltimore, March, 1883. Coal, from *Cumberland Review*, April, 1883. Proposed Ordinance and Rules and Regulations for the Regulating of Plumbing, etc., P. Blakiston, Son & Co., Philadelphia; price 10c. Darwin and Humboldt, J. Fitzgerald, New York; price 15c. Reports of Comptroller, City Engineer, December 31, Kansas City, Mo., Ramsey, Millett & Hudson. Cornell University Register, 1882–83, Ithaca, N. Y. Bulletin of American Geographical Society, 1882, New York, No. 3. Local Government in Illinois, January, 1883, Baltimore, John Hopkins University. Report from San Miguel County, 1882, Las Vegas, N. M. Proceedings of the Academy of Science, Philadelphia, 1883.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

In the record from March 20th to April 20th here given, it will be noticed that the usual high winds of March have been delayed this year till April. At the close of this report cherry, plum and apple trees are in blossom and the forest trees begin to look green. Altogether the season continues very backward. The rain-fall is rather light but as yet nothing suffers especially from drought.

The barometric range has been specially low in April, and these low pressures have been accompanied by wind-storms in which the velocity has several times reached sixty miles per hour. The wind-travel on April 14th was nearly 1,000 miles.

The maximum thermometer recorded 93° on the 13th.

Thunder-storms occurred April 4th and 12th.

Rain has fallen on nine days.

The prevailing winds of the first decade were north and west, those of the last two decades were south.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Mar. 20th to 28th.	April 1st to 10th.	April 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	24.4	40.1	50.3	38.3
Max	48.9	69.2	75.4	64.5
Min. and Max	37.2	54.15	62.8	51.4
Range	24.4	28.1	25.1	25.9
TRI-DAILY OBSERVATIONS.				
7 a. m.	28.8	42.9	51.8	41.2
2 p. m.	47.0	64.2	74.6	61.9
9 p. m.	36.9	50.4	59 6	48.9
Mean	37.4	51.41	61.39	50.4
RELATIVE HUMIDITY.				
7 a. m.	..	..	..	..
2 p. m.	.	..	..	..
9 p. m.	..	..	..	..
Mean	..	..	..	..
PRESSURE AS OBSERVED.				
7 a. m.	29.27	28.92	28.83	29.01
2 p. m.	29.26	28.95	28.80	29.00
9 p. m.	29.24	28.94	28.80	28.99
Mean	29.26	28.94	28.81	29.00
MILES PER HOUR OF WIND.				
7 a. m.	9.2	11.7	18.0	13.0
2 p. m.	16.1	28.8	30.6	25.2
9 p. m.	11.0	13.7	18.8	14.5
Total miles	2560	4490	4568	11618
CLOUDING BY TENTHS.				
7 a. m.	5.9	5.0	6.4	5.8
2 p. m.	4.0	4.8	3.6	4.1
9 p. m.	3.5	2.3	4.8	3.5
RAIN.				
Inches	1.40	0.01	.76	2.17

SCIENTIFIC MISCELLANY.

OLD MAPS.

PROF. G. C. BROADHEAD.

The study of the olden maps of our country is instructive. From them we see at a glance the wonderful progress of settlement and the important changes that have taken place in boundaries and political divisions. They are an epitome of history.

Jefferson's Notes on Virginia, 1801, contains a county map of the State, showing that the portion of the State east of the Blue Ridge does not materially differ from its present divisions, but west of the Kanahawa (the spelling of Mr. Jefferson) River, the only counties then organized were Wythe, Washington, and Russell; all in the extreme southwest. While north of the K. River and west of the Alleghany Mountains are only six counties, viz.: Kanahawa, Greenbrier, Randolph, Monongahela, Ohio, and Harrison. Northwestward across the Ohio River we find Northwest Territory where now is the populous State of Ohio.

In Geology of North America, by Wm. Maclure, Phila., 1817, there is a map of the United States, colored according to the then accepted geological nomenclature as Primitive, Transition, Secondary, Alluvium and Old Red Sandstone. This was the first Geological map published of the United States. Besides the olden states we find upon it Alabama Territory, Illinois Territory, and Northwest Territory, the latter having been removed farther west than on Mr. Jefferson's map; extending north from Illinois to British America, and lying between Lake Michigan and the Mississippi River. The State of Louisiana had its present bounds, and Missouri Territory extended from Louisiana northwardly to British America, and from the Mississippi River indefinitely west. Kansas River is spelled Kans., and Arkansas is spelled Arkansaw, as pronounced. A Choctaw village we find located on the south side of the Arkansas River, not far from the present location of Little Rock. A Delaware village we find on White River, just below the junction of Black River (in Arkansas). An Osage village on the south side of the Missouri River. A Kans (Kansas) village near where Wyandotte, Kansas, now stands. A Sac village at the mouth of Des Moines, and another just below the mouth of Rock River. On this map we also find Chicago placed directly at the north boundary of Indiana, and the northwest corner of that State is considerably to the westward.

In the Gazetter of Illinois and Missouri, by L. C. Beck, Albany, N. Y., 1823, we find seventeen counties south of the Missouri River and ten north, and three of the latter, Ralls, Chariton and Ray occupy the northern portion of the

State from the Mississippi River to the western State boundary. Lillard county extended from the Missouri River to Grand River, and Saline bounded it on the east. Saline and Cooper extended from the Missouri to the Osage. Wayne county included a fourth part of south Missouri, extending from Washington to the west State line.

On this map Pike County included all of Illinois west of the Illinois River, and on the north reached across to Indiana. There were twenty-six counties in Illinois, and Ft. Dearborn was on Lake Michigan where now is the city of Chicago.

In Schoolcraft's Travels, through certain portions of the Mississippi Valley, 1821, we find a small map of the Ohio Valley with Illinois, Michigan and Eastern Missouri. On this map we find laid down on the north side of the Ohio, from opposite the mouth of White River (of the Wabash) to opposite the mouth of Tennessee River, the Oshawana (Shawnee) mountains. From Chicago to St. Louis and near the Illinois River, we find Mt. Joliet, Rock Fort, Ft. Clark, and Mauvais Terre. In this volume there is also a small geological sketch map of the Lead District of Eastern Missouri, extending from the Missouri River to beyond Fredericktown. This map is printed with south at top, and north at bottom.

On Mitchell's Map of Missouri, 1835, we find that there were then thirty-two counties in Missouri, and Green county joined Gasconade and Crawford on the east, with Pulaski on the south, while west of these the State seemed yet not to be divided into counties. Jackson and Lafayette extended to Grand River on the south and Pettis reached to the Osage. The Platte Purchase was not yet made and Clinton extended from Clay to the north line of the State. Chariton also extended from the Missouri River to the northern boundary, and Missouri was bounded by Wisconsin Territory on the north. From Potosi westward to the Gasconade River we find the "Black Hills." The Ozark Mountains extended from northwest Arkansas northeastwardly to central South Missouri.

On Morse's Map of the United States, 1844, the south and west boundary of the United States is: beginning at the south, the Sabine River and west boundary of Louisiana to Red River, thence up Red River to a little west of the twenty second meridian west from Washington, thence north to Arkansas River, thence up said river to the summit of the Rocky Mountains about west longitude 29° from Washington, thence along the crest of said mountains northwestwardly to the parallel of 42°, thence west to the Pacific Ocean. Our north boundary was 49°, as far west as the Rocky Mountains, but west of these we claimed to 54°, 40′. The strip between 49° and 54° 40′ was soon after ceded to Great Britain. Oregon included all of the United States west of the Rocky Mountains, and Indian Territory all west of Arkansas and Missouri, with Missouri Territory lying north, and Iowa extended from Missouri to British America, with Wisconsin on the east and Missouri Territory on the west. Texas was independent and not yet annexed to the United States. California and New Mexico still belonged to Mexico.

In Maps of Goodrich's history, 1853, Minnesota has a place north of Iowa with Missouri Territory and Indian Territory, as on Morse's Atlas. The north boundary of Oregon was 49°, and Utah included Nevada, and New Mexico included Arizona, and they were portions of the domain of the United States.

On Mitchell's Map, 1864, the United States have their present boundary and all the States their present boundaries, but Idaho comprised all of the present Territory of Montana and part of Wyoming. Wyoming Territory did not as yet occupy a place upon our maps, but it has since been taken off from portions of Dakota, Idaho and Nebraska.

THE MINES OF OLD MEXICO.

Pachuca, Real del Monte, El Chico and Santa Rosa, in the State of Hidalgo, are among the richest mining districts in the Republic of Mexico. Pachuca is the capital of the State, and lies fifty-seven miles north of the City of Mexico. The journey can be easily made by means of the Vera Cruz Railroad, with which Pachuca is connected by a tramway. As the tramway approaches Pachuca the mountains seem to draw near, one of them having on its summit a stone formation which, in the distance bears a striking resemblance to a huge cathedral with domes and towers. It is in the region of this grand cathedral that some of the richest ores are found.

It is obvious the advantage of this region over other districts in Mexico, being thus easily connected with the great capital and having easy access to the coast. That miners have availed themselves of this advantage is shown by the list of mines: Pachuca works 154, Real del Monte 76, El Chico 24, Santa Rosa 13—a total of 267. The powerful "Real de Monte Mining Company" works 77 of these. Real Del Monte lies to the northeast of Pachuca, El Chico to the north, and Santa Rosa to the northwest.

From the time of the conquest up to the present date it is estimated that these four districts have yielded $1,000,000,000 out of $4,000,000,000, the total amount extracted from the mines of Mexico. The Aztecs, before the conquest sought silver in these regions, and after the subjugation innumerable Spanish miners dug holes in the mountains, extracting what ore they could before their works were obstructed by water, when they abandoned them to dig other holes. The silver was obtained by smelting by the early miners, but it was in 1557 a Spaniard named Bartholeme de Medina discovered, in Pachuca, the process of amalgamation with mercury. His discovery is the basis of the "patio" process, which is the system most in use in Mexico, having been found, so far, the cheapest and possibly the best adapted to the country.

The ore when brought from the mine is cracked into small pieces and assorted according to its richness by hands employed for the purpose; it is then put in sacks and carried by mules to an "hacienda de beneficio." Here it is ground to a fine powder by being crushed between huge revolving stones, turned by horse-power. These grinding stones are called "arrastres." When the ore is sufficiently fine it is mixed with mercury and salt by means of mules tramping through it an average period of ten days. The mass is then washed, the refuse passing off with the water, the amalgam sinking to the bottom. This washing is done in Pachuca by men who steady themselves with ropes hanging from the roof of a shed and walk backwards and forwards in the "torta." As the water is allowed to pass off it runs through a narrow channel, the bottom of which is laid in ridges. In this channel little boys shuffle their feet about, detaining in the ridges any portions of metal that may pass off. The boys earn twenty-five cents a day for this work. For the most part these workers looked chilled and unhealthy, splashing around in the muddy water. In Guanajuato the washing is done by means of hugh stones revolved in the water. When the water passes entirely off from the works the natives often obtain from it large quantities of silver. Many of them are at this work all day in the waste water as it leaves the "beneficio." The process of separating the silver from the mercury is simple and well known. In Pachuca there are seven reduction works, most of them on this system. There is but one "pan" mill so far established. Foreigners are at present trying to introduce improved methods and machinery. This, when accomplished, will be of great service, as ores not yielding more than $30 a ton are not considered worth working by the present process. Great quantities of these depreciated ores lie outside the mines waiting for some less expensive method. Miners not owning their own works can have their metal reduced at the "beneficios" at $20 or $22 a ton, with a charge added for the loss of mercury, which is about ten per cent of the quantity used.

The immense wealth of these regions was proved by one Pedro Jose Bornero de Terreros, a Spaniard, in 1739. He having acquired a fortune in Queretaro, started for his native Spain, but on his way he stopped to look into the mines of this region. He became so much interested that he soon put into them his entire fortune. In this he was assisted by Bustamente, a friend who joined his enterprise. When their capital was exhausted, nothing daunted, Bustamente returned to Queretaro to raise funds and Terreros went for a like purpose to the City of Mexico. Bustamente failed, but Terreros returned to his mines to be reimbursed, when finally he brought out of them $11,000,000 and the title of Conde de Ste. Maria de Regia—Regia being the name of one of his mines.

Santa Gertrudis, one of the mines now in "bonanza," has within the last four years given a gross yield of $4,000,000. It is as yet only worked 160 yards deep. More than $2,000,000 has been paid over to shareholders in dividends or used for improvements in the mine. It has an engine of fifty horse power, for which was paid $75,000. The hoisting apparatus is often moved in these mines by horse power. The machine is called a "malacate." In the region of Santa Gertrudis, San Pedro, Rosaria, Guatomotzin, etc., ores vary from $20 to $300 per ton even running as high as $500. The ores found in the region of Santa

Rosa contain quite a percentage of gold; selected ores have assayed $15.20 gold, $103.50 silver per ton. From Cueva Santa selected ore has assayed up to $350 per ton of silver.

Pachuca has a population of 25,000, which is increasing rapidly by the incoming of miners, drawn thither by mines in bonanza. A considerable part of the population is made up of Cornishmen, who are for the most part the skilled laborers in the mines. They make $3 per head a day, while Mexican skilled labor can only claim $1 a day, and common labor thirty-seven and a half cents. The miner working at $1 a day is entitled to one eighth of the ore he obtains. Owing to this he loses no time, and bends all his energies to make his eighth as large as possible. A man is only employed twenty-four hours a week, in order that all may have a chance at work. This, however, may be the case only in some of the mines. The Real del Monte Mining Company pays as much as $30,000 a week to miners. and it is estimated that as much as $75,000 is paid out by the four mining districts together.

Of all objects of interest in Pachuca and its vicinity there is nothing so beautiful as the road from Pachuca to El Chico. A narrow bridle-path runs over the mountains fifteen miles. The mountains themselves from their very height lend a grandeur to the scene. For some distance they are crowned with huge perpendicular rocks, which are called the "Frailes," perhaps because they look so stern and grave. One points a great stone finger up to heaven. At one spot is passed a great rock projecting from the mountain-side under which twenty persons could find a shelter if not made nervous by its curious poise; but this and other great boulders that the stone monks have rolled down from above, seem to have stopped a moment (grown into centuries) in their downward course. Another mountain with a rocky crown has on its summit a huge stone eye to which the heavens give a blue pupil. Still another bears on its crest a solitary tree for which the birds of the air must have sown a seed long years ago. At the most beautiful point in the road two huge moss covered boulders meet in a bend, and above them two others. Over these mossy steps from opposite directions two laughing streams come dancing; they take the fall together, and dash down the ravine, jumping moss-grown trees that fall across the way, and curving great round rocks encased in moss and dotted with anemones. The trees around have a hidden ambition for ship-masts, or great beams in the mines, they stand so tall and straight, holding their heads high even on the edge of a ravine, never deigning to stoop forward or bend in their dignity. Here and there a red cross is thrown out against the green, marking the kilometers of the way, and redeeming the pass from a devil's haunt. This region is so high it never knows the drouth and parched aspect of the dusty dry season; it is always an emerald, one of Mexico's jewels without price.

The road from Santa Rosa to El Chico is rugged and picturesque, but lacks the verdant freshness of that of El Chico. It was on this road that we travelers sought shelter in a "palqueria," "El Angel." It was rather surprising to find ourselves sitting on "The Angel's" bar. It is wonderful with what rapidity the rain creates mountain torrents; an hour will serve to convert a pebbly path over which one has walked, into a hoarse, raging stream, defying a passage. On this occasion El Chico, as the clouds lifted, was as pretty as a picture. It differs from other Mexican villages in having peaked thatched roofs, and with its pointed caps nestled against the mountain, is unusually attractive to the traveler's eye. In every direction when crossing the mountains can be seen the tall red chimneys of the mines.—*Cor. Globe-Democrat.*

SEWAGE AND SEWERAGE.

The report of Mr. James T. Gardiner to the N. Y. State Board of Health on the methods of sewerage for cities and large villages is a most valuable and interesting document. Mr. Gardiner begins with an unqualified condemnation of the system of privy-vaults and cess-pools; pronounces "dry removal" by means of earth-closets or pails to be much better, but open to serious objections, as requiring constant vigilance and intelligence on the part of householders; declares the ordinary method of combined sewerage, in which both the sewage proper and the much larger body of storm-water are conveyed together in subterranean sewers to be, from the sanitary stand-point, a failure; and finally praises as the best plan yet devised, the separate sewerage, by which *excreta*, slops, and waste-water are removed through mains, while storm water is either provided with separate conduits of large dimensions, or led off on the surface to natural channels of outflow. The most perfect example of this system is found in the sewerage of the city of Memphis, designed by Col. George E. Waring, the eminent sanitary engineer, and operated since 1880 with complete success. Mr. Gardiner quotes at length from a report of Mr. C. H. Latrobe, who examined the Memphis system for the city of Baltimore.

The most striking points of Mr. Gardiner's paper are these:

1. There is probably no such thing as a poisonous "sewer-gas," to which the diseases caused by the admission of sewer air into dwellings may be ascribed. No proof exists that ammonia, sulphureted hydrogen, or any other gaseous products of organic decomposition, do or can cause zymotic diseases. On the contrary there is much evidence going to show that these diseases are produced according to the so-called "germ theory," by *bacteria*, the germs of which are developed in the sewer-air under the favoring conditions of heat, moisture, darkness, and the presence of ammonia, and growing thus on the damp walls of sewers, may float off and be borne like dust on the atmospheric currents.

The reader's first impression may be, that this is a distinction of little practical importance. What difference does it make to the victim of bad plumbing, to be told that he is poisoned, not by the gas from the sewer, but by germs in the gas from the sewer? The practical difference to the moribund victim may indeed be nothing; but it is highly important to prudent people, not yet about to die, and to sanitary engineers. For it follows, first, that the odor of sewer-gas, though a useful warning of its presence, is not a measure of its poisonous character. A slight odor, given by air from a large and ventilated sewer, may accompany the maximum proportion of *bacteria*. Again, since damp exposed sewer-walls favor the multiplication of these low organisms, it is evident that large brick sewers, which run full in a heavy rain, and half full or nearly empty at other times are the worst that can be used for this purpose, and not the best, as many engineers have supposed, and as indeed would be the case, if the dilution of the sewer-gas with the air were an efficient means of rendering it harmless.

2. The large sewers have been adopted for this reason partly, and partly because they were required to convey sudden accumulations of storm-water, and it was thought a good thing to combine the two things, and secure a periodical natural flushing of the sewers. But it now appears that the best possible conduit for *excreta*, grease, and waste-water would be one exposing a minimum interior surface, and also permitting, by its small size, the use of enamel on that surface. This smooth material is easily kept clean, and the conditions for the growth of *bacteria* along the walls are greatly diminished or destroyed.

3. But such small sewer-mains would be totally inadequate to carry the storm water, which is, during violent rains, nearly fifty times the ordinary sewage. Hence the necessity of a separate disposal of the storm-water. For the great majority of towns, no sewers would be needed for this purpose. The clean storm-water could be left to flow away to natural channels, as it does in the open country. In such cases, the cost of the small sewer-system would be from one-fifth to one-third only of that involved in the combined system. The estimates for the latter type in Memphis, ranged from $800,000 to $2,225,000; the actual cost of the separate system was $137,000. For towns which require short storm-water sewers to lead the rain-fall to natural channels, the expense would still be generally less than that of the extended and comprehensive combined sewerage. Finally, there are, no doubt, a few large cities, where complete underground systems of storm-water drainage are required. In these cases, the expense of a completed double system will be about one quarter greater than that of the combined system; but the sanitary gain will be worth its cost.

This subject is one of great and growing importance to all cities, and particularly to those which are beginning to organize water-supply and drainage. They will find great economy in beginning right; and the light which modern sanitary science has thrown on the subject comes none too early for them.

The articles on the sanitary condition of New York, contributed by Colonel Waring, some months ago, to the *Century Magazine*, should not be overlooked in this connection. Together with Mr. Gardiner's paper, they contain more "solid sense" on the subject of sewerage than many bulky volumes.—*Engineering and Mining Journal.*

EDITORIAL NOTES.

VOLUME VII commences with this issue of the REVIEW, and we send it forth in the hope that it will meet with so favorable a reception that its future career will no longer be questionable. We are satisfied from a comparison with other magazines and from testimonials received from disinterested sources that the REVIEW is worthy of the patronage of all friends of popular education in the west and that more valuable matter is furnished for the price than by any of its contemporaries.

In addition to this, our terms to clubs and offers of discounts on books and magazines are so liberal that those who avail themselves of them obtain the REVIEW literally and absolutely free of cost.

Again, we claim that as a factor in building up the West, by calling attention to its resources and advantages, it has played no insignificant part, and that those of our subscribers who have the REVIEW sent to distant friends benefit themselves directly or indirectly by the results.

If the REVIEW were a source of profit to its publisher, such remarks might be regarded as egotistical, but when everybody knows that it is strictly a public enterprise and that all he asks is reimbursement of his outlay in publishing it, they are certainly allowable.

IN Philadelphia a committee consisting of seven architects, seven plumbers and seven physicians and citizens has been appointed to provide a plan for a systematic management of Sanitary matters and has recommended to the city council an ordinance with rules and regulations for regulating plumbing, house-drainage regulation and licensing of plumbers in that city. These rules and regulations are admirable and something similar should be adopted by municipal governments all over the country. Published by P. Blakiston & Co.; price 10 cents.

IN the Proceedings of the Philadelphia Academy of Sciences Prof. Cope stated that the existence of Man in the Pliocene period would in his opinion soon be demonstrated, and adduced the Calaveras skull, said to have been found in the gold-bearing gravel of California, as a very strong case in point, since it was partially filled with the solid adhesive "cement," characteristic of that ancient formation. At the same meeting Professor H. Carvill Lewis objected to the Calaveras skull as a proof of the antiquity of man, on the ground that the implements found with it were of modern workmanship, and the skull itself resembles that of a modern Indian. Neither is the compact gravel adhering to it and in which it was found shown to have been previously undisturbed.

MESSRS. JOHN WILEY & SONS announce the publication by them of the United States and British Official Metric Conversion Tables, with an introduction by Professor R. H. Thurston. It is an octavo volume of ninety-six pages, and will be sold at $1.00. This book will be found useful to every civil, mining or mechanical engineer as well as to all other persons interested in scientific measurements and rules.

MR. HERBERT B. ADAMS is editing a series of articles upon Historical and Political Subjects entitled "Johns Hopkins University Studies." Those received so far are Number III, Local Government in Illinois, by Albert Shaw, A. B., and On Local Government in Pennsylvania, by E. R. L. Gould, A. B.; No. V, Local Government in Michigan and the Northwest, by Edward W. Benns, A. B., and No. VI, Parish Institutions in Maryland with illustrations from Parish Records, by Edward Ingle, A. B. These papers will be valuable contributions to American literature and history.

GENERAL Passenger Agent W. F. White, of the Atchison, Topeka & Santa Fe R. R., with characteristic liberality gives the Press Association of Kansas an excursion to Chihuahua, Old Mexico, on the 10th inst., which will doubtless prove an extremely gratifying and instructive trip, and one which will result in a more full and complete "writing-up" of that comparatively unknown portion of the continent than it has ever received. Having accepted an invitation to accompany the party we shall pay especial attention to the geological, mineralogical, meteorological and archæological features of the country along the whole line, so as to be able to give the readers of the REVIEW at least a general idea of its most attractive points in the June issue.

Col. A. C. Dawes, the genial General Passenger Agent of the Kansas City, St. Joseph & Council Bluffs R. R., on the same day starts the Missouri Press Association on a delightful excursion trip to St. Paul, Duluth, etc. Being a member of this Association and having heartily enjoyed several editorial jaunts with it, we hesitated which road to take, but finally concluded that we could not forego this rare chance to "revel in the Halls of the Montezumas."

PROFESSOR CHAS. E. MUNROE, of the U. S. Naval Academy, is publishing a series of notes on the Literature of Explosives, and asks authors, publishers and manufacturers to do him the favor of sending him copies of their papers, publications, trade circulars, or expert testimony in infringement cases.

THE tornado season has commenced. For the next two months we are liable to feel their effects at any time. In this connection we call attention to the articles written by Mr. Finley, of the U. S. Signal Service, and published last June and July in the REVIEW. They will be found to cover the whole subject very fully indeed.

WE learn from Mr. J. P. Finley of the U. S. Signal Service, that the unsettled question of the origin of atmospheric electricity is receiving especial attention at present from the Johns Hopkins University and similar institutions in England, France and Germany, the immediate object being to determine definitely the most approved methods of investigation. Delicate and costly experiments are now being made with this end in view.

WE are indebted to Prof. A. V. Leonhard, of St. Louis, for a copy of his paper upon The Occurrence of Millerite in St. Louis, illustrated with four beautiful artotype plates. Millerite is the minerological specialty of St. Louis, not having been found anywhere else in such abundance and so beautifully developed.

THE interesting and thoughtful article upon "The Age of the Missouri River" in this number of the REVIEW was delivered by Judge E. P. West before the Kansas City Institute. It has been published in a neat pamphlet and is to be sold for the benefit of that association at 25c per copy.

ALL subscribers to the REVIEW desiring their copies bound can have it done in half-morocco for one dollar a volume by leaving their back numbers at this office.

MR. E. P. VINING, Freight Traffic Manager of the Union Pacific Railroad, at Omaha, in remitting for the REVIEW, says "I consider the vocabularies of the South American Indian languages, by Dr. Heath, contained in your last issue well worth the cost of a year's subscription."

PROF. JAMES H. CANFIELD, of the State University of Kansas, has commenced the publication of a monthly Index of Periodical Literature, to contain the alphabetical and topical contents of all magazines sent him for the purpose and to be distributed gratuitously among the institutions of learning and libraries throughout the State. He expects to obtain sufficient advertising patronage to pay expenses of publication, and to remunerate himself by the large number of periodicals he will receive.

S. E. CASSINO & Co. announce a new work entitled "Limestones and Marbles—Their History and Uses"; 1 volume, Royal octavo, (handsomely illustrated), pp. 412, $6.00.

WE find in the Quarterly Report of the Kansas State Board of Agriculture, among other valuable papers, one by Prof. F. H. Snow upon "Injurious Insects and How to Destroy Them." It is eminently instructive and practical, as all of his articles are.

PROF. H. E. SADLER, of the Kansas State Normal School, at Emporia, in renewing his subscription, says of the REVIEW, "It seems to me surprisingly well suited to the needs of intelligent people throughout the Missouri Valley, and I omit no opportunity to say a good word it."

BY August 1st it is expected that the ascent to the summit of Pike's Peak can be made upon a tramway instead of by the present laborious and dangerous horseback plan. The tramway will be in three sections, two of which, the upper and lower, will be operated by steam engines, and the other by water-power. The time consumed in the round trip will be about three hours.

DR. EDWIN R HEATH'S account of his explorations in Bolivia was sent to the Royal Geographical Society, of London, where it was enthusiastically received. Mr. Clements R. Markham, late President of the Society, read a paper before it on April 19th in which he dilated largely upon Dr. Heath's report and gave him the highest credit for intrepidity, perseverance and the achievement of most important results.

TEXAS may be called the land of cactus. One species recently sent by Prof. J. D. Parker from Fort McKavett to Washington, was not contained in the Botanical Gardens there. One species of cactus in Texas bears fine berries which look and taste like strawberries. They sell for twelve cents a quart, and are a great favorite for dessert. One mammoth cactus several feet in diameter is covered over with fiery-red blossoms and looks on the prairie like a little haystack on fire.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *North American Review* for May contains nine articles, nearly every one of which discusses some topic or problem at the present moment prominent to the public mind. Senator John T. Morgan writes of "Mexico," and sets forth the considerations of commercial advantage and international comity which are rapidly bringing about a more cordial understanding between that country and the United States. The Rev. William Kirkus, taking occasion from Bishop McQuaid's recent vaticinations regarding the decay of Protestantism, makes a vigorous counter charge upon the papal system in an article entitled "The Disintegration of Romanism." In "Emerson and Carlyle," Edwin P. Whipple discourses with all his old-time keenness of psychological insight and perfection of literary form upon the strangely diverse mental and moral characteristics of those two great thinkers. Prof. Felix Adler offers "A Secular View of Moral Training," arguing that the current skeptical habit of thought demands an independent system of practical ethics, based primarily on observation rather than on revelation. "Communism in America," by Prof. Alexander Winchell, gives very forcible expression to the apprehension of those pessimistic observers of the trend of events in this country who think that they see in our political and social development all the signs of impending national decay. The other articles are "Affinities of Buddhism and Christianity," by the Rev. Dr. James Freeman Clarke; "Woman as an Inventor," by Matilda Joslyn Gage; "College Endowments," by Rossiter Johnson; and "Extradition," by A. G. Sedgwick.

THE *Tennessee Journal of Education* makes its first appearance with the March number. It is a large folio of twenty-four pages edited by Colonel Leon Trousdale and published by Wheeler & Osborn, Nashville, Tenn. It presents a fine appearance and being one of the very few educational magazines of the South, should be well supported. $1.00 per annum.

BULLETIN No. III of the American Geographical Society contains a very valuable article upon the exploration of the River Beni in Bolivia, by Dr. E. R. Heath, of Wyandotte Kansas, with a map of the region. The principal points in this article were first published in the REVIEW for September, 1881, and widely copied. The Bulletin also contains an article by General Egbert L. Viele on the Frontiers of the United States, with map.

Harper's Magazine for May is on hand more promptly than usual and presents the following bill of fare: "The Sisters," (frontispiece), engraved from a Picture by E. A. Abbey. San Francisco—William Henry Bishop, with eleven illustrations. The Treaty of Peace and Independence, II.—George Ticknor Curtis, with seven portraits. The Singer; A Poem.—Herbert E. Clarke. Nehemiah's Plan; A Story.—Kate W. Hamilton. The National Academy of the Arts of Design, and its Surviving Founders.—Benson J. Lossing, with three portraits. A Castle in Spain; A Novel, Part I, with six illustrations by Abbey. Galatea; A Poem.—Elizabeth Stuart Phelps. Roman Carnival Sketches.—Anna Bowman Blake, with nine illustrations by Reinhart. Anthony Trollope.—Walter Herries Pollock, with portrait. The Middle Colonies before the Revolution.—John Fiske. Fresh Air in Summer.—Titus Munson Coan. The Brooklyn Bridge.—William C. Conant, with twenty-one illustrations. Art Study at Home and Abroad.—John F. Weir. The Oldest Friend; A Poem.—Louise Chandler Moulton. Editor's Easy Chair. Editor's Literary Record. Editor's Historical Record. Editor's Drawer.

Science for April 6th contains a sensible editorial upon the present ill regulated distribution of public documents, and advocates a single agency for all such distributions, giving public libraries the first care and supplying individuals afterward. As we understand it, under this plan all applications to Congressmen and the different departments and bureaus will be referred to this distributing agency with proper recommendations, which prevent duplication and insure appropriate selections, both of which are exceedingly desirable.

THE *Humboldt Library*, No. 43, furnishes its readers with the Lives and Work of Darwin and Humboldt, the first by Prof. Huxley and others, and the second by Prof. Louis Agassiz, forty six pages, octavo; price 15c.

THE contents of the *Popular Science Monthly* for May are as follows: The Remedies of Nature—Comsumption, by Felix L. Oswald, M. D. Science and Conscience, by Professor Thomas Sergeant Perry. Physics in General Education, by Professor T. C. Mendenhall. Micscropic Life in the Air, by Louis Olivier, (Illustrated). How Much Animals Know. By F. A. Fernald. Chemistry and Pharmacy, by Professor Ira Remsen. Position and Stroke in Swimming, by R. Lamb, C. E., (Illustrated). How the Ancient Forests Become Coal, by M. G. De Saporta. A Superstitious Dog, by Eugene N. S Ringueberg. From Buttercup to Monk's-Hood, by Professor Grant Allen. On the Colors of Water, by M. W. Spring. A Wonder from the Deep Sea, by M. L. Vaillant, (Illustrated). Gymnastics, by Alfred Worcester, A. M. Why are We Right-Handed? by W. C. Cahall, M. D. Lengthening the Visible Spectrum, by Johannes Götz, (Illustrated). The Boundaries of Astronomy, I,—Is Gravitation Universal? by Robert S. Ball, F. R. S. On Brain-Work and Hand-Work, by R. M. N. Sketch of Professor Richard Owen, F. R. S., (with Portrait). Correspondence. Editor's Table. Literary Table. Popular Miscellany. Notes.

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SOCIOLOGY.

CRIMES AND CRIMINALS: HOW SHALL WE TREAT THEM.

GEORGE HALLEY, M. D.

The great social problem that is now agitating every form of governmental organization, is How shall crime be prevented? It is a wail of agonized anguish that began with the history of the race, and increasing in intensity and pathos now ascends to heaven from every kindred, and tribe, and nation, and tongue, as well from the high-bred and cultured Anglo-Saxon, as from the most degraded tribe found on the "dark continent." Almost the opening chapter of the history of the race, is the recital of the most terrible of crimes,—murder!

It is the spectre that stalks us at the entrance of this field of explorations. It is a constant companion at every step of our progress, and at the present time is the great unsolved problem in sociology, as well as the rock on which all organized government is liable at any moment to split. The cry of the world now is "A government for the people and by the people!" But a large mass of those people are criminals who know, feel, fear, and care for no restraint but force—cruel, vindictive, physical force. How shall they then who are steeped to the lips in crime, knowing nothing of morality, feeling no moral restraint or obligation, and, of course, ignorant of all law but that of force, control themselves or frame laws to control others (that criminal element) in that body politic? It is like asking the water of the river to carry back again to the top of the mountain tops, the silt that it has just carried down into the valley, or for the dark and silent grave to give back the beloved form that it has just folded to its bosom. The wand of a fell spectral magician is upon them. They see, but do not perceive. They hear, but do not understand. They are sick, and miserable, and blind, and naked, and yet insist that they are in health, enjoying luxury and pleasure.

What is wrong, and wherein does the diseased process lie? In what does the morbid condition of the moral nature consist? Man is at least a dual being, physical and moral.

Of the physical we know much, principally because of its very nature we are capable to taking cognizance of it by our physical senses. Breaking of physical law is at once followed by tangible results—either producing physical suffering or even somatic death. We see it acted upon by the very same laws that are acting on all organized matter. It begins to live—so does a tree or a blade of grass. It reaches an equilibrium of existence and reproduces its kind, and so do all forms of animate nature. It declines just as a plant does, and dying, like the plant, returns to its original dust.

We know something of the laws that govern it. We study them in every avenue of scientific investigation. But the laws that govern our moral being are not so known or understood. They have never been studied or formulated. No laws are laid down for the maintenance of its health or general well-being, in any text-book, or system of science, and we are yet groping in the dark. Knowing we have a moral nature we are still in the dark as to the laws of its existence.

But is it really true that we know no laws that govern it? Are they different entirely from those that govern our physical nature, or are they not all under the same great general laws, each nature having some special and differentiating law, where the natures are entirely differentiated?

In our physical organism we know of and describe a great many processes that occasionally go on in the economy, and which, being allowed to continue, finally culminate in death. We call them disease. It may be erysipelas in the hand for instance. We say the *man* is sick—not the hand—for the organism is a unit, and all suffers, though the manifestation is only in one hand. Or the lung is inflamed, and the whole economy suffers, not because the whole economy is diseased, but because the organism is a unit, and one portion or part failing puts all other parts out of harmony—breaks the fine adjustment of the chord in the grand anthem of existence. We have said the whole economy is sick though only one organ is diseased. Why is this? The food that feeds the one hand feeds also the other. The food that is supplied to the lung, if not the same, is drawn from the same great fountain that also supplies the brain. But that fountain of supply is also the receptacle for waste from the whole economy, and when a tissue or organ is diseased, its worn-out (and diseased) particles going back by nature's systematic carriers, pour the waste in the common reservoir and so pollutes the whole mass. Almost every diseased process illustrates the truth of this.

Now a medicine is an agent that when taken into this circulating current has the power of changing the nutritive qualities of the fountain of food. It may be, by destroying what is poisonous, or it may—and generally is—something that enables the economy of nature to remodel or re-elaborate the food, in a way that will not only enable it to be not poisonous, but it shall contribute to the tissues what was intended. These latter remedies are called alteratives, eliminators, nutrients, etc.

Nutrition is the taking up from the nutritive current, material that is fully prepared to, and does take on, and give forth vital manifestations. It is always made up of substances that are chemically or physiologically like the tissues of organs it is destined to build up and take the place of. In this way the tissues of the body are maintained in a state of health, from month to month, and from year to year; worn out parts being replaced by tissue made up of similar compounds to that that has been worn out. But certain kinds of food when given for a long time, will produce marked changes in the bulk of, and relative proportion of the tissues. This will not be so marked in an individual, as in large masses of people, as for instance the beef-eating Englishman and the rice-eating Chinese; or on the wine-drinking Frenchman, and the beer-drinking German. It does not alter the argument to say that the climatic or atmospheric conditions have compelled certain people to live as they do. That there are most important differences in races that at a comparatively recent period were identical, is beyond a doubt, and that food and feeding have contributed largely to those conditions is also undoubtedly true. Shakespeare makes Cassius say.

> "Upon what meat doth this our Cæsar feed,
> That he is grown so great."

Feeding then, perhaps more than any other physical factor changes the physical form; promoting not only growth, but development.

But a new factor now comes into the field to dispute for pre-eminence in modification of the physical nature. It is not the albumen or hydrocarbons, modified by any material of a medicinal nature, alterative, eliminative or nutrient. It comes not through the blood current nor by the process of digestion and assimilation. It is not climatic or atmospheric. It is not weighed by grains or pounds. It is mental impressions through the physical and on the moral nature.

We often—nay, are constantly—in the habit of under-valuing these, though they have been known, and acted on by men of the world for more than four thousand years. Jacob, in order to defraud his father-in-law of his share of the increase of the flock, had recourse to mental impressions on his herds, and as the narrative tells us, with remarkable success, the increase being "ring, streaked and speckled." But to the human race again.

I find in that same history just quoted from, another most marvelous story, and which to-day attests the truth of what I am trying to prove. It is the story of Ishmael.

Let us for a moment read the history given of him, and in order to fully comprehend it we must begin with his mother. In the first place then, she was a slave, she was an African, and she was a *woman*. The wrongs of slavery are of too recent date to require dilating on here. But the slavery of America was as nothing compared with that of barbaric life. There, power without responsibility, was law. The will of the master was absolute, and could not be questioned. The power of life and death even was in his hand, and none might call him to account for it. But in this case it is not only an African slave, but that slave is a *woman*. In a Christian land and with the social habits that Christianity has founded, it is hard for us to conceive of a state of society where a woman has absolutely no rights, and yet that is the status of woman to-day in pagan lands, and was most certainly the status of woman in those times, the history of which we are quoting. But in reading further on we find she is given over to the lust of her master without even being consulted in the matter, and when her mistress finds she is about to become a mother she is angry with her, and even for a slave is said to have *dealt hard* with her. How much that means no tongue can now tell. She was of a despised race. She was the slave of a furious woman. She ran away, but had to come back again, and in that plight she was when she brought forth a son. What a beginning for the father of a nation!

But again. He grows up in that camp the bastard son of a negress slave, and was the butt of scorn and ridicule in that nomadic camp. But he has a fine constitution derived from his parents, and soon shows that he can hold his own with the best of them. He is spoken of as a probable heir to the whole estates of his father. But he despises him and when a real heir is born, he mocks at the ceremony at his birth. He is driven from the camp, with the tigress that has nutured him, and becomes a wild man. Just what he is most fitted for, both by conception, birth, and early training. "With his hand against every man, and every man's hand against him." Is such a father not a fit progenitor of the Arab of to-day, leading essentially the same life, on the same soil, and in many ways under similar conditions to what their father led? They are a standing verification of the truth of the story, as detailed in the Book of Genesis.

What has been done to the moral nature of this race? How has it been twisted, and distorted, turned as it were into another channel? A mighty force has been projected into the track of this race, and forced it into a new and continually diverging channel, a force that has been potent enough, to entirely divert the destiny of the whole race into the new channel that it was projected into, for more than forty centuries.

But these are not the only examples that I could adduce; I might refer you to the gouty subject. His parents for generations may have been healthy and frugal. They lived temperately and enjoyed the reward of it, in good health. They moreover transmitted to him a good hereditary tendency along with a handsome fortune. In this they did well. But in one thing they failed. They left his moral training to the companions he might pick up, and it results in his becoming a high and fast liver, the result of which is that his excretory organs become impaired; there are retained in his blood-current large quantities of nitrogenous compounds which from defective oxidation are acid in reaction and uniting with the alkali of the blood sodium form compounds that are named gouty.

But this state of health does not terminate with himself, if he have progeny, any more than does the color of his hair or eyes. The evil forces that thwarted and misdirected his nature, are carried on into even his children's children, though they do not lead the same manner of life.

To those who object to the harsh and vindictive, or even as some say, unjust paragraph in the second commandment, I have to say that the law of our organic nature shows the truth of it, and when studied closely, the justness and mercy of the law, more forcibly than any mere verbal statement could have made it.

We see then how profoundly our physical and mental natures are bound up by our moral nature, or, I may say, with the morality that has existed from generation to generation. How the whole moral phase or morality of a nation may have been the result of fortuitous circumstances. How a mighty force projected into a national life may for generations change the whole moral nature of that people.

But what is true of nations is true of individuals, and conversely. National life is but the aggregation of individual lives.

A case that is often quoted from the criminal records of New York is of a woman who was abandoned to all good influences and by adverse circumstances and was at first, *driven* to crime and speedily became its slave, in less than one hundred years had a progeny numbering in the neighborhood of six hundred, of whom nearly four hundred were criminals.

What was it that in her case brought about such dire results. The history of her race reveals no special notoriety. The disturbing influences attacked her, and the results were most disastrous. That it could have been avoided there is but little doubt. The only thing done was to punish the criminals after they are made. Would it not have been much better to stop making criminals, than simply punish for the commission of crime?

But how do we treat criminals, and is it rational? Is it in the least in consonance with the physical law of our nature; in harmony with our moral nature, the law of God or is it even in harmony with the law of disease, in the physical organism, for I have shown that it is in all particulars a disease of the moral nature in the same sense that disturbing influences are disease in the physical organism. What is done for the man who is physically diseased? He is put on a strict diet. He is fed with substances that experience has shown modify the course of life, and bring it back to a state of health. Do we do anything like this for the criminal class? Do we not do for them, what was done three thousand years ago for the leprous. Nay, what in barbarous nations is still done for them, put them off by themselves till they end their mortal career.

If a man breaks his arm or leg, fractures his skull, cuts his flesh, opens a large blood-vessel, we at once seek out a man skilled in putting the bones in proper position, closing the gaping edges of the wound or stemming the purple tide, and having all done that could be, to promote a return to a state of health. We not only give that injured part rest, but the whole body; that the whole of the vital power may be directed, as far as possible, to effect the needed repairs.

Opiates are administered, to relieve pain, and all means known, to promote rapid and healthy repair, are resorted to, in order not only that he may be healed, but healed speedily, and with the least injury possible to the rest of the body.

But cases do occur where a portion of the body has to be removed, in order to save the rest from deadly infection, as a mangled limb or cancerous breast, etc. No such exigency, however, can arise in the body politic. Complete segregation is always possible, without death. We feed the consumptive on a diet that experience has taught us restores the wasted tissues. The rheumatic or gouty are fed on agents that promote more complete breaking up of disintegrating tissue, and again bring about a right state and composition of the blood. The dyspeptic has supplements for his wasted secretory organs, the tired man *rest* for his aching limbs.

But the sickly or diseased morally, in the body politic, are, as soon as they go astray, thrust in a crowd, into a dungeon; not only get no restoring agents for their sick morality, but are aggregated—mingled, in such a way—as to secure complete contamination of the whole mass of such beings. The novice in crime, with the most hardened criminal. What *could* be expected but that the novitiate will come out a thoroughly trained criminal. It is as if when a consumptive became ill, his friends should shut him up in a damp cellar, and feed him on the worst and most unwholesome food they could find for him. Nay more, expose him at the same time to the malign contagion of every other disease and *thus* expect to cure him.

What would people say, if the large hospitals in any of our cities were conducted on such principles? Would there not be a cry of indignation, from one end of the land to the other? But that is exactly what is being done for the morality of every prisoner who is sent to a prison, throughout all this enlightened land, despite its boasted culture, intelligence, and refinement.

The statistics of crime come in here to verify my statements; showing from year to year an increase of crime despite the increase of learning. Man is not naturally vicious. It is a disturbing influence thrust into his nature. And, that like a deadly contagion spreads from individual to individual, and from community to community, and our prisons, in place of being moral hospitals, for the restoration to health of such, are nothing but pest-houses or, we might almost say, training-schools for criminals. Those persons have inherited strong passions—which is always necessary for a strong morality. But crime comes in with its distorting hand, and no sooner touches the opening bud of human existence, than the flower changes from the rose of Sharon to Deadly Nightshade, and the fruit will be as apples of Sodom ripening only for bitterness, and death.

Neither are all persons, arrested and imprisoned, criminals, even though they may have committed a breach of the law of the land. He only is a criminal who is a breaker of the law after mature deliberation. The man we now regard, and punish as the worst criminal—the murderer—is not always, nor indeed often, a premeditated criminal. More often than otherwise, he perpetrates this terrible crime in a passion, or on the impulse of the moment. He is thrust out of society

—probably with justice—for he had lost complete control of his passion and should be disciplined thoroughly. But to a mortal pest-house he should not be sent. For if he was not a criminal when he went to prison, he will most certainly be one when he comes out. His prison-life has made him ten-fold more the child of hell, than he was before.

But I am told when advancing these arguments, that society must protect itself. Certainly! but we don't put patients infected with small-pox, measles, scarlet-fever, typhoid-fever, cholera, yellow-fever and every other contagion into a den, and there let the poor wretches die and rot in one great festering charnel-house, in order to protect the community from the contagion. We have places arranged on the best principles known to sanitary science for curing them, and we give such remedies as modify the course of, or cure the disease itself.

Now would it not be much more rational to do this for the morally diseased? Would it not be cheaper for the State? And would it not do more toward stamping out crime, than all the laws that are, or can be put on the statute-books of the land? And is it not the *true scope* of *civil government?*

Government in this country is an organization of the people for mutual protection and mutual benefit, "for the people and by the people," and for securing the greatest good to the greatest number. They then have the right to separate from their number any and all that may injure or contaminate them; for they are disposers of the rights of others when they affect the rights of the community. For the individual only gives up to the community his communal rights, not his individual rights, and that communal society can only hold him to account for acts that are against the interests of the community.

They have the right then to separate, for purposes of moral sanitation any diseased member, but they have no power to inflict a penalty—in the sense of retribution for breaking law. Man never has, and never can delegate individual rights. He is morally responsible to but One—the Author of his existence—and by Him, and Him alone, can a penalty for moral turpitude be exacted. God has declared: "Vengeance is *Mine*, I will repay." Man may not lay his hand on his fellow's throat and say, For your crime you shall suffer, this or that. God alone holds to account the breakers of law *by a penalty.*

But we profess to be actuated in our social relationship, and government by the law of the gospel—the law of love. Fear never has, and in its very nature never can prevent crime. The essence of crime consists in the *desire* to do a wrong. To prevent crime, then it is necessary to so instruct the moral nature, educate it —that virtue and morality shall appear desirable, that it is advantageous, and will eventuate in perfect happiness, that from the very nature of their life "The wicked shall not live out half their days." Not because God in His word has said so, not because he is ready to punish sin and crime; but from the nature and organization of the human family. The grand organic law of our being is the law of love. It is the key note of all organized existence. You may call it affinity, or selection, or choice, or love. They are only different expressions of the same thing. The plant takes—selects—from the soil what it requires—what it loves—to array itself in a glory more gaudy than Solomon. The tree does the same thing in donning its verdant garb. The law of its nature teaches it to select just such substances as are best for its growth and development. It is fulfilling the law of its physical life. Why can we not do for moral nature, what they do for their physical nature, squaring our lives by this law of love.

We have by consent resigned to the church the sole duty of instructing in morality, but how poorly and miserably the large proportion of the professedly Christian ministers teach this law of love, needs no comments from us. One faction is well pictured by the poet Longfellow in Kinnellworth Tales.

> "The parson too, was there, a man austere,
> The instinct of whose nature was to kill;
> The wrath of God he preached from year to year,
> And read for pastime 'Edwards on the Will.'"

Another faction seeks by emotional excitement to gather adherents—to make proselytes—from the world. And when they have so made him "he is ten-fold more the child of Hell than he was before." Another faction teaches abnegation to the functionaries of a sect as meritorious and taking the place of this grand law of existence, love as a basis of morality. But there is still a few, bound by no creed, owning no sect or name, who believing in the *power* of this law, not only square their own lives by it, but from day to day, teach it from the sacred desk. Having no text-book they fall back on the Bible—the book that alone pretends to teach this law,—and yet our school legislators have excluded it from our schools. We are forgetting in our boasted enlightenment how much we owe to the promulgation of this law. Is there not fear that we may wander back into barbaric night and heathen ignorance, in thus despising the only text-book on morality in existence? In thus putting under a bushel the only lamp of morality? The lamp of life? Love?

What then in the light of these truths is the duty of every right thinking member of society? Is it not to demand as a first principle, that this organic law of morality, be systematically taught in all our public schools, and colleges? It is what pertains to society. It is part of the communal right, of the individual. Not his individual right alone. Education without this is a failure. It is as if a man were given a giant's strength and only the knowledge of a child to direct it, or a ship with powerful engines to propel but no rudder to guide it. The possibilities are all present in every man, the right directing agency only is wanting, *love*—not a sickly sentimentalism, not pity, but love as a *power*, a power to control, enlighten, guide, restrain, and elevate. It has this power. For all we possess to-day of civil liberty, under an enlightened government, has been brought about by this means—is the result of the teaching of this law, imperfectly as it has been done. Shall we not then, as a people give it a wider scope, a more thorough and systematic trial? When the imperfect work has done so much, given us so much, shall we stop, content with what we have, or shall we not rather yield fully to this all powerful influence which

"In happy triumph shall forever live,
And endless good diffuse, and endless praise receive."

When we do this, and only then, shall we recognize that "God-likeness is profitable unto all things." That it is cheaper as well as better to teach people to be and do good, then punish them for doing ill, and that when they go astray, it is better to lead them back to the ways of virtue and morality than to *punish* them for having gone astray.

In this way, and in this way only, shall we bring about, what we so often pray for, "Thy kingdom come, Thy will be done." He is love, and His kingdom and power, is not physical force, but love. To do this effectively and systematically, it must be taught in our schools, taught in our colleges, taught in our literature and in every day life, as well as from pulpits and lecture stands. Our prison management must be schools for reforming, and not dens for punishing criminals. No life must be taken, for society has no right in *life*. None are so bad that they cannot be kept separate, even it may be for the whole of life. With proper training in most cases a truer appreciation of the object and scope of life will be obtained by criminals by the time set for the period of incarceration. If at that time they show no ability to control themselves, let the time of training be extended, and not as is the case now, send them abroad to again prey on society. In other words cure the moral distemper, no matter how much time it may require

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BOTANY.

HISTORY OF THE POTATO.

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The common potato was unknown to the inhabitants of the eastern continent till after the discovery of America by Columbus. The potato known to the ancients, and that is spoken of by Shakespeare and other English writers, was not the common potato, but it was the sweet potato, Convolvulus Batata. The early history of the potato is involved in considerable obscurity, as the references to it by the historians of those times are quite meager and somewhat contradictory. A careful collation and sifting of the various references to this subject seem to justify the following statements:

The first reference we find to the potato in connection with European history is related to the first voyage of Columbus. When on the island of Cuba some of his men visited the interior of that island and there discovered maize and a root that was used for food, and that was doubtless the potato. On visiting the continent of South America, European adventurers and travelers found the potato growing both in the forests and in cultivation. The wild potato was found growing in the Andean forests from New Grenada on the north to Buenos Ayres on the south. And it is now known to be abundant as far north as New Mexico, in the United States, where it is a common and important article of diet with the Indians of that region. Humboldt does not seem to have been successful in finding the potato growing indigenously in some portions of the country where others assert that it was found. He says that "the potato is not indigenous to Peru, and that it is nowhere to be found wild in the Cordilleras situated under the tropics. M. Bompland and myself herborized in the back and in the declivity of the Andes, from the 5° north to the 12° south, and informed ourselves from persons who have examined this chain of colossal mountains as far as the Le Pau and Oruro, and we ascertained that in this vast extent of ground no species of solanum with nutritive roots vegetates spontaneously. It is true there are places not very accessible, and very cold, which the natives call 'Parana de las Papas.'" But it seems that though these distinguished naturalists did not succeed in finding the wild potato growing in these regions, others were more fortunate. Meyer states that "if the potato had migrated from Chili to Peru it would probably have retained its Chilian name; but this conjecture is no longer necessary, for it grows wild in both countries. I myself have found it in two different places in the Cordilleras of these countries."

Hooker[1] states that Don Jose Pavon, in a letter to M. Lamhert, says that Solanum tuberosum grows wild in the environs of Lima and fourteen miles from Lima, on the coast, and I myself have found it in the kingdom of Chili. And M. Lamhert adds, "I have lately received from M. Pavon very fine wild specimens of Solanum tuberosum collected by himself in Peru. In Chili it is generally found in steep, rocky places, where it could never have been cultivated, and where its introduction must have been almost impossible. It is very common about Valparaiso, and Cruikshank has noticed it along the coast for fifteen leagues to the northward of that port; how much further it may extend north or south, he knows not." Mr. Caldcleugh, of Rio Janeiro, in sending some tubers of the wild potato to the secretary of the London Horticultural Society, writes as follows: "It is with no small degree of pleasure that I am enabled to send you some specimens of Solanum tuberosum, or native wild potato of South America. It is found growing in considerable quantities in ravines in the immediate neighborhood of Valparaiso, on the western side of South America, in latitude 34½° S. The leaves and flowers of the plant are similar in every respect to those cultivated in England and elsewhere. It begins to flower in October, and is not very prolific. The roots are small, and of a bitterish taste, some with red and others with yellowish skins. I am inclined to think that this plant grows on a large extent of the coast, for in the south of Chili it is found, and is called by the natives maglia, but I cannot discover that it is employed for any purpose.

1 Botanical Miscellany.

The mountain of Chancay is mentioned by Jenin and Pavon as a locality where the potato is to be found in a wild state.

From the foregoing it appears the native habitat of the potato is found in the valleys of the Andes Mountains and the table lands bordering on the Pacific, several species extending as far north as New Mexico. But the potato was found by the European explorers not only growing wild, but it was also found in cultivation in a highly improved state. It has been in cultivation by the old Aztec race from time immemorial. At Cuzco in Peru, Quito in Equador, and perhaps as far north as Mexico, it had formed an important article of diet to the aboriginal inhabitants of America long before the discovery of that country by Europeans. The varieties in cultivation were far superior to the wild varieties, these last being quite bitter and unpalatable, while the cultivated varieties possessed considerable excellence.

At just what period the potato was first carried to Europe we are not informed. Spanish adventurers doubtless carried it to that country at quite an early day. Certain it is that it was cultivated in Spain as early as 1550. From there it soon made its way to Italy, Burgundy and the Netherlands. It was, however, early introduced into Italy, directly from South America. The early Spanish and Portuguese adventurers being zealous papists, it is probable this new esculent was very early sent to Rome as a present to the Pope.

There seems to be a conflict of opinion in regard to the introduction of the potato into Ireland. One account credits its introduction into that country to a Capt. Hawkins, a slave-trader, who, it is said, carried it from Spain in 1565. But Sir Robt. Southwell stated before the Fellows of the Royal Society that his grandfather had introduced it directly from Raleigh. Again, the Irish have a tradition that it was brought to their country from France by a Catholic priest. The potato was introduced into England by Sir Francis Drake on his return from a voyage to the Pacific Ocean in 1565. On his way home he touched at the Virginia coast, and carried away the discouraged colonists from that place. Whether he obtained it on the west coast of America or from the colonists in Virginia we are left to conjecture.

Sir Walter Raleigh is credited with introducing the potato into England from Virginia in 1586. Some authorities, however, place it as late as the year 1623. A somewhat careful examination has raised quite strong doubts in my mind whether this is correct. Raleigh, it appears, did not visit Virginia himself at all, but merely furnished ships and provisions, and sent others out. The return of Sir Francis Drake with the colonists from Virginia, seems to have been the only chance for the introduction of the potato about that time. In 1589, Raleigh disposed of his interest in the new world, and from that time we have no evidence that he gave any attention to colonial matters. To my mind the more plausible theory is that he received some of the tubers that Drake had brought from his southwestern voyage, and having cultivated them one year, introduced them to the public as a product of the new country in which he was at that time greatly interested. Again, there does not appear any evidence that the potato was to be found in Virginia at that time. It is not indigenous to that country, and if found there at all it must have been procured from Europe, which is contrary to both history and the requirements of the case.

Peter Cieca, in his "Chronicle," printed in 1553, says that the inhabitants of Quito had, besides mays, a tuberous root which they called papas, and which was an article of diet with them. Clusius, a botanist of Vienna, supposed this to be the potato, specimens of which he had received both from South America and from Flanders. Thomas Henriot, a mathematician, describes the potato of Raleigh as follows: "These roots are round, some as large as a walnut, others much larger; they grow in damp soil, many hanging together, as if fixed on ropes; they are good for food either boiled or roasted." The first figure of the potato was given by Gerarde, in his "Herbal" in 1597. He calls it the Batata Virginiana. He states that "the root is thick, fat, tuberous, not much differing in shape, color and taste from the common potato, save that the roots hereof are not so great nor long; some of them are as a ball, some oval or egg-fashioned, some larger, some shorter, the which knobby roots are fastened into the stalks with an infinite number of thready strings. It groweth naturally in America, where it was first discovered, as report says, by Columbus, since which time I have received roots hereof from Virginia, otherwise called Nurenbega, which grow and prosper in my garden as in their own country. The Indians do call this plant 'papas,' meaning 'the roots,' by which name also the common potatoes are called in those Indian countries. We have the name proper to it mentioned in the title, because it hath not only the shape and proportion of potatoes, but also the pleasant taste and virtues of the same, we may call it in English 'potatoes of America or Virginia.'"

What is here called the "common potato," was the sweet potato, which was the root in common use previous to 1600. This was the plant alluded to by Shakespeare in the "Merry Wives of Windsor," where Falstaff is made to say,

"Let it rain potatoes, and hail kissing comforts.

Gerard speaks of the round potato as a great delicacy, and recommends that it be eaten as such, and not as a common dish. In 1630, Parkinson published a figure of the potato along with other roots that were eaten. It seems to have been quite rare in England for many years after its introduction. So little attention was given to this plant that it was not mentioned by Loudon and Wise in the edition of their "Complete Gardener," published in 1719. Bradley, who wrote on horticulture about the same time, says that: "The potato is of less note than horse-radish, radish scorganers, beets, and skerret." During the reign of James I. they were furnished to the royal table at two shillings per pound. And during the succeeding reign, and the Commonwealth, the potato continued very scarce and high in price. So slowly did it come into use that it was only toward the close of the eighteenth century that it came into common use. Hence we find that in Essex County in 1796, 1,700 acres were planted to supply the London market.

The potato made its way to Scotland in 1728, where it met with considerable opposition on religious grounds, because "the potato is not mentioned in the Bible." But a severe season in 1742, proved the value of this tuber for food, and so stimulated its culture that it soon became a common and reliable article of diet.

It was introduced into Germany in 1710. The government took quite an interest in its introduction, and in some parts of the country used compulsion to promote its cultivation. France received the potato about the same time that it was taken to Germany, but it seems to have met with quite strong opposition, having been pronounced poisonous by the National College of Physicians. One Parmentier, was instrumental in making it popular in that country. He first saw it as he returned from the siege of Mayence. He studied its cultivation in Germany, and on returning to France he entered upon the task of educating his countrymen in a knowledge of the value of this esculent. He exerted himself by every means in his power to attract the attention of the public to the merits of the potato as an article of food. It is true he overestimated its value, believing that it was equal to wheat. But he had not taken account of the value of gluten in wheat that had been discovered in 1727 by Bececaria. In order to overcome the prejudices of the people he wrote and spoke in its favor, recommending it to the poor as a cheap food product. He planted a field of potatoes, and, in order to impress the peasantry with its importance, he had it guarded by gendarmes, giving out that it was a very valuable food product. In a short time the guards were ordered to relax their vigilance. Some potatoes were stolen by the peasants, others followed, and finally the whole crop was disseminated among the people of the adjacent villages, and its excellence proved to be so great as to remove all the prejudice in regard to the tuber as an article of diet. Parmentier also secured the attention of the nobility to the value of the potato. On one occasion he appeared in the presence of Louis XIV. with a nosegay of the flower of the potato. The king inquired in regard to the plant, and was easily persuaded to introduce its cultivation into the royal gardens. The example of the sovereign was imitated by the courtiers, its popularity was thus secured.

Notwithstanding the efforts of those who appreciated it, the potato grew in favor very slowly, and did not become generally popular with all classes till the beginning of the present century. But when its merits were fuliy understood it soon became one of the most important food crops in cultivation. Such was the dependence of some of the people of Europe on the crop that when the rot appeared and destroyed the crop, it left the people in a destitute condition.

The destruction of the old varieties by this malady led to experiments in the production of new varieties to take the place of those that had seemingly lost their vigor. Mr. Goodrich took the lead in the production of varieties from the seed of the wild varieties. Though his success was not eminent he laid the foundation for improvements that have resulted in the production of hundreds of new varieties, many of them of very superior excellence.—*Gardener's Monthly.*

CHEMISTRY.

THE PRESERVATION OF WOOD FROM DECAY.

PROFESSOR F. W. CLARKE.

[*Read before the American Forestry Congress, April, 1882.*]

That the protection of wood from decay is one of the most important of industrial problems can hardly be denied; and yet in this country it has scarcely begun to receive proper attention. Our forests are rapidly wasting away, the price of wood is continually increasing, its applications are becoming more and more numerous, and still little is done. In 1855 lumber sold for about $18 per thousand, in 1860 for $24, and in 1865 for $45. Although a single acre of pine land yields on the average only about six thousand feet of timber, billions of feet are annually sold in the United States. It is estimated that the supply of white pine will be exhausted, at present rates, in about eight years. The question of preservatives will force itself upon our notice so urgently that it cannot be ignored. Prudence already insists upon a more rigid economy.

In Europe, much attention has been paid to the problem—England, France, and Germany taking the lead. In Great Britain alone not less than fifty patents for the preservation of wood have been taken out during the present century. To be sure, some patents have been granted at Washington, also, but their value is relatively slight. What is the consequence of this trans-atlantic superiority? Simply that railway sleepers, bridge timbers, and telegraph posts last more than twice as long abroad as in America, and that all other exposed wood has similarly gained in durability. Surely this fact is worth the attention of our practical men. Mere temporary cheapness cannot much longer pass for economy.

Many experiments demonstrate the advantage of protecting wood by chemical means. Prepared and unprepared timbers have been exposed together, and the overwhelming superiority of the former proved. A great variety of preservative methods have been found practicable, but an attempt to decide upon their relative merits is quite difficult. The material for criticism is bulky enough, but deficient in quality. All the desirable details are rarely given. A process which thoroughly protects one kind of wood may utterly fail with another. One method may succeed with seasoned timber, yet be useless for preserving green wood. Accordingly we find the most contradictory statements concerning every prominent protective process. One man finds it admirable, another denounces it as worthless. In order to get at results of true practical value, and to avoid these seeming discrepancies, we have to consider several things: first, the general efficacy of each process; secondly, the kind of wood to be used, and its condition; thirdly, the expense, both actual and comparative; and fourthly, the particular use to which the wood is to be applied. The first and second of these questions can be settled only by the evidence of actual tests. The matter of expense involves, to some extent, the subject of locality. The fourth question opens up considerations of this sort. Given two processes for preserving wood, one of which will protect for fifteen years and the other for only ten, the latter being decidedly cheaper. If, now, we are to deal with the timbers of a bridge, the first of these processes, notwithstanding its greater expense, may be the more desirable of the two. But if we are to lay down wooden pavements which will be worn out by the wear and tear of travel long before the cheaper preservative has lost its protecting power, then the latter, though the inferior process in general, is the better for our purposes. In other words, an expense which may be advantageously incurred in one case, may be wholly unadvisable in a second.

The decay of wood may be generally traced to one of three causes. It is due either to slow oxidation, to the ravages of certain minute animals, or to an action induced by contact of the fibre with the decomposing albuminoid substances of the sap. It has at times been ascribed to the growth of fungi; but as these have been found to appear only after decay has fairly commenced, this supposition may be set aside. The rapidity of the change, however, is much influenced by external circumstances. In perfectly dry places wood rots very slowly, and has been known to remain sound for hundreds of years. Completely immersed in water, except where it is exposed to the attacks of the teredo, it is similarly permanent. The piles of Old London Bridge were found to be good after having been down eight hundred years. But in damp places, or in places alternately wet and dry, especially where there are frequent and great changes of temperature, wood decays very quickly. This is the case with wooden pavements particularly. Snow, rain, sun-heat, and frost are ever at work upon them, and particles of fermenting animal matter, like horse-manure, are constantly getting in between the blocks, and making the difficulty of preservation greater.

Now, leaving out of account altogether the processes of drying, washing, boiling, and steaming wood, we shall find that four distinct classes of methods for its preservation have been proposed. The first class contains all those methods which deal simply with the surface of the wood, leaving the interior structure unprovided for. Every process of this sort consists merely in the application of some air-tight varnish to the wood, none of these varnishes being sufficiently valuable to warrant description here.[1] The second class of processes comprises those by which the surface of the wood is carbonized, and the layers immediately beneath are somewhat affected also. Three plans of this sort have been proposed. In the first, which has no recommendations, the wood is charred by immersion in strong sulphuric acid. The second plan is to dip the wood into mineral oil or naphtha, then, after withdrawing it, to kindle its surface, and allow it momentarily

1. The recipe for such a varnish may be found in *Scientific American*, Vol. VI.

to burn. The third process, and the one which has been the most thoroughly tested, is that of M. de Lapparent, as used in the dockyards of Cherbourg, Dantzic, and Pola.[2] A jet of flame from a specially constructed coal-oil lamp is thrown upon the surface of the wood to be preserved. The outer layer is carbonized, while the layers immediately beneath undergo a partial destructive distillation which results in the formation of antiseptic, empyreumatic substances within the wood. This method has been highly recommended for the preservation of ship timbers, but is manifestly inapplicable to cases in which numerous small pieces are to be handled, as with wooden pavements. The cost of the labor involved in carbonizing the immense surface of the necessarily small blocks would be unbearable. There is an improvement upon de Lapparent's process, due to Hugon.[3] The difference is in the construction of the lamp. The improved method has been successfully employed in France for the preservation of telegraph posts.

In the third class of processes we find all those whereby the wood may be charged with insoluble mineral substances, and so protected from change. These all depend upon the principle of double decompositions—the wood being successively impregnated with two solutions which are capable of precipitating each other. Methods of this sort were proposed by Gossier in 1828; Treffry, in 1838; and Fliselli, in 1840. In 1837, the Industrial Society of Annaberg recommended the use of water-glass and hydrochloric acid. Ransome seems to have reiterated this suggestion, possibly with modifications, in 1845. Burkes, in 1844, proposed water-glass and sulphate of iron; and Feuchtwanger has recommended soluble glass and lime-water. In 1846, Venzat and Banger suggested the use of sulphate of copper with caustic baryta. Muller[4] claims to have obtained good results with sodium phosphate and barium chloride; and Schweitzer[5] asserts that a combination of sodium sulphate and calcium chloride has merits. But Payne's process, brought forward in 1841, has been more thoroughly tested than any other in this class. Payne tried experiments with various saline couples, but especially with a mixture of the sulphide of barium or calcium, with the sulphate of iron. Sulphide of iron and the sulphate of the earth were of course formed within the wood. The process, however, was costly and imperfect, and is now pretty much, if not altogether, abandoned. The same may be said of similar double processes. I have cited these methods only for the sake of completeness.

All the preservative processes at present in vogue belong to our fourth and last class. They depend upon the injection of various antiseptics into the wood, and vary not only with regard to the antiseptic used, but also in the method of applying it. The simplest method of application is merely to soak the wood in the preservative liquid. Almost as simple is the device of boiling the wood in the antiseptic. At one time, Boucherie recommended absorption by the living tree. Deep cuts were made in the trunk near the roots, a sort of tank built

2 Dingler's Pol. Journal, 181, 42, 1866.

3 Dingl. Pol. Jour. 189, 456, 1868.

4 *Sci. Amer.* 25. 328, 1871. Dingl. Pol. Jour. 202, 290, 1871.

5 Dingl. Pol. Jour. 125, 121, 1852.

around them, and the tank filled with the solution to be used. Sometimes the tree, immediately after felling, was placed upright, with its lower end in a vat of liquid. In either case the preservative solution was drawn upward by the capillary force of the tree, and penetrated even to the leaves. According to Hyett,[6] a poplar tree, ninety feet high, placed thus with its lower end in a solution of crude acetate (pyrolignite) of iron of sp. gr. 1.056, absorbed about ten cubic feet of the solution in six days. In a variation of this method, the preservative was applied to the top of the recently cut log, being enclosed in a kind of rubber cup. Different sorts of wood were then found to be differently penetrated. Beech absorbed the antiseptic readily, poplar with less ease, and ash scarcely at all. Heart-wood of Scotch fir, says Hyett, resisted permeation entirely. But all these methods of impregnation have been supplanted by the process which originated with Breant, and which, adopted since by Bethell, Burnett, and Boucherie, has been made well-nigh perfect. The wood to be preserved is enclosed in a strong iron cylinder, from which the air is exhausted by means of a powerful steam pump. Then, under great pressure, the antiseptic fluid is allowed to flow in, and permeates the wood in a most complete manner. Of course, the cylinders vary in size, and different pressures are employed. The most convenient dimensions seem to be about thirty-five feet by five, and the suitable pressure, about 125 pounds to the square inch.

As for the antiseptics which have been applied by these various methods to the preservation of wood, the list is very long, beginning with the recommendation of tar by Glauber, in 1657. Coal-tar, vegetable tar, creosote, petroleum, bitumen, and the so-called "pyrolignite of iron," have all been employed. Rosin has been used for the protection of wooden pavements in Cleveland. Solutions of rubber in naphtha or bisulphide of carbon have been recommended, but are of course too costly. Munzing, in 1840, suggested the use of the refuse liquor of the chlorine manufacture. Tannin, extracted from peat moss, gave unsatisfactory results. An arsenical solution, obtained from arsenical pyrites, was found to be dangerous to the workmen. Lime, and the alkalies, according to Parnell, really hasten the decay of wood; lime, however, has been highly recommended by some writers, and possibly it may work very differently with different varieties of wood. The other agents which have been proposed as preservatives, are common salt, sodium sulphate, borax, saltpetre, potassium dichromate, sugar of lead, zinc chloride, zinc sulphate, verdigris, copper nitrate, copper sulphate, ferric nitrate, ferrous sulphate, corrosive sublimate, and the various agents used in the process commonly known as "creosoting." This list may not be quite complete, but it is nearly so. Some of these compounds have been found ineffective, and others, as for instance borax,[7] have not been sufficiently tested.

The value of salt as an antiseptic is well known, but needs farther testing with reference to the preservation of wood. For this purpose it seems first to

6 See Parnell's Applied Chemistry.

7 Recommended by Sigismund Beer. *Sci. Amer.* Vol. 18.

have been recommended by Volmeister, in 1798. It has some good effect, which is due partly, if not wholly, to its hygroscopic action. Examples of its efficacy may be found in many salt mines, whose timbers exhibit remarkable durability. Ships engaged in the salt trade remain sound, it is said, much longer than other vessels. But the best test of the preservative power of salt was made some time ago in Saxony.[8] Wood prepared with this substance was exposed side by side with some which was unprotected. The impregnated timber was perfectly sound at the end of thirteen years, while the other became unserviceable in two.

At one time, corrosive sublimate was largely in vogue, but it is at present little used on account of its high cost, and its deleterious effects upon workmen. As a preservative of wood, it seems first to have been recommended by Knowles and Davy in 1821. Kyan, whence the term "kyanizing," introduced it in 1832. In 1837 Letellier proposed to use it in connection with gelatin. The double chloride, $HgCl_2+KCl$, (procured by the decomposition of carnallite with mercuric oxide[9] has lately been used as a substitute. The corrosive sublimate is injected into the wood by steam power, the standard solution containing one pound of the salt to five gallons of water. Its value as a preservative agent is unquestionable. At Woolwich,[10] pieces of kyanized and unkyanized wood were buried together in a trench. This trench was filled with putrefying vegetable matter and fragments of wood affected with dry rot, the whole being covered with horse-dung. At the end of five years, the protected wood was found to be unchanged; while that which was unprepared was seriously affected in one year.

With regard to ferrous sulphate, statements disagree. It has had the tests of experience less thoroughly than some other more fashionable preservatives. It was recommended by Strutzlei in 1834, Earle in 1843, and Apelt in 1853. Bohl, whose results will be considered in another connection, has employed it simultaneously with creosote. Its mode of action is rather complex. Injected into wood, it finds enclosed there a certain quantity of atmospheric air The oxygen of this air is soon absorbed by the ferrous sulphate, basic sulphate and some ferric oxide resulting from the change. On one hand, it is said that this action is beneficial. The fibre of the wood becomes coated with mineral matter, and is so protected from decay. In opposition, it is urged that the wood is weakened by this reaction, and that it is far less completely protected from decay than by some other more familiar processes.

Copper sulphate—blue vitriol—must pass for one of the very best of the preservatives of wood. Its merits have been tested quite thoroughly, and some occasional failures in its action have been satisfactorily explained. Boucherie, who made experiments with a number of antiseptics, after getting poor results with salts of lead and iron, finally settled upon this agent as the best of all, and time has in many respects justified his decision. At first Boucherie impregnated the wood by the process of suction, which we have already considered, but finally

8 Dingl. Pol. Jour. 202, 174, 1871.

9 Wagner's Chemical Technology

10 Parnell's Applied Chemistry.

he adopted the cylinder of Breant. Unfortunately, however, copper sulphate is not applicable to wood under all circumstances. Baist[11] has shown that it fully protects only green wood containing much sap, and Boucherie, Jr., somewhat corroborates this statement. Kirschweger,[12] also, claims that freshly cut wood is best for treatment with this preservative. This may perhaps enable us to explain the failure cited by Dalpiaz,[13] who says that on the Paris and Rouen Railroad, the timbers of a bridge which had been prepared with copper sulphate decayed with unusual rapidity. Either the wood was in an improper condition when treated with the sulphate, or else the impregnation was not carried out conscientiously. One other point remains to be noticed. According to Koenig,[14] resinous woods retain this antiseptic better than those which are non resinous. From the latter the sulphate may be partly, at least, washed out, while in the former it seems to be fixed by the resin, probably in the form of some basic compound. The resin itself, however, is a preservative.

The testimonials to the efficacy of copper sulphate in preserving wood are quite numerous. In some of the German mines it has been found to give even better results than the zinc chloride.[15] But on certain German railways, where it had been employed for the protection of sleepers, it was found to attack the iron. On the other hand, it is said that if the sleepers be thoroughly dried after impregnation, no such objectionable result will follow. In 1855, the Jury of the French Exposition put forth an extremely favorable report concerning Boucherie's process, asserting not only its value, but also its superior cheapness over the plan of creosoting.[16] In 1846, about eighty thousand sleepers saturated with copper sulphate, together with some which were unprotected, were laid down on the Northern Railway of France. In 1855, nine years afterward, the prepared sleepers were as good as ever, the others having long been decayed and replaced by new ones. For preserving telegraph posts, copper sulphate has been similarly effective. The saving to French lines alone, up to 1855, was estimated at two and a half million of francs.[17] Examples of this sort could easily be multiplied, but one more will suffice. In 1868, Boucherie, Jr.,[17] exhibited to the French Academy specimens of wood which had been prepared according to his father's process, and exposed since 1847. These specimens, after twenty-one years of exposure, were as sound, as elastic, and as strong as when new, and readily yielded the reaction of the copper they still contained.

In England and America the chloride of zinc has probably been used much more largely than any other metallic salt for the preservation of wood. Having been introduced by Burnett in 1838, its application to wood is known as "burnettizing," and the wood thus prepared is said to be "burnettized." The solu-

11 Dingl. Pol. Jour., 162, 397, 1861.
12 Dingl. Pol. Jour., 122, 223, 1851.
13 Dingl. Pol. Jour., 120, 140, 1851.
14 *Sci. Amer.*, 5. Dingl. Pol. Jour., 160, 48, 1861.
15 Dingl. Pol. Jour., 202, 174, 1871.
16 Jour. Frank. Inst., 32, 1, 1856.
17 Comptes Rendus, 67, 713, 1868.

tion commonly employed contains one pound of the salt to ten gallons of water, and is injected by steam pressure in a cylinder like that of Breant. The same limitations which apply to the copper sulphate seem also to hold good of the zinc chloride, the latter compound having the advantage of cheapness, and being nearly, if not quite as efficient a preservative. Burnettized wood was found to stand the Woolwich test as well as that which had been kyanized. In Germany the chloride has been applied successfully to railway sleepers, bridge timbers, and telegraph posts, and also to the wood-work in some of the Hartz mines. Furthermore, it has been successfully used for the protection of wooden pavements.

One more preservative method remains to claim our attention, namely, that of creosoting. Bethell, in 1838, using a vacuum cylinder, injected into wood a preparation of coal-tar oil, known commercially as "gallotin." Since that time, peat and brown coal creosote, paraffine, pyroligneous acid, and the so-called "pyrolignite of iron," have been applied in the same way. The best of all the substances of this class, however, is the heavy oil or "dead oil" of coal-tar. That portion is chosen which boils at about 180° C., and depends, to a great extent, for its efficacy upon the phenol which it contains. This phenol coagulates the vegetable albumen, while the bituminous oils completely penetrate the capillaries of the wood, cover the fibres with an impervious coating, and protect them entirely from the action of water and air. Bohl[18] finds that the poorer the liquid is in oily matter the more readily it penetrates the wood. Since much of the creosote is easily washed out, he subsequently treats the wood with ferrous sulphate, in order to fix the preservative. Ferrous hydroxide is precipitated, which is gradually converted into the ferric hydroxide at the cost of such atmospheric oxygen and moisture as may have been retained in the wood. There are two main objections to the plan of creosoting timber. The first is that it is applicable only to winter-cut hard woods. In this respect it is just the reverse of the copper sulphate process. The latter protects green but not seasoned wood, the former preserves seasoned but not green wood (See the paper by Baist already cited). The second objection is based upon the amount of the preservative to be used. Lumber, properly treated, absorbs about eight pounds of the coal-tar oil to the cubic foot.[19]

At present Bethell's process is largely used in England. For the preservation of railway sleepers it is said to be employed to the total exclusion of all other processes. On the Buckinghamshire R. R. ninety thousand kyanized, burnettized, and payenized sleepers were laid down, with thirty thousand which had been creosoted, and the last proved the most durable.[19] In the mines of Prussian Saxony, Upper Silesia, Thuringia, and Saarbruck, coal-tar for the protection of timber is preferred to the zinc chloride;[20] and in an experiment by Price at Gloucester, England, when unprepared wood decayed in a year, kyanized wood

18 Dingl. Pol. Jour., 144, 448, 1857.
19 *Sci. Amer.*, 3, 186, 1860.
20 Engineering, 13, 30, 1872.

lasted for seven, and then rotted, while creosoted specimens were as good at the end of twelve years as at first.[21] As a general process, Bethell's, including its variations seems to be the best of all.—*Proceedings Ohio Mechanics' Institute.*

21 Dingl. Pol. Jour., 123, 146, 1852.

ENGINEERING.

THE ENGLISH MILE: ITS RELATION TO THE SIZE OF THE EARTH.

JACOB M. CLARK, C. E.

This itinerary, on account of its lack of geographical correlation, and singular dimension, has evoked much interesting discussion, and been the means of bringing to the surface, under new aspects, a variety of important facts.

The reader is referred to a very instructive article in Vol. 25, p. 69, of this magazine, giving a full abstract of the views of M. Faye, as read before the Paris Academy, "On the Origin of the English Mile."

In that paper, the writer favors the view that the dimension is traceable to the survey of Eratosthenes, compared with that of Ptolemy; and, incidentally, that the surveys were conducted in terms of the Babylonian degree, and by implication, for the purpose of determining its length, or rather the subtense of one minute of arc; that the error in dimension arose partly from misapprehending the relative values of the stadia of different epochs, through disregarding the assumption that the computation of Eratosthenes was based on surveys made with the Egyptian foot[1] (0.27m. = 10⅜ inches), while the survey of Ptolemy was based on the Philetærian foot (nearly 0.36 m. = 14⅙ inches).

Much additional light is thrown on the subject through a valuable contribution to these pages, from the pen of Prof. Mansfield Merriman ("The Shape and Size of the Earth," *Van Nostrand's Magazine*, Vol. 22, p. 53–62, 115–128, and 233–241). Reference is more particularly made to the different versions of the earth's circumference by ancient mathematicians on page 58. In the absence of direct evidence to the contrary, the results, the definition of amplitude observed by Eratosthenes, and the chronology,[2] as given by Prof. Merriman, must be taken as clear and conclusive.

1. The Egyptian foot is uncertain. The dimension above given agrees very fairly with the ady of Malabar, the palmo of Malta, Messina, Naples, Sardinia, and Nice, the pied of Rouen, the stonecutter's schuh of Zug, and the miner's spanne of Prussia; dimensions varying from 10.265 to 10.570 inches.

The Philetæric foot is quoted by Alexander as equivalent to 13.893 inches.

2. In a recent discussion (Trans. Am. Soc. C. E., Vol. XI, p. 415), the writer, adopting this chronology, inadvertently placed Aristotle 200, instead of 100, years earlier than Archimedes.

Hitherto, the moderns have regarded these statements as the results of successive experiments by the ancient geometers, to ascertain what has been supposed to be unknown to them—the length of the terrestrial degree, or, at any rate, the true circumference of the earth; and, on the face of it, the discrepancy is certainly glaring enough to justify the impression, and, at the same time, to suggest the theory both of serious errors in their work, and confusion among them as to the dimensions of the stadia used in the different surveys.

The true character and object of these operations can only be understood by reading them in the light of contemporaneous history and in view of the spirit of the times, aided by such knowledge of the actual dimensions made use of as can be obtained or fairly inferred.

It should be borne in mind that, as a rule, conquest has always involved more or less serious interference with the metrics of the people. And, from the nature of the case, this was a prominent feature of state policy among the ancients. So long as a subjugated, but powerful and intelligent people retained the use of their traditional measures, cherished by the philosophers, and indissolubly connected with the mysteries and service of the temple. their complete subjection would be a matter of doubt. But the perils involved in the sudden and arbitrary overthrow of entire systems, were generally, in fact, sought to be avoided by modifications—compromises, under more or less specious and flattering pretexts.

Now as to the measures—the stadia probably used—and the mode of reckoning:

The Greek stadium was $\frac{1}{8}$ of their mile of 1,000 paces, or double parade-steps; value = $604\frac{3}{8}$ feet. The Romans had practically the same mile. Elsewhere, the stadium was 100 fathoms, and the fathom generally, 3 cubits. But the Hebrew fathom was 4 cubits.

The Egyptian, Phenician, and Persian cubits was $\frac{1}{100}$ of the schœnus, which was equivalent to $145\frac{92}{100}$ English feet. The Hebrew cubit was $\frac{1}{80}$ of the schœnus.

The Babylonian cubit was apparently the subtense of 1° on a radius of 100 duodecimal feet, or 1,200 inches. Its value would depend on that of the inch. A form of it appears in Egypt, with some uncertainty as to the date of its introduction, under the name of the royal cubit. The Turin and Nilometer cubits, so called, are versions of it. The dimension was not far from 1.75 feet. A slight modification, to be understood further on, would place it at 1.75104 English feet.

There would result:

The Egyptian stadium = $437\frac{76}{100}$ English feet.
The Hebrew stadium = $729\frac{6}{10}$ English feet.
The (supposed) stadium on fathom of 3 Hebrew cubits = $547\frac{2}{10}$ English feet.
The (supposed) stadium on fathom of 3 royal cubits = $525\frac{312}{1000}$ English feet.

Among the peoples concerned, the reckoning, for all general purposes, was purely decimal, except that the Babylonians had the duodecimal mixed up in their system, with alternations of 6 and 10.

To facilitate the view, the different results are arranged in the table in chronological relation with prominent epochs, and in connection with the above lengths of stadia:

Epoch.	Event, etc.	Earth's circumference in stadia.	Length of stad. English feet.
B. C. 538	Babylon taken by Cyrus.		
B. C. 525	Independence of Egypt destroyed by Cambyses.		
B. C. 340	ARISTOTLE	300,000	437.76
B. C. 332	Macedonian Conquest; end of the Pharaohs.		
B. C. 250	ARCHIMEDES	300,000	437.76
B. C. 230	ERATOSTHENES	250,000	525.312
B. C. 146	Greece made a Roman province.		
B. C. 90	POSIDONIAS	240,000	547.20
B. C. 30	Cleopatra's death; end of the Ptolemies; Egypt becomes a Roman province.		
A. D. 170	PTOLEMY (in the reign of Marcus Aurelius)	180,000	729.60

With these values of the stadium, the circumference in each case is 131,328,000 English feet.

By Clarke's elements of 1878, as quoted by Prof. Merriman, the mean circumference is 131,331,455 English feet.

The skill and accuracy of ancient astronomers is strikingly illustrated by the survey of Almamoun, in Mesopotamia, in the 9th century, referred to for illustration by both Prof. Merriman and M. Faye. Taking the Arabian mile (palpably a version of Ezekiel's 500 reeds) at Haswell's quotation, 2,146 yards, with the Professor's statement of the result, $56\frac{2}{3}$ miles to the degree, the circumference is $2,146 \times 3 \times 56\frac{2}{3} \times 360 = 131,335,200$ feet, a trifle above the ancient and modern, in a total disagreement as to the whole circumference of less than a mile and a half.

Both Egypt and Mesopotamia are fairly situated for apprehending the mean circumference by meridian observations.

Leaving aside. for the moment, the above suggested adjustment of the royal cubit, the question arises pretty distinctly whether the most promising theory to square with all the facts may not, after all, be something like this:

(1.) At the very earliest assignable epoch, the mean circumference of the earth, and consequently its radius, were known with astonishing precision. Under a very perfect system of geometry, the metrics of the ancient leading nations were founded on this knowledge. The opinions of Aristotle and Archimedes were derived from this source, through Egypt.

(2.) After the Macedonian conquest, it became apparent that, by the breaking up and commingling of nationalities, the multiplicity of units was inconvenient and perplexing. The Mosaic and Babylonian cubits were in collision. The "cubit and a hand-breadth" of Ezekiel, by this time widely diffused and popularized, differed from the two-feet rule by about an inch. The Egyptian and Persian cubit was becoming confounded with the Indian[3] cubit of eighteen inches. And the Greek measures were a new element of discord. Eratosthenes was charged by Ptolemy Philadelphus with the work of reform. To satisfy the prevailing preferences for the decimal method, and at the same time strike a reducible mean among the cubits, an itinerary was invented which should be an even decimal of four terrestrial great circles. It is more than probable that the survey of Eratosthenes was simply to test the correctness of the ancient standards, and fix the adjustment of the royal cubit. The circumference was already known, according to the Egyptians, and if their account proved correct, the *relation* was apparent beforehand. The royal cubit would have to be $\frac{6}{5}$ of the Egyptian $= \frac{24}{25}$ of the Mosaic $= 1.75104$ English feet.

(3.) This unwieldy division of the circle, unfit for geography or astronomy, along with the strong preferences of the Egyptians, Persians, Hebrews and kindred races for the ancient measures, and their wide-spread traditional sympathy as against Babylonian methods, finally broke this system down. Accordingly, after the Roman supremacy was established, and in the reign of one of the later Ptolemies, Posidonias restored the Mosaic cubic, but in a 3-cubit fathom, so that his itinerary was decimally related to the hour angle. And so far from his survey being the worst measurement of a degree ever made, it serves to verify in a very lucid way the work of his predecessors. The aptness of his system, as an itinerary, is attested by the survival of the Turkish mile, through all vicissitudes, and of its correlative fathom, by dozens of analogues, in the islands and along the Mediterranean and in Central Europe. And it may seem significant to many that in the Apocalypse, written 186 years later, the division of the circle by 24 is paramount.

(4.) Finally, in the reign of Marcus Aurelius, a further attempt at unification seems to have been made, by re-instituting the Mosaic itinerary—the leuga of the ancient Gauls and the mile of Sardinia. This was the survey of Ptolemy. Possibly it involved some concession to the Egyptians, in that the schœnus became simply 20 fathoms, instead of 33⅓ as by their ancient method, or 26⅔ as by that of Posidonias. It lacked, however, the key-note of Ezekiel's reform—radius to be the base of direct and square measure, itinerary to be ruled by the division of the circle.

There seems to be little, either in the accounts we have, the necessities of the case, or the character of the rulers under whom these operations were con-

3. It is a peculiarity of the purely duodecimal method that, reckoning from the inch, it has no longer dimension than the 12-feet pole or "joktan." And, wherever it has taken root, this dimension, as well as its derivatives by bisection, the vulgar fathom, the yard, and the Indian cubit, as also the foot, when used as units, are, as a rule, but with occasional intermediaries of 3 and 6, reckoned upwards decimally. Its singular distribution—about the Meridian, among the islands, as Great Britain and Japan, and upon the salients of Africa and Asia—are strikingly suggestive of the maritime enterprise of busy Tyre.

ducted, to indicate that they were instituted for any other purpose than that above suggested—verification of the ancient work, and adjustment of the standard for the particular purpose in view at the time. Neither is it apparent that in any of them, the Babylonian degree was either used or its dimension sought (except possibly as to Ptolemy), or that the Egyptian foot, whatever it may have been, or the Philetærian foot or the Greek stadium were used or referred to at all, or that the geodetic work had any other fundamental base than the ancient public surveys of Egypt, familiar to the learned throughout the whole period of operations, and unquestionably made with the schœnus. And this view is confirmed by Eratosthenes' definition of amplitude, as quoted by Prof. Merriman—$\frac{1}{50}$ of 4 right angles—a decidedly decimal expression as well as by the general ancient preference for the decimal method.

The English mile, by its dimension, suggests with strong probability that it was at first either equal to 1751 yards, representing the survey of Eratosthenes, or else 1824, like the Turkish mile, the itinerary of Posidonias; and that it took its present form at the time the English forced the 36-inch yard into their land measure, by means of the invention of Gunter's chain. The former is the more probable of the two.—*VanNostrand's Magazine.*

ASTRONOMY.

METEORS.

R. J. M'CARTY.

History records many instances of the fall of masses of stone, iron, and other substances from the higher regions of the atmosphere. Until the beginning of the present century these records were regarded by many as either entirely mythical or based upon some events entirely susceptible of explanation from local causes, so that there was hardly sufficient faith in the fact to stimulate the philosopher to search for the cause. But when on April 26, 1803, near L'Aigle in Normandy, a shower of stones followed the explosion of a fiery globe which rushed with great velocity over that region, and when this fact was officially verified by a commission of the French Government, there was left no room for doubt that meteoric light is often followed by the precipitation of matter to the earth.

From observations made of the instants of appearance and disappearance of the light and of the position of its path with respect to the stars, astronomers have been able to calculate that the source of meteoric light lies always within the limits of the atmosphere and that the velocity of the meteor varies from seventeen to thirty-six miles per second.

It is, therefore, impossible to doubt that meteors are masses of matter rushing with tremendous velocity through the air.

But this amounts to little more than a definition and does not explain the physical causes of the phenomena, and the questions arise:—Whence the light by which we know the meteor, and whence the matter of which it is composed?

Now it is known that resistance to motion will always generate heat and that great heat is always accompanied by light. For instance, an axle or journal, if not properly lubricated, while rapidly rotating under great pressure, will become red-hot, and the reason it does not become red-hot when lubricated is that the oil reduces to a great extent the resistance due to friction and at the same time absorbs the heat generated by the resistance which it is not able to destroy.

Moreover, we know that the atmosphere offers resistance to the passage of bodies proportioned to the squares of their velocities.

Experiments in gunnery show that a fifteen-inch shot moving with a velocity of 1,500 feet per second encounters an atmospheric resistance of about one and one-half tons If such a shot could be given a meteoric velocity of thirty miles per second, equal in round numbers to 150,000 feet per second, the resistance would be increased to about 15,000 tons. The quantity of heat generated by such a resistance under such circumstances is unknown, but, reasoning by analogy from the above instance of the red-hot axle, it seems perfectly reasonable to conclude that sufficient heat would be evolved to ignite and perhaps dissipate many rigid and practically incombustible substances. It is therefore generally conceded that meteoric light is caused by heat developed by the atmospheric resistance incident to the great velocity with which such bodies are known to move. If the meteor is composed of matter sufficiently fixed a portion of it often survives the great heat and falls to the ground in a highly heated state. If it is composed of more inflammable material it is consumed and dissipated in the air, which explains why we may not expect a meteorite from every meteor.

Respecting the origin of meteoric matter many theories have from time to time been advanced. For instance, it was supposed by some to be formed by the condensation of vapors of various substances in the air in a manner similar to that by which hailstones are produced from the vapor of water. The absurdity of this is manifest. LaPlace, with more reason, supposed that such matter was cast from the Moon by volcanic action with such force as to be brought within the limits of terrestrial gravitation, and indeed considering the absence of atmospheric resistance on the Moon (for that luminary has little or no atmosphere) and considering that the force of gravitation at the lunar surface is but one-fourth what it is on the earth, it is not impossible that the tremendous volcanic action peculiar to the Moon might accomplish such a result; but, as will appear further on, such a supposition is incompatible with the general facts attendant upon meteoric phenomena.

It happens that mechanical science is able to demonstrate that meteoric matter is entirely foreign to the earth or Moon, thus—

The greatest velocity with which a body, moving under the action of terrestrial gravitation alone could possibly strike the earth, would evidently be attained by letting the body fall from an infinite distance—and it is demonstrated by a well-known theorem in dynamics that under such circumstances a body would strike the earth with a velocity of about seven miles per second; but we have seen that meteors move with velocities varying from seventeen to thirty-six miles per second, so that they must have a velocity not due to the earth; which is but another way of stating that they must have a planetary motion.

Therefore meteors are cosmical bodies; that is bodies having their origin in the same general cause which produced the Sun, Moon and stars, so that they may be regarded as minute planets or comets moving around the Sun, obeying the same laws and controlled by the same forces which order the motions of the most gigantic planet of our system.

When we consider that between the orbits of Mars and Jupiter there are more than two hundred small planets, varying in size from two hundred and fifty to sixteen miles in diameter, and that others are being discovered every year, it seems entirely reasonable to conclude, even without reference to meteoric phenomena, that there are myriads of such bodies belonging to the solar system so very small that they can never be detected.

And meteoric phenomena show that the orbital motions and positions of these small bodies are such as occasionally to bring them within the dominion of terrestrial gravitation, whereupon they are drawn from their orbits toward the earth with increasing velocity, and striking the atmosphere burst into flame from the causes given above.

However satisfactory it may seem in explaining the ordinary meteor, which may be seen on almost any clear night, to flash like a rocket across the sky, it would be spreading the above reasoning over too much surface to extend it to those periodical phenomena, called meteoric showers, which make it appear as if all the stars in the heavens were being precipitated upon us.

It having been observed that all planets revolve around the Sun in the same direction and nearly in the same plane, and that the Sun himself rotates in the same direction about an axis nearly perpendicular to the mean position of the planes of the planetary orbits, the suspicion arose that this could not be the result of chance, and that therefore the mechanism of the solar system must derive its motions from a single physical cause—and indeed it has been demonstrated that the probability for a single cause for 228 planets moving in the same direction around the Sun is $1-\frac{1}{2^{228}}$ in which 1 represents certainty. The fraction $\frac{1}{2^{228}}$ when developed would be represented by 1 divided by a number of sixty-nine figures, so that the value of the fraction would be almost nothing, which shows it to be a practical certainty that such motions are the result of law and not chance.

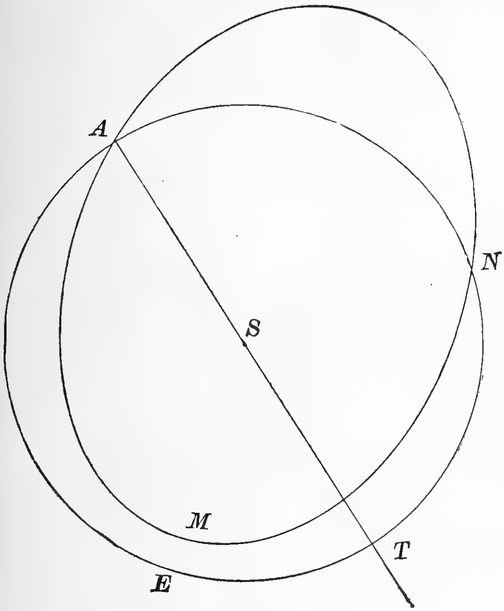
The attempts to discover this law directed somewhat by the suspected existence of gaseous nebulæ, culminated in the nebular hypothesis, which resting as it does upon such a high degree of probability, conforming so entirely to natural law, and explaining so many phenomena entirely inexplicable on any other theory, may be regarded as established as fully as any speculative principle can be without becoming a fact or truth.

Broadly stated, it is as follows: At one time all the members of the solar system were united in a single mass of blazing matter rotating about an axis nearly coincident with the present axis of the Sun, and, by reason of the expansion due to excessive heat and the operation of centrifugal force, extending its lenticular form far beyond the orbit of the outermost planet. By the process of cooling, the action of centrifugal force, and the law of gravitation, the outer portions of this chaotic mass became detached from the main body and broken into small fragments, thus forming an immense annulus, each member of which revolved around the original mass, just as planets revolve around the Sun. Some of these fragments afterward became united by gravity and collision and the result was a larger mass continually increasing in size by absorbing its smaller neighbors just as the earth now absorbs meteoric matter, and still revolving around the original mass. By a repetition of this process at the different stages at which the centrifugal force, increasing with the increase of velocity due to the gravitation of the denser portions of the nebula toward its center, would balance gravity, the solar system as it now stands was formed, the Sun being the remnant of the original chaotic mass—all of which, judging from the behavior of matter under somewhat analogous conditions here on the earth, is in perfect conformity with physical law.

Now unless we are prepared to combat the Nebular Theory we must admit that at certain epochs of its development the solar system was swarming with millions of small meteor-planets; that these have either all been since consolidated into the masses of the few larger planets or that there are some still remaining, which, owing to their peculiar situations and motions, have escaped the clutches of their more powerful neighbors.

The latter is by far the most reasonable, since it is difficult to conceive how all these small bodies moving as they do, could be absorbed by the larger in any finite time—and here it may be well to remark that it must be owing to the great distance between the orbits of Mars and Jupiter that the asteroids have not been appropriated by one or the other of those planets, and to the peculiar positions of their orbits that they have not been united in a single mass. The Nebular Hypothesis therefore permits us to assume, if it does not force us to believe, that not only are there many small isolated bodies revolving around the Sun as planets, but also that these bodies revolve in groups and even in continuous rings.

Suppose that one of these small bodies should revolve in an orbit of exactly the same period as the earth. It is evident that so long as this was kept up the small body would preserve its identity, but should its period be changed in even the smallest degree, it would become a question of time when the earth would transform it into either a meteor or satellite. Let S. represent the Sun; A. N. E. the orbit of the earth; A. N. M. the orbit of meteor planets; A. S. T. the line of intersection of the planes of the two orbits. Suppose a group of meteors to revolve in A. N. M. with a period differing from the period of the earth. It is evident that this group of meteors and the earth would at some time reach the point A. at the same instant and the result would be a meteoric shower.



Such meteoric masses as were not absorbed by the earth in this rencountre would pursue their course and after a certain period some of them would again be caused to contribute to a similar meteoric display.

It is easy to see that this display would happen about the same time of the year and at regular intervals determined by the relation between the periodic times of the earth and group of meteors

Suppose now that A N. M. should represent the orbit of a continuous stream of meteors moving around the Sun like an immense ring. Every year when the earth arrived at A there would be a meteoric shower. This is what happens each year about August 10th.

Thus far we have kept within the limits of the solar system entirely in order to show that all meteoric phenomena could be accounted for within those limits.

But there are certain meteoric displays, notably those which appeared in 1799, 1833 and 1866, which cannot be considered as coming within the limits of the above reasoning, because it is known that the group from which these meteors emanate has a retrograde motion and moves in a cometary orbit. But this fact no more militates against our previous reasoning than do retrograde comets against the nebular theory. It only enlarges the scope of the inquiry and shows that while many meteoric masses are proper to our system many also wander to us from the remote depths of space.

From what has been said we conclude that meteoric phenomena are but the continuation of that process by which the solar system has for infinite ages been collecting the scattered matter from outer space and by which the planets have grown to their present size; that this process now retains but the shadow of its ancient vigor and will probably slowly fade and finally vanish in the great end toward which all creation tends.

Kansas City, May 5, 1883.

A COLOSSAL ENGINE AT WORK FOR MAN.

EDGAR L. LARKIN.

It is known that if a balance-wheel revolves, the mass of the rim draws against the centre. If the wheel is heavy and in rapid revolution, the spokes restrain a powerful tendency of the circumference to break in pieces and fly away on tangent lines. Or, if we revolve a grindstone too rapidly, it will burst into fragments, each being hurled away on straight lines with great force. Indeed, should we have a solid mass of steel in the shape of a disc, say twenty feet in diameter and five feet thick, and hung on an axis, it could be burst in pieces simply by causing it to revolve with sufficient velocity! We are all familiar with this tendency called the *centrifugal*, and recognize it as being one of the most powerful energies developed by motion; while with the indulgence of the reader, we desire to present one of the most magnificent examples of its action, in the endeavor to impress the mind with some idea of nature's grandeur. We will present the case in its most elementary form, and ask that the student will follow in a computation that we promise shall not offer difficulties.

1st. The *acceleration* due to the centrifugal tendency of a moving body, is equal to the square of its velocity divided by the radius of its path. Let us take a rod of steel five feet long, attach one end firmly to an axis, and the other to a cannon ball whose weight is fifty pounds, then revolve the axis fifty times per second and compute the acceleration due to the centrifugal tendency. Since the radius of the circle traversed by the cannon ball is five feet, its circumference is 31.41 feet; and since the ball makes fifty revolutions per second, its velocity is $31\ 41 \times 50 = 1570$ feet per second. By the rule—1570 squared=2,464,900 which divided by 5=492980 feet as the acceleration.

2d. The entire centrifugal tendency is equal to the acceleration multiplied by the mass of the body, and tension on the steel rod is proportional to the acceleration and gravity. The mass of the cannon ball is fifty pounds and the intensity of the earth's gravity is able to impart to a falling body a velocity of 32.2 feet per second at the close of the first second of fall. Therefore:—$492,980 \times 50 = 24,649,000$ which divided by 32.2=765,496 pounds tension on the rod! What bar of steel could withstand this enormous force? We see what tremendous power is developed by rotary motion, for here is a force of 383 tons evolved in a simple machine capable of being run in any of our manufactories, and moving with a velocity of only 1570 feet per second! Now let us make application. We will take a rod of cast-iron 92,882,917 miles long and fasten one end to a sphere whose diameter is 866,394 miles, and the other to a ball 7925 miles in diameter and set the machine in revolution. To the small ball we will impart a velocity of not a few feet, but a rate of 97,642 feet or 18.4927 miles per second. When the vast engine has attained its full speed, and is in revolution in regular circuit, then let us calculate the strain on the rod of iron to keep the little ball from flying away.

Proceeding as in the case of the cannon ball, we divide the square of the velocity by the radius in order to find the acceleration of centrifugal tendency. If we square the velocity per second of the revolving ball and divide the square by 92,882,917 the quotient will be .00000368 of a mile or .233285 of an inch per second. By rule 2d the total centrifugal tendency or strain on the iron rod, will be equal to the acceleration multiplied by the *mass* of the moving ball and the product divided by the force of gravity exerted by the mass of the large sphere upon the small. The question now—before we can proceed—is to find the mass and gravity of the two globes in space.

We remark that our hypothetical spheres are none other than the Sun and Earth, as they actually exist in the solar system.

The diameter of the Sun	866,394	Miles.
The diameter of the Earth	7,925	Miles.
The diameter of the Sun	109.31823	Ratio.
The diameter of the Earth	1.	Ratio.
The mass of the Sun	333,426.2356	Ratio.
The mass of the Earth	1.	Ratio.
Distance between centres of Sun and Earth	92,882,917.	Miles.
The density of water.	1.	Ratio.
The density of the Earth	5.66	Ratio.
Weight of the Earth	6,743,610,190,383,705,901,809.	Tons.

This weight of the Earth needs explanation, for considerable error is attached to its meaning. If we cut up the Earth into cubes, bring each, one at a time to the surface, weigh it and replace in original position, we would find, that if each block should weigh a ton, their number would be as given. The reason is, that each cube would be subjected to the attraction of the Earth's mass. Of course, if the Earth were the only mass in existence it would not "weigh" anything there being no matter to attract it.

The mass of the Earth in tons as above is simply its mass in relation to itself, and cannot be used in a computation seeking centrifugal tendency. We must have its weight in reference to the Sun, before we can find the tension on a rod assumed to hold them together. And this weight in relation to the solar mass we shall find to be quite different; and we must also learn the intensity of gravity exerted by the Sun's mass at the Earth's distance, because we see by the law that attraction is a factor in these calculations.

It is known that the force of gravity on the surface of a sphere is equal to its mass divided by the square of the radius.

The mass, radius and square of the radius, and therefore the gravity of the Earth, are each equal to 1. The mass of the Sun is 333,426, its radius,=109.-31823, the square of its radius,=11,950 whence, mass divided by the square of the radius=333,426÷11,950=27.83. Therefore solar gravity is 27.83 times stronger than the Earth's; that is: a stone that would weigh one pound on the surface of the Earth would weigh 27.83 pounds on the Sun. Also, gravity exerted by the mass of a sphere at any distance from it, is equal to gravity on its surface divided by the square of the distance.

That being the case, let us learn how much solar gravity is weakened at a distance of 92,882,917 miles from its centre The radius of the Sun is 433,197 miles; and 92,882,917 divided by 433,197=214.41248 whose square is 45,972.-71158. Now we have seen that the Sun's attraction is 27.83 times stronger than the Earth's, hence one ton on the Earth taken to the Sun would weigh 27.83 tons. Suppose we now take the 27.83 tons into space 92,882,917 miles from the Sun, how much would it weigh then? If we reduce 27.83 tons to ounces and divide by 45,972.71158 the quotient will be 19.37 ounces! That is, if we carry a stone that weighs one ton on the Earth, to the Sun, it will weigh 27.83 tons, and then if we remove it 92,882,917 miles away from the Sun into space, the great weight will dwindle to 19.37 ounces or a little more than one pound. Great results follow from this method of mathematical induction. Let us see. Why not take the whole Earth to the Sun? If we could, it would weigh 27.83 times as much, or 187,718,612,962,379,075,475,000 tons. Now carry the Earth back into space from whence it came, then each ton of its weight on the Sun's surface, would shrink to 19.37 ounces; the weight of the whole Earth dwindling in reference to its weight while on the Sun, to 4,083,261,651,590,510,370 tons.

Then using rule 2d to find the tension exerted on our imaginary rod of cast-iron, we must multiply this newly determined mass of the Earth (in relation to the Sun) by the acceleration and divide the product by the force of solar gravity exerted by the Sun on the Earth. The acceleration we found to be .00000368 of a mile per second; but a curious circumstance comes in here, which renders the problem different from our cannon-ball computation. This is: the acceleration is just equal to gravity, i. e. the Earth does not fly away from the Sun; nor does it approach, hence we need not multiply one number by another and then divide the product by the same, we do not change values. Hence a cable or bar that would be able to hold the Earth on its orbit, must be strong enough to hold a weight of 4,083,261,651,590,510,370 tons.

With what appalling force does the mighty mass of the Sun attract the Earth; and what manner of engine is this, that toils night and day simply that such beings as men might live a few days and expire? One-half of the Earth is turned toward the Sun all the time, and it is easy to find the number of square inches in the hemisphere. Suppose now that we attach the ends of a cast-iron bar to the Earth and Sun, and instantly let the Sun cease attracting, then the Earth would tend to fly away from its orbit on a straight line; and since this centrifugal tendency is equal to its weight (referring to the Sun), we find the force or pressure exerted on each square inch of the entire half of the Earth's surface to be 20,619 pounds, or 10.3096 tons. But cast-iron is capable of sustaining a pressure of only 18,656 pounds, hence a solid bar of this material 7,925 miles in diameter could not hold the earth on its path, but would snap like a thread, sending our world headlong into frigid space. Of course, the weight of the bar itself has not entered into this reasoning. Or, if the Earth should stop in its orbit, it would at once begin to fall, and a mass of cast iron equal to its diameter would be crushed. What is this mighty engine for? Does it labor solely for our existence? Are we worthy of it all? Did God intend that such colossal power should be chained to the servitude of beings who slay one another in war? Does the gigantic Sun hold the world in place simply as an abode of creatures filled with vice, misery and debasement? Or, are beings out of harmony with God and His goodness fit for the home provided at such cost? Really, in our present state, we do not seem worthy; it appears unreasonable that such energies should struggle in ceaseless round,—all for us. The only reason we can see why such powers were assigned to our use, is that humanity will eventually advance morally and mentally, until they do become suitable beings to receive such manifestations of the Divine care.

NEW WINDSOR (ILL.) OBSERVATORY, May 10, 1883.

THE SUN AND PLANETS FOR JUNE, 1883.

W. DAWSON, SPICELAND, IND.

The Sun moves in right ascension about two hours each month. So his R. A. will be 4h. 37m. on June 1st at noon, and 6h. 37m. on June 30th. He passes the summer solstice (in R. A. 6h. 00m.) June 21, a few minutes after noon. This will be the longest day of the year—14h. 50m. in latitude 40°, along the north line of Kansas. On the south line of Kansas, 37°, it will be 14h 32m.; 18 minutes shorter than 3° farther north. On June 7, Regulus will south at 5 o'clock in the evening; but can be oserved with a small transit instrument. On the same evening Denebola will south at 6 41. Spica, the bright star in Virgo, souths on that evening at 8:16. Remember that all the stars south about four minutes earlier each day on account of the Sun's increase of right ascension, and this is caused by the Earth's annual rotation.

The Moon becomes new, or "changes," on the 4th near midnight—one lunar month after the great eclipse, May 6th. This time she will pass a little south of the Sun, and there cannot be an eclipse on the Earth.

The Moon will pass over Saturn again—producing an occultation—about 3 o'clock in the morning of the 4th; but too near the Sun to be well observed. She will pass near Spica on the 14th. The Moon's north edge will nearly graze a star of fourth magnitude on the 21st.

Jupiter still "holds the fort" as an evening star, though he is just approaching the eve of conjunction with the Sun. Saturn has passed the Sun and is now a morning star. Mercury, after so brilliant a display in May, has now shut himself up in the dazzling rays of the Sun. He will reach inferior conjunction with the Sun near midnight of the 7th; after which he will be morning star till July 20th.

Uranus occupies a good position for observation. It is about 5° nearly west of Beta in Virgo. It is just visible to the naked eye when the Moon is absent – like a star of sixth magnitude. Neptune is a morning star, and will be very near Venus June 8th. Both will be in the same field of view in a telescope; Neptune being about 10′ south of Venus. The latter is getting nearer the Sun and dimmer, but is still a prominent morning star about daylight. Mars on the 10th is an hour above Venus, but not of much prominence or interest. On the 19th Venus and Saturn will be in conjunction—Saturn being 35′ south of Venus.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, May 5, 1883.

Boiler explosions are of late of frequent occurrence, and the conclusion of the inquiry into a catastrophe is, "cause unknown, the boiler was in a good state and the water at the proper level." The latter two explanations may be quite correct. Now the cause which escapes control is exactly what remains to be investigated. Professor Donny, of Ghent, in 1846, drew attention to the fact that water when freed from the air which it always holds in solution, boils no longer at 212°, but must be over-heated to some 256° before it reaches the ebullition stage. Then the transformation of water into steam takes place suddenly and in volumes, as that the vessel containing it bursts.

Thus there is water saturated with air normally, and water which on being progressively heated, parts with its air. In the latter condition when the temperature is augmented, no steam is generated, the air being no longer there to aid the work of ebullition. The fireman consults the indicator and finds the water to be at the same level; he concludes the temperature to be insufficient; he adds fuel upon fuel; the indicator remains still stationary. Suddenly the water having been over-heated, to 256°, immense volumes of steam are generated suddenly and an explosion follows.

The danger is at its maximum in the morning and at noon when the operatives resume work. About seven in the evening the fireman banks the fires, after having filled the boiler with water leaving the manometer indicating a pressure of four atmospheres. In the morning the pressure is down to say two atmospheres; it adds fuel to augment to six atmospheres. However, during the night the boiling water has gradually got rid of its air and has become dangerous, presenting the conditions for exploding. The same observations apply to the rest the boiler enjoys during the dinner hour. Thus explosions mostly occur when the operatives are resuming work.

There is a relation between the temperature of the water and the pressure of the steam, hence the duty of the fireman ought to be to consult a thermometer and a manometer; if the two instruments disagree, the fires instead of being increased should be extinguished. Capt. Treve proposes that a tube be specially laid in the boiler, furnished throughout its length with conical apertures, along which the external air could be pumped; thus the water could be supplied with the air which it lost during the night and meal time. An electric apparatus could be made to communicate with the engineer's office, to register and signal all discrepancy between the thermometer and the manometer.

Salmon rearing has proved a success in Paris. In 18,9 some sa'mon eggs were received from California and placed in the tanks or basins of the Trocadero. The incubation was successful; the fry were fed on chopped whitings, and from half a pound weight increased to five pounds. Thus it is demonstrated that California salmon can be bred and reared in captivity under exceptional conditions, as change of climate and habit. It is proposed to stock the southern rivers of France with salmon where it is unknown.

When one experiences a violent blow, the eye, from the effects of the shock, perceives an infinite number of sparks. Under certain influences the nervous system then experiences certain luminous vibrations. Indeed there are persons so sensitive that they cannot bear a sound or a noise without experiencing at the same time the sight of these colors. To the auditory sensation is united the luminous and the colored. Each sound has its peculiar color; such a word corresponds to red and another to blue, as one note may be green and another yellow. This phenomennon of audibleness and simultaneous vision is called "color-hearing." To Dr. Nussmaumer, of Vienna, belongs the honor of discovering the seeing-colors at the same moment that he perceived sounds. Others have since observed these colors when listening to notes of music. Equally strange, a melody played on a saxophone will create a yellow sensation, while on a clarionet, it will be red, and on a piano, blue. The compass thus of the sound exercises an influence on the phenomena. The energy of a sound corresponds to the intensity of color. The most brilliant silver-white colors accompany the shrillest whistle. The human voice determines a multiplicity of impressions: thus the vowels *i* and *e* produce on emission the most lively colors: *a* and *o* shades less brilliant, while *u* has a sombre tint. It is a curious fact that individuals who can thus perceive the colors of sounds fail to recognize those of their own voice.

Major Jouffret in his volume on the "Theory of Energy" states, that it is completely impossible for us to know the veritable essence of atoms; all we are certain of is that they are not immovable, that each molecule resembles a little solar system or like nebula in constant agitation. What is meant by the tenuity of gas? for example. It is commonly regarded as the result of a kind of bombardment of petty projectiles against an enclosing envelope, and the rapidity of these projectiles is such as to confound the imagination. According to Jules, Clausius, Maxwell, etc., each gaseous molecule has a velocity peculiar to itself of 2,187 yards per second, and when turned aside by neighboring molecules, that velocity can be augmented seventeen milliard times. There are as many molecules in the compass of a pin's head, that if imagination could conceive counting them at the rate of one million per second, 250 millions of years would be necessary to complete the numeration; that is to say, had the calculation commenced when our solar system was in the nebulous stage, the addition would not be terminated even now.

Professor Crie has followed up his volumes on fossil botany, by a very interesting study on the "Primordial Flora." He traces the first vestiges of life in the strata anti-primordial of Canada, England and Sweden. But nothing is more difficult than an exact classification of the primordial vegetation, owing to the rarity of the proofs or specimens, their imperfection, and the difficulty to fix the true geological position of those strata where fossil remains exist. As an instance how widely opinions differ, some scientists view the fossil impressions not as belonging to plants but due to worms, crustaceous organisms, and even to inorganic objects which, driven by the waves, left their mark at the bottom of the sea. M. Rouat even is of opinion that many of the so called plant impressions are simply produced by gaseous emanations in the sands. This fact is certain, that however far back we go, we never find animal separated from vegetable life.

M. de Lesseps has no doubt as to the financial as well as the engineering success of the inland sea in Southern Tunisian and Algeria. The Mediterranean will be allowed to flow in through a canal to be excavated, some eighty miles long, and when the depressions are flooded, the sea will be in places seventy-five feet deep. As at the Straits of Gibraltar, the same current will be out-flowing as well as inflowing, and there is no fear of the depressions being silted up by the deposit of salt, as the sea water keeps such dissolved.

M. Launette holds a theory, that the sardine fishery off the coast of France is due to the direction of winter winds. According to him, the detritus from the cod fishing and curing stations of Newfoundland is carried to the west of France, where the sardines come to feed; now the last winter the winds were S.SW. and hence the detritus was blown into the Gulf stream, where the fish must go and seek it. Conclusion—the sardine-fishing will be bad this season.

M. Paul Bert has so far been able to mix oxygen with protoxyde of nitrogen or laughing-gas, as to make that anæsthetic now practically reliable; he has thus been able to keep dogs in a complete state of insensibility during half an hour, without any indications of asphyxia.

M. Wroblewski, a young Polish chemist, has succeeded in liquifying oxygen gas He produces the most intense cold as yet known, by boiling ethylene in vacuum, and then submitting oxygen to a pressure of 22 atmospheres, when the gas assumes a liquid form and is perfectly colorless, thus differing from ozone, which is blue. He has been equally successful with nitrogen.

Dr. Jules Guerin has performed some brilliant surgical operations, by employing caustics to destroy sensibility round the parts diseased. The caustic formed a skin wholly impervious to the fluids of the ulcers at the same time.

LETTER FROM FORT McKAVETT.

Robert Robinson, Esq., who lives near Fort McKavett, Texas, has furnished me some interesting facts that have come within his knowledge, in reference to centipedes and tarantulas. One evening in 1861, while living in the house now occupied by Major Jewett, he was leaning against the outside wall of the house, while standing on the veranda, when he felt something crawling over his hand as it rested against the wall. Springing away he got a lamp, and found it was an immense centipede. Taking the tongs he caught the centipede and put it into an empty glass jar, and placed it on the mantel. The centipede was in continuous motion day and night, but could not get out of the jar, although left uncovered. About three days afterward some member of the family caught an ordinary sized mouse, and Mr. Robinson put him into the jar with the centipede. When the mouse was introduced the centipede backed up and humped himself, as a cat sometimes does before it springs on its prey, and then seized the mouse with his forceps by the head between the eyes and ears, and crunched him down head foremost, the mouse entirely disappearing in twenty seconds by the second-hand of the watch. During this process the centipede showed his incisors like those of the fish head.

About two weeks after this, he caught a horned frog, and placed him in the jar with the centipede. The frog jumped about all night in the jar which was covered now, and there was a terrible racket, a kind of pounding, in the jar. In the morning Mr. Robinson took the jar out into the yard, and emptied it on the ground. The frog went off apparently uninjured, but the centipede gasped three times and died. He then measured the centipede, and found that he was ten inches and a half in length, a mammoth centipede for this locality. He had no alcohol, and as it cost about $20 a quart, he concluded not to preserve the specimen. The horned frog was undoubtedly protected in the terrible contest, from the poison of the centipede, by its hard thick skin which serves as a kind of armor.

Mr. Robinson has caught centipedes three inches in length, and thrown them into the nests of the fierce red ants which build houses of sand and gravel here. The ants would immediately cover them all over and bite off the legs of the centipedes. Larger centipedes would have strength to crawl out of the nests of the ants, but when they were thrown back a few times, into the nests, the ants would disable them by eating off their legs.

These ants are so furious that a person will sometimes have to divest himself of his clothes for a few minutes to get rid of them, when he has unfortunately stumbled upon one of their nests.

Centipedes live under stumps, and dead pieces of wood, and in the walls of deserted houses. Mr. Robinson has lived in Texas twenty five years, and near Fort McKavett twenty-two years, but although several persons have been stung by centipedes, and bitten by tarantulas, he has never known any one to die from the effects. Tarantulas appear the last of April.

Mr. Robinson says the large red wasp that makes his nest of wood pulp on houses, will fight the tarantula and kill it. The wasps generally fight in pairs. Two wasps will attack a tarantula. As the tarantula is slow and the wasps are quick, they will dart upon it, and shake it as the terrier does a rat. Then they will fly off for a moment, and dart upon it again, and watching their opportunity, sting it. They seem to realize that the tarantula is a dangerous enemy, and are very quick, and careful not to give it a chance to bite them.

There is a ground-wasp here that lives in a hole in the ground. Sometimes they are three inches in length. They will capture the largest sized tobacco worms found here on tomato vines, and drag them to their holes in the ground. The dirt-daubers, the wasps which construct mud nests on houses, catch a black spider and put them away in their nests for their young. The boys use the larvæ of the red wasps for fish-bait here. The San Saba is a very clear, beautiful stream, full of fine bass and a great variety of other fish.

If we could only start an academy of science down here in Texas, and set people with scientific proclivities at work, we might make the most valuable contributions to our scientific knowledge. Texas needs a scientific survey of the State more than anything else.

JOHN D. PARKER.

FORT McKAVETT, TEXAS, May 2, 1883.

LETTER FROM CHIHUAHUA.

CHIHUAHUA, MEXICO, May 21, 1883.

EDITOR KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY:

Within the recollection of men much younger than the writer the journey from Kansas City to Chihuahua, 1400 miles, was made only with ox-teams laden with merchandise, and occupied full four months of wearisome and dangerous toil and exposure. Now the same trip can be made almost over the same trail, in the luxurious palace-cars of the Atchison, Topeka & Santa Fe Railroad Company in less than three days, while the inner man can be regaled with viands unequaled in quality, quantity and variety at its elegant eating stations all the way through.

Starting on May 9th with the Kansas Press Association, a body of about 160 intelligent, vivacious and companionable gentlemen and ladies, under the management of the courteous and vigilant veteran F. P. Baker, of the Topeka *Commonwealth*, we rapidly passed across the well-known rich and thickly settled counties of Johnson, Douglas and Shawnee, thence southwestwardly from Topeka through the coal-fields and pasture-lands of Osage County into Lyon County, one of the oldest and most productive in the State, where we strike the Neosho Valley at Emporia, a handsome and metropolitan kind of city. Speeding along westwardly over a lovely and fertile country well built up with towns and farms, we reach Newton at breakfast time, where we turn almost directly south to the place of the Press meeting, Winfield, Cowley County. The country from Newton to Winfield is surpassingly rich and attractive, so much so that it is one of the most thickly settled regions in Kansas. After the regular exercises of the session, consisting of addresses, election of officers and a social reception by the citizens of Winfield, we commenced the excursion.

The first point of interest visited, was Garden City in Sequoyah County, near the extreme western border of the State of Kansas. Here the soil is very fertile, but the rainfall is unreliable and insufficient for agricultural purposes; hence an extensive and successful system of irrigating the fields has been adopted, from which very gratifying results have followed. The members of the Press Association were taken in carriages and other vehicles some two or three miles up the Arkansas River to the head of the canal, where the whole plan was explained. The process of course simply depends upon securing a sufficient head of water to overflow the lands below and then leading it by small ditches and furrows through the fields and over the growing crops.

The best crops are wheat, oats, rye, barley, potatoes, sweet potatoes, onions and vegetables of all kinds, millet, broom corn, sorghum, Alfalfa clover, and, in fact, all crops are produced in this latitude.

The following table will show the amount produced per acre and prices obtained for the same, in 1882:

Productions.	Bushels per acre.	Weight per bushel.	Price rec'd.
Barley	50	52	$ 75
Corn	30	60	90
Oats	75	45	75
Potatoes	300	60	2 00
Sweet Potatoes	500	55	2 25
Onions	750	57	2 25
Turnips	1,000	50	50
Artichokes	400	56	1 00
Alfalfa Clover . . . tons	12	. .	8 00
Millet . . . tons	5	. .	5 00
Sorghum . . . tons	200	. .	3 00

And other crops in proportion.

Fruit trees and small fruits grow to satisfaction, and yield abundant fruit of superior quality. Corn does moderately well, and will be a successful crop as the country grows older.

The planting season is from March 1st to July 1st.

There are four main canals now opened, (May 10, 1883), embracing an area of 300,000 acres of land that can be flooded.

Size of canals, from ten to forty feet wide, and from one to four feet deep.

After enjoying the hospitalities of the citizens for a few hours our train pushed onwards towards the west and night fell upon us in the solitudes of the Raton Mountains. We reached Las Vegas the next morning, where we spent the forenoon in examining the queer and quaint civilization of the descendants of the Aztecs, now becoming rapidly overshadowed by the modern ways of the "Gringos." Street cars, gas, water works, and telephones, may be seen side by side with the burro, the adobe hut, the primitive ox-cart without a nail or other iron part in its construction, and the large out-of-doors earth-built oven; but it has little effect upon the true Mexican. He looks on calmly, shrugs his shoulders compassionately as he witnesses this reckless haste, and as he wraps himself in his blanket for a siesta, mutters his favorite expression "mucho tiempo" (plenty of time). The business of Las Vegas is growing rapidly and it has assumed within the last two years an air of solidity which it did not have when we saw it last. A branch of A., T. & S. F. R. R. takes passengers to the celebrated Hot Springs, about four miles out, where is to be found the largest and finest hotel west of St. Louis, known as the "Montezuma." At this hostelry we were royally feasted and feted, bathed and irrigated with hot water to our heart's content, and our body's renovation. The medicinal qualities of the springs, of which there are about fifteen or twenty within a compass of a few acres, attract many invalids from all parts of the country.

An analysis made by Professor Lovewell, of Washburne College, Topeka, gives the following results:

The quantity of Magnesium Carbonate in most of these waters is very small, with indications of a small quantity of Potassium and traces of Lithium. Carbonic Acid is probably in the bubbles arising from most of these springs.

Santa Fe was our next stopping place. There we again found the ancient civilization giving way to the new, though sufficient of the former still remains, and will remain for many years, to make the city an object of interest to the tourist. Ancient churches, old Government buildings and old ruinous adobes of all sizes and shapes vie with the Palace Hotel, the Windsor, the new cathedral, the University of New Mexico and the Railroad Depot.

One of the principal objects of interest is the Palace. Some irreverent tourist says it has more the appearance of a rope factory than of a palace. It is said to have been first built in 1581 by the Indians, from material taken from an Indian pueblo; it is one story high, with a porch in front, and occupies one side of the plaza, or public square. Some of the walls are five feet thick. It had been the palace of the Pueblos before the holy name of Santa Fe had been given in baptisemal blood by the Spanish conquerors; palace of the Mexicans after they broke away from the crown of Spain; palace during its occupation by El Gringo; the

No. of Springs.	Temperatures, Fahrenheit.	Parts of Solid Constituents Contained in 100.000 Parts of Water.					
		Sodium Chloride.	Sodium Sulphate.	Sodium Carbonate.	Calcium Carbonate.	Silicic Acid.	Total Solid Residue.
2	105.5	27.36	16.82	5.02	4.03	9.97	65.53
3	120	27.38	15.72	3.04	2.01	4.41	54.06
4	92	23.41	14.62	2.55	4.02	7.20	58.33
5	103	28 54	16 96	2 10	3 03	8.88	57.90
6	122	27 86	16.86	3.30	2.00	6.03	56.20
6½	123	28.02	17.98	1.24	1 05	6.60	55.63
7	71	28.63	17.86	2.01	3.02	6.03	5.80
8 and 9	114	27.86	10 80	1.54	2.01	?	54.60
10	117	27.70	15.12	3.20	2.05	5.45	56.40
11, with 10 and 12	124	26.04	17.86	1.52	1.18	6.10	54.83
12	112	26.03	15.70	3.14	5.26	6.80	56 46
13	136	28.03	17.72	1.50	3 01	6.16	57.00
14	92	28.85	18.00	1.03	1.24	6.93	55.40
15	82	27.36	18 64	1 00	1.16	?	55.90
16	112.5	27.36	19.86	2.01	1.05	7.26	57.73
17	112.5	27 86	17.22	.98	1.06	5 33	53.00
18	96	26.63	17.54	1.08	1.00	?	56 16
19*	...	...	...	...	...	...	...
22 with 20	106	26.87	11.54	1.23	1.55	6.20	54.56
21	86	28.19	14 10	1.16	1.10	?	56.95
22	75 ?	27.36	17.32	1.15	1.08	6.63	57.00
23	123	28.19	12.50	2.33	3.01	6.20	60.20
Cold Sulphur†	. .	33 01	18.14	11.20	38.52	1.20	102.06

* Spring overflowed at time of collecting water. † Sulphuretted hydrogen gas.

palace of the territorial governor, Gen. Lew. Wallace while he wrote "The Fair God" and "Ben Hur;" and now the palace of Gov. Lionel A. Sheldon. In the stormy scenes of the 17th century it withstood several sieges, was repeatedly lost and won as the white man or red held the victory. Who can say how many have been the dark crimes hidden within its walls? In it lived and ruled the Spanish captain-general, who was in name a general but in effect a king. Here met all the departmental and legislative bodies that have ever assembled in the capital of New Mexico. Here have been planned all the wars and defenses against invasion that have ever occurred in the Territory. Within its walls were imprisoned many important personages, who, without trial or examination, were led out and shot, by the dictum of the man of the "palace." The history of the palace is the history of Santa Fe. There are so many points of interest in and around Santa Fe that only a few can be mentioned here. On the bank of the Santa Fe River, a small stream which flows past the city, stands the oldest house in America, erected in 1542. San Miguel Church, the oldest church in the United States, is still used; it was built in 1680 and rebuilt in 1710. The

Archbishop's garden is beautifully laid out with walks, fountains, arbors, ponds stocked with fish and trees bearing nearly every variety of delicious fruit. Old Ft. Marcy, on a hill in the northeastern part of the city, erected in 1846 by Gen. Kearney, was the site of the encampment of De Vargas in 1693. Many other places of as much interest might be mentioned. Right over the old San Francisco chapel, as it stands, are being reared the massive stone walls of a cathedral, to cost $150,000. It is modern in style. Santa Fe is showing signs of contact with the outside world, not only in the enterprise of her business men but the architecture of churches, hotels, etc. The climate of Santa Fe is delightful, its elevation of 7044 feet counter-balancing its southern latitude. The soil in the vallies is good and produces enormously under irrigation. The Cerillos gold, silver and coal mines are adjacent. These mines produce largely of an excellent quality of anthracite.

Passing along, we strike the Rio Grand River at Wallace, an eating station of the A., T. & S. F. R. R. and a mining centre. Here the Indians, clad in blankets and vermillion, silently offer turquoises, opals, and other mineral specimens to the travelers at "two bits" each. Morning found us at El Paso, Texas, a busy, thriving American town of 3,500 inhabitants, with a visible admixture of Spanish and Indian citizens. It is in the midst of a vast sandy plain, but being the terminus of five railroads it has fine promise of future commercial greatness.

Immediately across the Rio Grande is the old city of El Paso Del Norte, in the State of Chihuahua, Old Mexico. This "Gateway of Mexico," though brought into prominence by its railway connections, is still the typical Mexican village. The quiet streets present rows of low adobe houses, the windows guarded by lattice or iron bars; on the plaza stands a church said to be 270 years old. The general offices of the northern division of the Mexican Central R. R. are located here, also a custom house and small military garrison; a weekly paper is published in the Spanish language, and short terms of the State court are held at stated intervals. The town runs down the river several miles, and the adjacent valley is thickly settled. There are a number of vineyards in a high state of cultivation, and under proper management wine-making might become a very profitable branch of industry, for the soil is especially adapted to the cultivation of the grape.

There are no towns worthy of mention between Paso del Norte and Chihuahua. For thirty miles south of Paso del Norte the road runs over a vast sandy plain with a scanty growth of mesquite, thorn bushes and cactus. From Samalayuca some characteristic views can be obtained. On both sides of the road bold, isolated peaks rise from the plain to altitudes varying from 2,000 to 3,000 feet. These detached mountains form a peculiar feature of the landscape. At Candelaria, forty-seven miles from Paso del Norte, the Candelaria range comes into full view. At San Jose, seventy miles from the Rio Grande, the appearance of the country changes and vast grazing ranges stretch away from the track on both sides; the Rio del Carmen furnishes water for irrigation, and farming is made very profitable. Here a new feature of the landscape makes its appearance; to the southwest as far as the eye can reach, heavy timber fringes the banks of the Carmen. From this point on to Chihuahua there is no marked change in the landscape; the country over which the track passes appears as if it had once been the bed of a series of lakes, and the soil is very fertile. The soil is a peculiar chocolate colored loam. Everywhere immense herds of cattle are seen, and herds of deer are frequent.

Chihuahua is the Capital of the State of the same name and its principal town, situated 4,640 feet above the level of the sea, in 28° 38′ N. Lat., and 10° 30′ W. Long. from Greenwich, and containing a population at the present time of about 16,000. It was settled toward the close of the 17th century by some adventurers for the purpose of working the rich silver mines discovered about that time in its vicinity. Among these the most prominent mine was the "Santa Eulalia." When this mine was in its most prosperous state the city contained more than 170,000 inhabitants. But the general expulsion of the Spaniards, and the revolutions which followed, caused the partial abandonment of the mine and a great decrease in the population of the city.

Chihuahua, as approached by the railroad, presents a picturesque appearance To the south are the conical hills in bold relief against the clear blue sky; to the east and west are short ranges of mountains, while the city itself, surrounded by massive cottonwoods, with its towers and domes and peculiar adobe architecture makes quite an oriental picture. The city of Chihuahua was founded in 1604 and is the Capital of the State of Chihuahua. It is 225 miles from El Paso. It lies on the bank of the Conchos River, a stream of pure, clear water that winds around the foot of a picturesque range of mountains just below the 29th parallel of N. Lat., and has an altitude of 4,600 feet. The city is laid off regularly, with paved streets and sidewalks which are kept clean by being swept every few mornings and the dust carried away. Nearly all the houses are of adobe—although the public buildings and some of the dwellings are of stone—and one story high, and are built in the usual Mexican style, around a square or court called a "placita." The city is supplied with water from the river Churiscar, ten miles distant, by means of an aqueduct built by the Spanish between 1717 and 1720. It is built of stone and cement, a large part being built upon great arches of masonry, and is in a perfect state of preservation.

The chief attractions are the celebrated cathedral, the mint, and the square called "Plaza Major." The cathedral is situated on the west side of the plaza and is a beautiful and imposing brown-stone structure. It was commenced in the year 1738 and finished in 1849, costing about $750,000. It is a fine specimen of architectural skill, is surmounted with a dome and two towers, and is in the Moorish style of architecture. A clock illuminated at night ornaments its dome, and its facade is embellished with life-sized statues of the Saviour and Twelve Apostles. In one of its towers is a bell which was pierced by a cannon-ball at the time of Maximilian's invasion in 1866, and in which the renowned patriot Hidalgo was at one time confined and afterward executed. The plaza is a beautiful place occupying the space of a block; it is paved and contains an elegant fountain thirty feet high. The plaza is laid out in walks lined with orange trees and beautiful flowers. Every evening the walks are filled with promenaders and an excellent band discourses sweet strains of Spanish music for their entertainment.

The population of the city is officially stated at 18,000. The present mayor of Chihuahua is Don Juan Zubrian, a gentleman of broad views, well educated, refined, and courteous. He takes pleasure in giving information to Americans, and under his rule the city is as orderly as any of the same size anywhere. He gave our party a very cordial reception and expressed himself anxious to cultivate closer commercial relations with the people of the United States.

The silver, gold, and copper mines of the State of Chihuahua have in former years been very productive, and even in 1844, the mint of Chihuahua, struck $61,632 in gold, and $290,000 in silver. In the year 1814, the coinage of this same mint amounted to $1,818,604 in silver and nearly $16,000 in gold. However, since the last named period the coinage has fallen off considerably on the account of the lack of energy of the mine owners in the operation of their properties. If work now in progress on these various mines continues the output must inevitably far exceed that of all previous years.

The most thoroughly developed and best copper mines at present known are those of Santa Rita, near the union of the Rio Felonida with the Rio Conchas. Veins of iron, cinnabar, lead, sulphur, coal and nitre have been discovered and explored, but never fully opened out. The chief mining districts and mineral deposits are those of San Bartolome, San Barbara, Chihuahua, Cosehuiriachi, Santa Eulalia, Jesus Maria, Loreto, Moris, Mulatos, Minas Nuevras, Parral, San Pedro, El Refugio, Santa Rita, Sierra Rica, Batopilas, Urique Y Ximenes, or as it is called Guajuguilla and Morales.

One of the most noted mines of Chihuahua is the Santa Eulalia, five leagues from the Capital. So rich was this mine that the cathedral, costing nearly $800,000, was built from a fund raised by a tax of one "real" (12½ cents) on every "mark" of silver ($8.00) obtained from it. The fund was collected during a period of seventy-two years, commencing in the year 1717 and terminated in 1789.

It was worked as early as 1705. Its registered product from that time to 1737 was $55,957,750, or an average yield of $1,748,742 per annum. From 1737 to 1781 it yielded something more than forty-four million of dollars, making a total of one hundred millions of dollars during a period of eighty-six years.

The district was gradually abandoned during the latter part of the last century on account of the invasions of savage tribes, but in 1791 it possessed a population of 6,000 inhabitants with seventy-three Haciendas for reducing metals and one hundred and three smelting furnaces; all these have gone to ruin and the product from 1791 to the present time is less than twenty millions of dollars, but the probabilities of restoring the mines to what they were is in the opinion of those who are competent to judge, undoubted.

The mine is now owned by a stock company, whose principal owners reside in Boston. The property consists of four square leagues or three miles square of surplus grants, which is one of the largest concessions ever granted by the Republic of Mexico. They have every indication favorable of a great deposit of silver ore underlying the whole property.

In the northwestern part of the State of Chihuahua are found many interesting remains of antiquity. These remains are to be found lying near the village and Casas Grandes River. Between Janos and Galeana ruins of large houses known as the "Casas Grandes" in the language of the country, exist in the neighborhood, built of adobes and square timber. They are two and three stories high with a gallery of wood and stairway from the exterior. They have very small rooms and narrow doors in the upper stories, but are without means of entrance in the lower. A great watch tower, commanding an extensive prospect, stands on an elevation two leagues southwest of it. A series of mounds, containing earthen vessels, weapons, instruments of stone, and fragments of white, blue and violet-colored pottery, extend along the banks of the Casas Grandes and Janos Rivers. C.

[*To be Continued*]

ARCHÆOLOGY.

AN ARCHÆOLOGICAL FIND.

J. L. R. WADSWORTH.

COLLINSVILLE, ILL., April 28th.—An interesting and valuable archæological find was made this week on the farm of Hon. J. R. Miller, two miles southwest of this place, on the bluffs bordering the east side of the American Valley, by Mr. McAdams, Assistant State Geologist. At this place there is a group of mounds situated on the summit of the bluff, and overlooking the valley below. In this vicinity parts of human skeletons have been plowed up, and Mr. McAdam selected this site for his excavations. After digging down but a few inches he discovered the first indications of relics, and in all nineteen human skeletons, a large number of specimens of pottery, copper and stone ornaments and domestic and agricultural implements. The skeletons found were both male and female, also both adults and children. They were arranged without system, as to direction of the compass, and were found lying one over another in layers. The upper layers were best preserved and regular, while the lower layers were disturbed, as if in digging the upper layers had been separated and detached from their original places. The relics were all found from ten to twenty-four inches under the surface, although, no doubt, they had been buried much deeper, but the soil had washed away. These skeletons were many of them in an excellent state of preservation, while others were partially disintegrated.

Some gave indications of having been partially burned. The skulls varied much in formation. Some were endowed with very prominent projection of the lower bones of the face; others comparing very favorably as to size and development with the present generation. The writer found one specimen of bad surgery that was quite interesting, and we have placed it among the archives, it being an anchylosed elbow joint. During life there had been a fracture, with dislocation of that joint, and the bones had consolidated. We noticed the surgeon (?) left the arm extended. Near the central portion of the group the remains of a splendidly developed man were found; his skull was unusually large and would indicate a large brain development. From the marked attention "the prehistorics" had paid to his burial, he must have been a prominent man, for near his head was found a large proportion of the pottery. Resting against each side of his skull, so as to discolor it, were copper and bone rings, that had probably been attached to his ears. It is difficult to describe them, for they were quite intricate. The bone, however, seemed to be overlaid in part with copper. A large number of shell ornaments of ornate form much elongated, with one or two perforations in the end, as if to run them on a string, also bone beads of various shapes. These seemed to be associated more with the remains of the children.

We noticed a few specimens made of shell—the external portions of which had been removed—perforated with small holes like a strainer, and they certainly would answer quite well for this purpose, as the shells were large, some six inches in diameter. The shells that were still in their natural state, of which there were several, were much larger than would be found in this region, and belonged to the miacidea or clam family. The pottery was by far the most interesting from an artistic point of view. A sculptured frog, six by ten inches, was perhaps the most prominent, and gave evidence of skill of no mean order. Mr. McAdams thought he was no common frog, for he held something in his right hand, possibly associating him with religious customs of those days. He was well formed, and a bowl-shaped opening was placed in his back, with a small opening from the bottom of the bowl, extending at right angles backward, and came out at the tail, as if it were a huge pipe, with the opening for the stem at the tail. There were several bowls of nearly as great capacity; one, in particular, that had sculptured lizards for the handles. These were quite perfect and the effect was fine. The lizard was in the act of surmounting the rim of the bowl, and his head peeping over the edge, as if inspecting its contents. Several bottles of the old Egyptian style, a flattened sphere for the body and a long slim neck, were also found. They were very skillfully made, and were not much thicker than glass, and well burned. Several needles of bone, similar to the modern crochet-needle, also one long copper needle, were found. We omitted to mention some little three-legged pots, holding about a gill, that had some sculptured designs on the sides.

Mr. McAdams showed us the first specimens of flint hoes that we ever saw. These he had just secured from some people living in the neighborhood. One was about seven or eight inches in diameter; another ten or twelve inches long, and four broad. Both gave evidence of considerable use, as the cutting edges were finely polished. We have no doubt that if the proper search and investigations were made, a large and more valuable collection of relics could be obtained in this region that would be of great interest to the archæologist, and do much toward filling the blank as to the history of the former inhabitants of this country.

—*Cor. Globe-Democrat.*

KANSAS CITY FOSSILS.

The Upper Coal Measures of Kansas City and vicinity have proved a rich field for the collector of its characteristic fossils. For variety, size and general perfection, these fossils will compare with those of any other locality in the same formation. Many of them are evidently new and have never been described. This is especially the case in regard to the Cephalapoda (Nautili, Goniatites, Orthocerates) of which there are a great variety, some of new and rare forms. Some of the collectors of this city have exerted themselves to make good local collections, and there is nowhere a wealth of material waiting to be worked up by some good palæontologist. As we have not got the books of reference and specimens for comparison, to make a study of these fossils ourselves, we are anxious to place our treasures at the disposal of some one who has the ability, time and facilities to make a complete monograph of them, believing that it will not only be of value to us but to the interest of science in general. The writer has in preparation a list of the fossils of this locality, so far as we have been able to identify them with our limited sources of reference and comparison, to be published in some future number of the REVIEW. It will necessarily be incomplete and somewhat imperfect, but we hope it will lead to a more complete and perfect list, and also show the abundance and variety of our material.

Mr. A. C. Austin, of this city, has just acquired a very fine fossil from the coal mines at Williamsburgh, Franklin County, Kansas. It is a lower jaw, twelve or thirteen inches in length, embedded in the upper surface of a block of coal, the teeth in place and well preserved. From the structure of the teeth it evidently belongs to a class of large Batrachians found in the coal measures of Ohio and other States, some specimens of which are figured and described in Vol. II, Geological Survey of Ohio, 1875, but rarely found west of the Mississippi. The owner would like very much to have it identified and named, and would be pleased to have any one familiar with this class of fossils call and examine it at his residence, southeast corner 8th and Oak Sts., Kansas City, Mo.

W. H. R. L.

GEOGRAPHY.

CALIFORNIA ON THE OLD MAPS.

E. L. BERTHOUD.

In the course of investigations relating to the early history of Louisiana, New Mexico and California, under French and Spanish rule, and also as to the earliest discoveries of the west coast of America, begun by the renowned conqueror Cortez, who strove like many others in that century to wrest the secret of that short passage into the South Seas and far Cathay which would open the wealth of India to them, we have been puzzled to account for the fact that beginning in the latter half of the 17th century and until the middle of the 18th century California was almost invariably represented as an island, while as early as 1546, the presumable date of Sebastian Cabot's map of the world, until into the 17th century, this Peninsula was invariably shown as connected with the main land. Cortez himself first explored the Gulf of California, which was known afterward as the "Mar de Cortez." Following this expedition he sent Francisco de Ulloa to explore this sea. Ulloa reached its north end, explored there a large river, ascertained the continuity of land on both sides of the Gulf; sailed out of the Gulf and explored the west coast of Lower California to the 28th N. Lat. Alarçon afterward under orders from Mendoza, Viceroy of Mexico, explored the same Gulf and ascended the Great Colorado over 200 miles, and, like Ulloa, he found that the land was continuous. Now, how did the change from peninsula to island occur, in both cartography and in geography?

We will analyze some of the earlier maps, and also those as late as in the middle of the last century giving still the erroneous idea of the insular character of California. 1st. The map of Sebastian Cabot, chief pilot of Spain, of date of 1540–46. This shows California as a peninsula extending on the Pacific coast to 32° N. Lat. at Cabo de Lengaguo, while on the east coast of Lower California the sea extends to about 34° N. Lat. where two large streams enter the Gulf of California, the one on the west called Maha-beyo, while the eastern river is called Damates. The gulf between the two is called Ancon Chay de San Andres; on the map we here find a legend as follows: "Esta tierra fué descuhierata por El Marques ad Valle de Guaxa Don Hernando Cortez." Which translated means that "The country was discovered for the Marquis of the Valley of Oaxaca, Don Hernando Cortez." Ulloa was probably the explorer who made the survey.

2d. The map of J. M. Patavino, Bologna, A. D. 1597. This also represents California as a peninsula, much wider from the Pacific to the Gulf than in

Cabot's map. Two rivers are also shown as discharging themselves at the head of the Gulf, which is called "Mar Vermejo," i. e. Red Sea. The south extremity of this peninsula is named Cabo California. For that period this map of North America is very complete.

3d. Du Val's map, dated Paris, 1682. This map represents all New Mexico and California, with a small portion of "Canada, or Nouvelle France" extending to the 263d Par. of E. Longitude; very near the present boundary between New Mexico and Arizona, an unheard of pretension. California is here represented as a island extending fully to the 46th N. Lat. Cape Mendocino in 42° Lat., while the "Port de Sir François Drac" (Sir Francis Drake) is an indentation in about 40° N. Lat. The Colorado is called Teçon River (Rio del Tison Sp.) a river of firebrands, with a branch marked Rio Xila—the Gila River. The whole sea between the California Island and North America is called "New Vermuille" or Red Sea. The main land of America between 40° and 44°, he calls Quivira or New Albion. The map of Du Val is inferior in accuracy to that of Patavino or Sebastian Cabot. Du Val seems to have tried to improve on the maritime map of Johannes Janssonius of early in the 17th century, who claimed Spanish authority for his innovation of making California appear as an island on his map.

4th. Is a map of North America appended to an edition of Dampier's voyages, Amsterdam, 1712. It differs but little from Du Val's map; does not, however, locate Canada in New France; shows New Mexico extending to the Mississippi River, while Florida is shown as extending to the Ohio River. California is a long wide island extending nearly to 49° Lat., where now are the Straits of Fuça.

5th. This is a copy of the Map of Father Eurebe F. Kino, Paris, 1724–25, from explorations made by him from 1698 to 1701. Map is from Lettres èdificantes, etc., of the Jesuit Fathers.

This map well represents the Gulf of California, and all Lower California, and its true connection with the continent of North America. The Colorado is shown for about 300 miles, which is, however, shown as trending too far east. The Rio Gila is also shown to a point many miles east of the Casas Grandes; while all over the map, and extending to Cinaloa, many small towns and missions are distinctly shown.

Father Kino made an overland journey to the missions on the Great Colorado, and his explorations then settled beyond doubt, that California *was not* an island as heretofore supposed, or believed. Yet, in spite of this evidence, we find in maps as late the middle of last century that it was still supposed to be, and was yet called an island(?).

The 6th map examined bears date of London, 1757, purporting to be a map of North America appended to an edition of Sheleveke's Voyage. This map represents Florida as extending to the Del Norte River, and north to the great lakes, while California, a vast island, extends to nearly 48° N. Lat. Opposite to its north end, but far inland, is an attempt to show the great Salt Lake, or Lake Impanogus of the Spaniards.

We have given this critique of the six maps examined, and the reader will naturally ask what then? what has all this proved or developed?

We have, we think, shown that the earliest explorations of the Pacific northwest coast, and of the Gulf of California, from 1533 until the middle of the 17th century or thereabout, proved that California was a large peninsula. That later in the 17th century it was then known and described first, we believe, by Janssen, a Hollander, *as an island*, and that by the middle of the 18th century it was again proved to be a peninsula.

Within a third of a century surveys and explorations in California have proved beyond doubt that extending west of the Great Colorado from near Fort Yuma, a vast depression exists below the level of the Pacific Ocean. That east of the San Bernardino Range and running southeast is a vast arid basin, treeless and almost waterless, sixty feet or more below sea level, with the present existing bed of a stream at its lower end leading to the Colorado and called "New River." This depressed area shows marks of the comparatively recent presence of water, and has been once completely submerged. Our theory is that since the early exploration of Ulloa and Alarçon, or even much later in time, this area of depressed land has been occupied by water, and that in Cabot's map the Maha-beyo is the present New River, now nearly dry. That Spanish explorations in the 17th century found this depressed area then covered with water, although land stretched westward from the Great Colorado to the then inland lake; that this lake had been formed by the overflow of the Great Colorado, which afterward became dry, its former communication with that stream being destroyed; a probable movement of elevation taking place, a few years exposure to the dry winds and intense heat of that region soon evaporating the overflowed area, and sufficing to render it what it really is, the dry bed of an evaporated fresh-water lake, in which a few estuary shells may have at one time of unusual height, crept up from the Gulf, when following the brackish waters mingling at the mouth of the Great Colorado.

We certainly believe this was the origin of Janssen's Spanish Account, while the latitudes given on Cabot's map certainly place the head of the Gulf much farther north than in more recent maps. New River is also shown in Patavino's map. Nor is it unreasonable to believe that three and a half centuries since the Gulf extended to near the present Ft. Yuma.

The *American Naturalist* for June, 1883, and *Science* for May 25th, present their readers with abstracts of Dr. Edwin R. Heath's article in the April number of the Kansas City REVIEW upon "Dialects of Bolivian Indians," as an important and valuable contribution to geographical and ethnological literature.

ENGINEERING AND MINING.

THE ATCHAFALAYA OUTLET.

There is a great deal being said about the danger of the Mississippi River seeking a new outlet to the Gulf, by way of the Atchafalaya Bayou, and the people of New Orleans are justly anxious over the possibility of their city becoming an inland town, with mouldy wharves and grass-grown streets.

The Red River flows into the Mississippi at a point about 210 miles above New Orleans. From the former just before it reaches the Mississippi, the Atchafalaya starts out and flows through swampy forests in a direct course to the Gulf of Mexico. Its length is 160 miles and it is 327 miles from the mouth of the Red River to that of the Mississippi.

The Atchafalaya was formerly a sluggish stream, hardly worthy the name of river, with a depth at its beginning of only two or three feet. Cows grazed on the reeds in its bed, huge rafts of fallen timber clogged its course and unexplored forests bordered its banks. This was the condition forty years ago but since that time there has been a wonderful change. It is now a mighty river with a depth of more than 125 feet and its swift torrent rushes and whirls among the old trees, sweeping them away in its resistless course.

In the current number of *Harper's Weekly* is given a sketch of this stream which has become so important. The Government engineers were divided in opinion as to the best course to be pursued in regard to it. Capt. Eads advised the closing of the stream by a dam, and, when a majority of the board disagreed with him, he resigned his place. There is danger both in closing this outlet and in leaving it alone. In the former case the Lower Mississippi country is liable to be overwhelmed with an excess of water, while in the latter event it is likely that the Atchafalaya will become the main channel of the Mississippi.

If the present channel should be changed there would be vast benefits and injuries. The latter would be inflicted upon the New Orleans and the costly jetties would become useless. The city, as is well known, is 116 miles from the mouth of the river and ships have to come up this distance. The current below Natchez is sluggish and winding. But if the Atchafalaya becomes the main channel there will be a swift deep current flowing straight out into the Gulf and Atchafalaya Bay will become the great harbor of that coast. Morgan City in such case would become a rival of Galveston and a larger town than Mobile or New Orleans.

It is questionable whether or not it is possible now to check the threatened calamity, for the water in both rivers is very high and it is a difficult matter to dam a stream which is over 125 feet deep and whose current is exceptionally rapid. If New Orleans should become an inland town, and the course of the Mississippi be changed, we believe it would be better for St. Louis and the whole of this great valley.—*St. Louis Railway Register.*

THE LAW AS AFFECTING MINING AND METALLURGICAL INTERESTS.

(*Recent Rulings of the Commissioner.*)

By a recent ruling, the claimants of mill-sites are permitted to cut and remove timber thereon for the purpose of constructing mills, reduction-works, tramways, or other accessory required in developing their mining interests. In permitting the removal of timber from a mill-site or tract of non-mineral land, prior to the issuance of a patent therefor, it is strictly forbidden to make such timber an article of sale for private gain or speculation.

The law recognizes two ways by which title to a placer claim may be shown one by a duly certified abstract; and the other, under the statute of limitations.

A final certificate received at the General Land Office is made out to John Doe *et al.* The commissioner advises the local offices that *et al.* is altogether too loose and indefinite a basis upon which to issue a mineral patent.

A local attorney asked the commissioner to dismiss an application for patent because no appearance had been entered here on behalf of the party. The commissioner says: Should the motion come properly before me for consideration, I require advice as to the rule which makes a failure to employ resident counsel sufficient ground for dismissing an appeal without considering the merits of a case.

Concerning the right to order a hearing, the commissioner considers it proper in the exercise of his discretion to order a hearing upon whatever question of fact arising in a case and at whatever stage of the proceedings he pleases. When entry is made of a mining claim and the money paid for the land, the receiver of the local land office in which the claim is entered fills out two receipts for the amount paid: one of these is transmitted with the final certificate of entry and the papers and the application for patent to the General Land Office. The other receipt is given to the purchaser. When patent is issued, it is delivered to the party holding the duplicate receipt, who surrenders the same. An attorney for the owner or any one else holding the duplicate receipt can obtain possession of the patent. Usually this receipt is held by the attorney attending to the business of the claimant.

Application for patent and publication of notice thereof, as required by law, do not exempt a lode claimant from making the annual expenditures thereafter upon his claim. That requirement ceases only after payment of the purchase-money and entry in the local land office.

"A" filed an application, and due publication was made. He failed to prosecute his claim, and the case rested, when "B" appeared at the local office and made a motion to dismiss the proceedings, in order to make application for patent, basing such motion upon a certificate of subsequent relocation and a decree of court in an action commenced by "B" against "A" to quiet title, which decree was rendered through the default in appearance of "A." The Commissioner of the General Land Office refused to dismiss "A's" application upon such a showing, holding that the courts had no jurisdiction at that stage of the proceedings; that the question of abandonment after the period of publication prescribed by law is one which must be determined by the Executive Department after an investigation. "B" appealed from this ruling to the secretary, who ordered a hearing to determine the question of abandonment before relocation.

The question of a disputed mining title is always one for judicial investigation, and can in no instance be determined by the General Land Office.

Application for patent cannot be received at a local land office for a lode claim embracing a portion of the surface ground of a claim for which an application has been previously filed and is still pending; but when an application has been properly refused a filing, the subsequent application for a patent for another lode should be received, although including part of the surface claimed adversely by others.

Where non-mineral lands have been fraudulently entered under the mining laws, disinterested parties may, at any time before patent issue, lay the facts before the General Land-Office, supported by affidavits of reliable persons; and, if sufficient to establish a *prima facie* case of fraud or illegality, a hearing will be directed to be held by the local land-offices for the purpose of determining the truth of the charges made, and, if substantiated, the entry will be canceled.

The rule which forbids the reception of an application for patent to a mining claim which conflicts with a claim embracing a prior pending application is derived from that provision of the statute which prescribes the method of filing adverse claims. Where the statute prescribes one way in which a thing shall be done, it precludes every other. It is easy to see that this rule is a salutary one; for were it otherwise, application after application might be accumulated in the local office, all relating to the same land, thus nullifying the law which requires adverse claims to be filed and prosecuted. A suit upon an adverse claim, commenced after the period prescribed by law has expired, does not justify the suspension of proceedings for patent.

Coal lands were never subject to location with Sioux or California University scrip.—*Engineering and Mining Journal.*

Advices from the Cariso mining district, in Western Texas, state that an immense deposit of chloride and horn-silver has been discovered in the neck of country lying between the Pecos and Rio Grande Rivers. The surface croppings of horn-silver are said to be very rich.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Apr. 20th to 30th.	May 1st to 10th.	May 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	..	..	..	..
Max	..	..	..	..
Min. and Max	..	..	..	..
Range	..	..	..	..
TRI-DAILY OBSERVATIONS.				
7 a. m.	48.3	58.0	53.2	53.2
2 p. m.	68.0	77.9	64.3	70.1
9 p. m.	54.4	64.1	57.8	58.8
Mean	56.3	65.7	58.3	60.7
RELATIVE HUMIDITY.				
7 a. m.	.92	.91	.92	.92
2 p. m.	.74	.74	.89	.79
9 p. m.	.91	.89	.91	.87
Mean	.86	.85	.91	.86
PRESSURE AS OBSERVED.				
7 a. m.	28.84	28.94	28.88	28.92
2 p. m.	28.84	28.94	28.87	28.92
9 p. m.	28.87	28.84	28.88	28.86
Mean	28.85	28.91	28.88	28.90
MILES PER HOUR OF WIND.				
7 a. m.	13.9	16.8	20.2	..
2 p. m.	19.9	27.5	26.5	..
9 p. m.	10.9	17.7	16.5	..
Total miles.	3489	4763	4405	12657
CLOUDING BY TENTHS.				
7 a. m.	6.3	6.5	5.8	6.2
2 p. m.	5.6	4.5	6.3	5.5
9 p. m.	4.0	5.1	5.1	4.7
RAIN.				
Inches.	0.83	0.25	3.57	4.65

The first two decades of this report were characterized by low temperatures, backward vegetation and high winds. The rains which began May 11th were very heavy, giving a total in this decade of 3.57 inches.

There have been at this station no wind-storms to do any special damage, and the rains came in season to be of great advantage to the wheat crop.

The very low barometer of April 22d is unusual, and has not been so low before at this point in five years—the period of our observations.

Highest temperature, 90°, May 2d. Lowest temperature, 36°, April 1st.
Highest barometer, 29.320, May 11th, reduced 30.304. Lowest barometer, 28.190, April 22d, reduced 29.125.

THE KANSAS CITY TORNADO, MAY 13, 1883.

On Sunday, May 13th, at least four different tornadoes originated in eastern Kansas and swept across a greater or less portion of the State of Missouri, viz: one near Troy, in Doniphan County, crossing into Andrew County, Missouri, and extending eastwardly a few miles; a second in Wyandotte County above this city and sweeping across the Missouri River into Clay County, and so on eastwardly along the H. & St. Jo. R.R. as far as Macon City, the third also originating in Wyandotte County and confining its ravages mainly to this city, as described below, and a fourth starting near Columbus, in Cherokee County, and passing directly into Jasper County, Mo., and doing immense damage in that and the adjoining county northeast

That in which we are most interested occurred at about 5 o'clock P. M., and swept across this city from southwest to northeast, destroying nearly two hundred buildings of all kinds and causing a loss of property amounting to nearly $200,000. Its most remarkable and unaccountable feature was the exceedingly slight amount of bodily injury done to our citizens. Scores of dwellings were unroofed—many of them utterly demolished—in an instant, and but two lives were lost and only a very few persons wounded.

Owing to our absence from the city at the time of the occurrence, we cannot give our personal experience or observations, but must be content to narrate those of others, beginning with an extract from the *Daily Journal:*

"The cool weather on Saturday was followed by a heavy fall of rain on Saturday night and Sunday morning. During the early part of Sunday the weather grew rapidly warmer, and the sultry atmosphere and the peculiar movements and appearance of the clouds indicated that vigorous contest of opposing warm and cold currents which always portends a storm of more or less seriousness.

"The writer was an observer of the gradual concentration of the mighty forces of nature from the time the first indications were noticeable in the southwest, west and northwest until the storm broke with such irresistible force over a portion of our city.

"Between 3 and 4 o'clock the appearance of all the western horizon as far as the eye could see from south to north was that of remarkable counter movements of clouds. The upper stratum of clouds moved counter to the lower stratum with an irregular and uncertain movement, as if they were contending for the mastery. About 4 o'clock the darkest point in the storm clouds was in the northward, and from that point at once appeared what John P. Finley, of the United States Signal Corps, calls a tornado, but what our people will be quite willing to call a cyclone. Its appearance was not to be mistaken. A vast white funnel-shaped cloud seemed to sweep north of the city of Wyandotte, crossed the Missouri River writhing and bounding and carrying with it great clouds of dust, and scooping up vast sheets of water in its course.

"It traveled east and disappeared. In the meantime the contending forces in the west seemed to battle with renewed fury, and a tremendous movement toward the south with indications of a second cyclone, was distinctly seen.

"If this storm took the shape of the first tornado or cyclone it was so enveloped in the clouds and rain that its outlines were not distinctly traced. It only presented peculiar, undefinable colors as it rushed on to the south. Gradually its course turned to the east, and in its progress seemed to throw off its surroundings and assume the funnel-shape, which fact seems to be substantiated by a number of cool, intelligent witnesses. Finally, taking a course almost due east, the storm passed through the bottom and struck the bluff at a draw near Sixteenth Street, and at the residence of Mr. Horton. In this instance the well-known tendency of these storms to follow draws was illustrated.

"From this point the storm veered slightly to the northeast, and with a breadth of about a block zigzagged its destructive course through the entire city.

"Seldom has a tornado condition been presented to a larger congregation of spectators or under more favorable conditions for observation. About 4 o'clock the elements gave indication that the forces from which tornadoes are born, were at work. These conditions are the meeting of two currents of air, one warm, the other cold—the former from the southwest, the latter from the northwest. As the afternoon advanced the southern sky was comparatively clear, the sun shining and the blue expanse obscured by only a few patches of white cloud, while the northern sky was obscured by a heavy mass of black and slowly advancing clouds.

"The line between the two was the meeting point of the two currents, the warm, moist air condensing as it met the cold current, forming the black clouds which advanced, as the cold current moved forward. These opposing currents could be distinctly seen through rifts in the clouds, the upper strata being more dense, of a less dark hue, and with more sharply defined edges. To their meeting was due the hail that fell.

"The barometer fell very rapidly during the half hour preceding the tornado, to 28.43 inches—lower than it has been for ten years, even lower than during the Marshfield tornado a few years ago, the lowest point up to the present since we have kept a barometer. The temperature was only 70°, showing the presence of the cold current, as in ordinary conditions with the barometer at such a low, the temperature would be above 100°—possibly as high as 110°. In this locality twenty-nine inches is a very low barometer, our's marking but twice below that for many years, once during the terrible storm that inundated the coast towns of Texas, the other during the Marshfield tornado referred to. These facts show the remarkable atmospheric conditions conspiring in this vicinity on Sunday."

Upon going over the ground traversed by the tornado, several days after its passage, examining many of the prostrated and less damaged buildings and questioning many eye witnesses of the phenomenon, the following conclusions were arrived at, viz:

1st. That the aërial disturbance was a veritable tornado with a whirling motion of intense rapidity and a progressive motion from southwest to northeast of about sixty miles an hour.

2d. That those buildings which were in the center of the whirl were twisted and prostrated by the actual force of the whirling motion, while those outside of the whirl, but in the progressive track of the tornado, were destroyed or damaged by the expansion of the air within them, which threw walls, furniture, and even persons, outwardly and upwardly in every instance.

3d. That almost the entire force of the tornado was expended within the city limits, for, as far as we can learn, no harm was done by it either before it struck the city on the southwest or after its disappearance at the northeast corner; that is to say, it was only about three miles long, while its width in no case exceeded six hundred feet, or two blocks, and in the greater part of its course it was hardly half so wide.

The temperature and barometrical pressure at the various Signal Office stations on this line, for the 12th, 13th and 14th of May, including the day of the storm and one immediately before and after it, were as follows:

		BAR.	THER.	WIND.
MAY 12, 1883, 2 P. M.				
	Ft. Concho, Texas	29.90	87°	S.
	Dodge City, Kas.	29.87	77	E.
	Leavenworth, Kas	30.12	54	E.
	Kansas City, Mo	30.09	60	S.
	Keokuk, Iowa	30.17	56	NE.
MAY 13th, 2 P. M.				
	Ft. Concho, Texas	29 76	84°	S.
	Dodge City, Kas.	29.41	75	NW.
	Leavenworth, Kas	29.22	64	SE.
	Kansas City, Mo	28.80	61	SW.
	Keokuk, Iowa	29.78	51	SE.
MAY 14th, 2 P. M.				
	Ft. Concho, Texas	30.05	76°	NE.
	Dodge City, Kas.	29.85	67	N.
	Leavenworth, Kas	29.77	57	NW.
	Kansas City, Mo.	29.76	67	S.
	Keokuk, Iowa	29.57	62	W.

It will be observed that the barometer was lower on the 13th than on the day before, or the day after, all along this northeasterly line, but in no other respect does there seem to be any special concurrence of phenomena.

There is a very uniform concurrence in regard to the funnel-shape of the tornado-cloud, though several persons testify to a different shape, a bar or beamshape—something like the masses or blocks of light often seen in auroral displays. Several are positive that they saw an electrical light in the small end of the funnel, others declare that when the cloud rose from the West Kansas bottom and struck the bluff near 16th and Holly Streets, balls of electricity were thrown out freely, while the telephone and telegraph operators state that there was no indication given by the wires of any unusual amount of electricity in the air.

One observer who lives on a hill commanding a full view of the eastern half of the track of the tornado, states that the funnel-shaped cloud swung or vibrated in the air like a balloon, and that when its apex touched the ground destruction followed. Another who was in its direct path states that the whirl cut like an auger, only on its outer edge, while in its center no harm was done.

The question as to the origin of tornadoes, whether electrical or not, is unsettled. Much can be said on both sides and the matter can only be decided after much closer study and more comprehensive observation than have so far been given to the phenomena attendant upon such storms. We found no results and have heard of no facts connected with this particular occurrence which could not, in our judgment, be fully accounted for without referring them to other causes than those ordinarily operating in the production of air currents. Still it is possible if we had witnessed this storm as others did, we might have seen cause to form different opinions.

BOOK NOTICES.

THE ASSAYER'S MANUAL: By Bruno Kerl. Octavo, pp. 313; Illustrated. Henry Carey Baird & Co., Philadelphia, 1883. $3.00.

In 1866 Professor Kerl published at Leipsig a large and detailed work upon assaying, of which the present is an abridgement, or, as set forth in the title page, it is an "Abridged treatise on the docimastic examination of ores, furnace, and other artificial products, by Bruno Kerl, Professor in the Royal School of Mines; Member of the Royal Technical Commission for the Industries, and of the Imperial Patent Office. Translated from the German by William T. Brannt, Graduate of the Royal Agricultural College of Eldena, Prussia; Edited by William H. Wahl, Ph.D., Secretary of the Franklin Institute, Philadelphia; Illustrated by sixty-five illustrations."

This work will be found a valuable addition to the literature of chemistry and metallurgy, and to the American student the introduction of the English equivalents of the French metric weights and measures, by Professor Wahl, will be a decidedly useful and convenient matter. The scope of the book can hardly be given in the brief notice we are confined to, but we will designate some of its main points. The author begins with explaining the object of assaying, and the wet and dry methods; also the manner of precipitating metals by electrolysis, volumetric assays, colorimetric assays and preliminary assays by the blow-pipe. Then mechanical manipulations, such as sampling ores, alloys and non-alloys, washing, weighing, and measuring, fluxes: chemical operations, such as ignition, carbonizing, fusion, precipitation, filtration, volumetric analysis, etc.; assay furnaces, muffles, charcoal and coke and gas furnaces, sublimation and distillation furnaces; assay vessels, balances and weights, tools and implements, and assay reagents. All of these are treated comprehensively and in detail under the first general division of the work and occupy eighty-four pages, copiously illustrated.

The special division includes specific and detailed instructions for assaying the ores and alloys of lead, copper, silver, gold, platinum, nickel, cobalt, zinc, cadmium, tin bismuith, mercury, antimony, arsenic, uranium, chromium, manganese, sulphur, and fuels, comprising 189 pages. An appendix, giving tabular synopses of atomic weights, fusing points of metals, etc., with the methods of assaying employed in the Oker (Lower Hartz) assay laboratory and Schaffner's assay of zinc, and a complete index close the volume. The reputation of the author guarantees excellence of a high degree, while the translator and editor seem to have done their work equally well.

WORK AND WAGES: By Sir Thomas Brassey, K. C. B., M. P. 12mo., pp. 296. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson.

This work was written at the suggestion of Mr. Arthur Helps, who was preparing a life of the author's father, and is probably as fair and comprehensive a statement and discussion of the questions at issue between employers and employees as has ever been published. The elder Brassey was one of the largest manufacturers and contractors of England in his lifetime and consequently had the greatest opportunities for studying this subject. These opportunities the son shared, and has in addition given much time to the study of the labor-question in all its departments.

The branches of the general subject treated are strikes, trades-unions, demand and supply, industrial capabilities of different nations compared, rise of wages abroad, comparison of the commercial progress of nations, fluctuation of wages, influence of American wages upon the English labor-market, etc. If Mr. Brassey's views upon trades-unions, which he shows conclusively to have been detrimental to the laboring class, could be thoroughly disseminated among both employers and laborers, the effect would certainly be beneficial and serviceable to both classes, as well as to the community in general.

PRACTICAL CARPENTRY: Fred T. Hodgson. 12mo., pp. 144; Illustrated. Industrial Publication Company, New York, 1883. $1.00.

This work is offered to builders and mechanics as a guide to the correct working and laying out of all kinds of carpenter's and joiner's work, with the solutions of the various problems in hip-roofs, gothic-work, centering, splayed work, joints and jointing, hinging, dovetailing, mitering, timber-splicing, circular work, etc. It seems to be thoroughly practical and reliable, and is written in a clear and concise manner, adapted to either master workman or apprentice. The first thirty-two pages are devoted to carpenter's geometry, with numerous illustrations, while the whole volume contains over three hundred explanatory engravings and cuts.

THE MAINTENANCE OF HEALTH: By J. Milner Fothergill, M. D., M. R. C. P. 12mo, pp. 366. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson.

This is a book which teaches a vast deal that should be known in every family concerning the means of preserving health and vigor of body. It is not a medical work, but rather a hygienic work; one however, that may be consulted without hesitation by medical students as well as by fathers and mothers, and nurses.

It commences with the discrimination between ideal health and practical health, explaining what the latter actually consists of, including bodily and mental conditions in the category. Then takes up the training of youth, the period of growth, the maintenance of bodily integrity in maturity, the changes induced by advancing age and the corresponding changes rendered necessary in habits, diet and clothing.

The succeeding chapters are devoted to food and clothing, to stimulants and tobacco, the effects of inheritance, the election of pursuit in life, overwork and physiological bankruptcy, mental strain, over-work and tension, hygiene, what to do in emergencies, advice as climates suited to consumptive, gouty and rheumatic patients, etc.

No similar work that we have seen covers so much ground or covers it so well.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY: Volume V; Illustrated; 4to. pp. 237. Department of the Interior, Washington, 1882.

This is one of the supplemental volumes of the United States Geographical and Geological Survey, in charge of Major J. W. Powell. It is most handsomely printed and fittingly illustrated. The first article is entitled Observations on Cup-Shaped and other Lapidarian Sculpture in the Old World and in America, illustrated with sixty-one engravings, by Charles Rau of the Smithsonian Institution.

The second is upon Prehistoric Trephining and Cranial Amulets; illustrated with eleven plates and figures, by Robert Fletcher, M. R. C. S., Eng., Acting Asst. Surgeon U. S. Army.

The third is one which we have noticed before, A Study of the Manuscript

Troano; illustrated by nine plates and one hundred and one figures, by Cyrus Thomas, Ph.D., with an introduction by D. G. Brinton, M. D.

We shall take occasion to refer to this volume again hereafter, as the subjects discussed and the able writers of the articles deserve more than a mere passing notice, such as we are confined to at present.

OTHER PUBLICATIONS RECEIVED.

Bulletin of the Philosophical Society of Washington, Vols. IV and V. Notes on Copper Implements from Mexico, by F. W. Putnam. Report of the Fish Commission of the State of Missouri for the years 1881 and 1882. How You may aid the Civil Service Reform, by Alexander Fullerton. *The Biographer*, May, 1883; Illustrated; $2.50 per annum. Proceedings of 4th Missouri State Pharmaceutical Association at Kansas City, October 25, 1882. Proceedings of the American Forestry Congress, Cinncinati, April, 1882, and Montreal, August, 1882. Technical instruction in France; Circular No. 6, Bureau of Education. Johns Hopkins University Circulars, Vol. II, No. 22, price 10c. Kansas: Its Resources and Capabilities; Its Position, Dimensions and Topography, prepared by Wm. Sims, Secretary of the State Board of Agriculture, Topeka. *The Acadian Scientist*, Vol. I, No. 4, Wolfville, N. S., A. J. Pineo, Editor, 35c per annum. Answers to inquiries about the U. S. Bureau of Education, Chas. Warren, M. D. The 14th Annual Report of the American Museum of Natural History, May, 1883. Bulletin of the American Museum of Natural History: The Atlantic Right Whales, Joseph Bassett Holder. The *Eclectic Monthly and Educational Journal*, Vol. III, No. 5, Little Rock, Ark., J. Kellogg, Manager, $1.50 per annum.

SCIENTIFIC MISCELLANY.

THE DRAMATIC PROFESSION.

E. R. KNOWLES.

"I think I love and revere all arts equally, only putting my own just above the others, because in it I recognize the union and culmination of all. To me it seems as if when God conceived the world, that was poetry; He formed it, and that was sculpture; He colored it, and that was painting; and then crowning work of all, He peopled it with living beings, and that was the grand, divine, eternal Drama."—*Charlotte Cushman.*

Let philosophers hold what different theories they will, one system of philosophy in particular must have a great attraction for any actor devoted to his profession; namely, that phase of idealism which maintains that all material objects that we perceive are the ideas of God sustained and presented in accordance with fixed and permanent laws by the eternal spirit for the contemplation of created spirits, imaginary ideas coming and going according as we will. All men are actors in that "grand, divine, eternal drama," simultaneously created and performed.

> "*Spiritus intus alit, totamque infusa perartus*
> *Mens agitat molem.*"

How God-like then, is the genius of the actor who by force of potent will, and by the fortunate possession of a sensitive and ardent soul, can, not merely assume the part of some character in history, or some ideal fictitious person; but, for the time, become another being, even to his own belief almost, and present a portrayal of the living character.

But are we not contemplating an ideal only realized or approached in the case of a minority of those who style themselves members of the dramatic profession? How many actors are there, in the present state of affairs, who are utterly oblivious of the honor and interests of their profession; how few who realize the truth (expressed above in the words of Charlotte Cushman) that

> —"by the mighty actor brought,
> Illusion's perfect triumphs come,—
> Verse ceases to be airy thought,
> And sculpture to be dumb,"

and appreciate the glory of their calling.

Granting all this to be true, we come at once to the conclusion that a complete change is needed for the interests of the profession and every worthy member of it. It is often stated that it is discreditable to our managers that so many excellent and experienced actors should be without means of support, while the veriest "sticks" are provided for because of their cheapness or notoriety, and also that the profession is misunderstood because of popular prejudices, and will, when those prejudices are overcome, be esteemed in its rightful place. These evils can only be overcome, not by idly lamenting them, but by taking active measures to remedy them. The dramatic profession should be protected in its high standing and integrity as the other professions are. Every actor who claims to be a member of this profession should be recognized therein, in the grade he aspires to hold, by some recognized standard authority made up of the brightest and most talented ornaments of our stage; such recognition to be obtained only by passing rigid examinations in such requirements as are necessary for the grade desired, and by satisfactory evidence of good character.

Were this the case, we should no longer witness such displays of ignorance and awkwardness as we now frequently meet with, on the part of even well paid actors, hardly fitted to occupy a position as a grocer's errand-boy, much less as one of a profession necessarily requiring intelligence and *savoir vivre*, and when the profession is slurred in consequence of dishonorable dealing or misconduct on the part of any so-called actors it could say with self-respect: "They are not of us." It is to be hoped, neither is it improbable, that the youth of the coming generation, instead of being impressed by teachers and associates and the press with the idea that the dramatic profession is an unworthy one, will find it a profession second to none, and will consider success therein an aim worthy of the noblest and most gifted.

EDITORIAL NOTES.

THE Eighth Anniversary Meeting of the Kansas City Academy of Sciences was held at the First Baptist Church in this city on the 29th day of May. The exercises consisted of the Reports of the various officers, an address by the retiring President Hon. R. T. VanHorn, and the election of the new officers, as follows:

President, Hon. R. T. Van Horn; Vice-President, W. H. Miller; Recording Secretary, Dr. R. W. Brown; Corresponding Secretary, Theo. S. Case; Treasurer, Dr. S. D. Bowker; Librarian and Curator, Sidney J. Hare; Member of the Executive Committee, Dr. John Fee.

Professor John D. Parker, was unanimously elected an Honorary Member of the Academy as a token of its remembrance of his faithful services during its early history.

The address of the President, entitled "The Progress of Science during the Past Year," was a full and able *resumé* of recent discoveries in science and of progress in scientific thought. It was very warmly received and will be published in full in the next issue of the REVIEW.

Our citizens cannot do better than to foster the Academy of Science in all practicable ways. They will be proud of it some day.

DR. EDWIN R. HEATH, whose explorations in South America have given him a world-wide reputation among geographers, and whose articles in the REVIEW have been copied widely, has recently had conferred upon him by the Royal Geographical Society of England, the position of one of its three Honorary Corresponding Members elected in 1883. In the letter of announcement Hon. H. W. Bates, the Assistant Secretary, who is also a great traveler and author, compliments the Doctor upon the superior correctness of his maps over any that have been published hitherto.

THE Semi-Annual Meeting of the Social Science Club, for Kansas and western Missouri, was held at Wyandotte, Kansas, on the 17th and 18th of May last. The proceedings were marked by dignity and ability, and are highly creditable to the literary and scientific tastes and attainments of our western ladies. The Society was organized at Leavenworth, Kansas, in 1881, with the object to promote intellectual growth, raise the standard of woman and open new fields of labor to her. It is composed entirely of ladies, and marks a new era in women's aspirations which is prophetic of a higher plane of womanly dignity and attainments.

WILLIAM SIMS, Secretary of the State Board of Agriculture of the State of Kansas, has prepared an admirably complete and comprehensive statement in a pamphlet of sixty pages, of the resources, capabilities, position, dimensions and topography of Kansas, with statistics concerning its lands, agriculture, horticulture, live stock, schools, manufactures, mines, minerals, etc., which will be sought for all over the country. It is also being printed for gratuitous distribution, in the German, Swedish and Danish languages.

WE observe that most of the Kansas editors, in their descriptions of the excursion to Mexico draw freely (as we do also) upon the pointers, folders and circulars furnished by the Passenger Department of the A., T. & S. F. R. R. This is a compliment to Mr. J. S. McLain, formerly of this city, who is the reliable author and compiler of most of them and whose accuracy is unquestioned.

F. W. CRAGIN, Sc. B., of Washburn College, Topeka, is one of the first western writers who has described the structure and habits of the *Copepods* or oar-footed crustacea of North America. This article is published in full in the "Transactions of the Kansas Academy of Science for 1882.

THE New York Life Insurance Company sends to its friends a handsome lithograph published by Root & Tinker, entitled "Origin of the Stars and Stripes," and accompanies it with an explanatory pamphlet containing numerous facts relating to the genealogy of Washington, and the origin of our flag that will be new to most readers.

AMONG the recent novels of the Trans-Atlantic Series published by G. P. Putnam's Sons, none are more interesting or ably written than King Capital by Wm. Sime, or My Trivial Life, in two volumes, by A Plain Woman. All the numbers of the series so far as we have seen them are vigorous in style and of a healthy moral tone. 50c each.

PROF. D. A. BASSETT, of Wabash College, Indiana, says, "I have not forgotten my promise to you to write an item on Crinoids for your REVIEW. I intend to do it yet. I like the REVIEW very much and inclose postal order for $2.50 for the year."

PROF. J. E. SIEBEL, Analytical and Consulting Chemist and Editor of the *American Chemical Review*, Chicago, writes "Please send No. 1, Vol. VI of the REVIEW, so that I may have the whole volume complete for convenient reference."

PROF. G. C. BROADHEAD, late State Geologist of Missouri, writes as follows: "The REVIEW may not be financially successful but it is certainly a valuable collection of information interesting to the people of the Mississippi Valley and the entire Rocky Mountain slope. My means are meagre but I must have it."

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

Harper's Weekly for May 26th is largely devoted to a description, with admirable illustrations, of the opening of the wonderful New York and Brooklyn Bridge on May 24th.

NUMBER 7 of the Johns Hopkins University Studies in Historical and Political Science is entitled "Old Maryland Manors," by John Johnson, A. B., and is the most interesting writer we have yet received. These Studies are edited by Herbert B. Adams, and published monthly in pamphlet shape; $3.00 per annum.

The Patent-Office News is the name of a weekly, sixteen-page, octavo, recently started by Messrs. Howe and Nicholas, at Washington, D. C. It is devoted to patent matters of all kinds. If the work of editing continues to be as thoroughly done as it is in the first few numbers, the *News* will be of great value to inventors and the public generally.

THE *Scientific American*, for May 26th, contains an illustrated article descriptive of a method proposed by John C. Goodridge, C. E., for erecting the pedestal and statue of "Liberty Enlightening the World," without the vast expense of scaffolding. It is, in brief, to construct the statue first and place it upon the site of the pedestal, then gradually push it upward as the masonry of the pedestal is completed beneath it. The plan seems admirably effective.

THE *American Trade-Journal*, of St. Louis, edited by Major F. F. Hilder, has spent a large sum of money in preparing a bird's-eye view of the Mississippi River, from the Missouri to the Gulf of Mexico, which is beautifully executed and surprisingly correct. It gives all the windings of the river, the towns and villages, bayous, lakes, tributaries, etc., with the greatest accuracy, and cannot fail to be of great value to all persons interested either in the geography or the commerce of the great valley.

THE publishers of *The Art Interchange* have decided to issue an eight-page extra on May 22d, thirteen columns of which will be given up to Notes, Queries and Answers, treating, among other subjects, on Artistic Furnishishings, Embroidering, Repousse Work, Wood Carving, Decorative Oil Painting, Stenciling, Painting on China, and Leather Work. This department is of great practical benefit to all interested in Art. The Extra will be furnished free to regular subscribers of *The Art Interchange*, and can be bought by others through news companies for ten cents, or by addressing *The Art Interchange*, 140 Nassau St., New York.

THE June number of the *North American Review* opens with an article by Joseph Nimmo, Jr., Chief of the Treasury Bureau of Statistics, on American Manufacturing Interests, in which is given a singularly full and instructive historical sketch of the rise and progress of manufactures in the United States, together with a very effective presentation of their present condition, and of the agency of tariff legislation in promoting diversified industries and encouraging the inventive genius of the people. Should this author's advocacy of protective legislation prove distasteful, the reader finds the needed corrective in an article by the Hon. Wm. M. Springer, on Incidental Taxation, which is an argument for Free-Trade. D. C. Gilman, President of Johns Hopkins University, writes of the Present Aspects of College Training, as affected by the increase of wealth and luxury, the development of natural science, and the influence of a larger religious liberty. Edward Self presents some weighty considerations on the Abuse of Citizenship, as exhibited in the machinations of the dynamitists against a friendly power, in disregard of the obligations of American neutrality. Prof. Isaac L. Rice criticises some of Herbert Spencer's Facts and Inferences, in social and political science, and Christine Nilsson contributes A Few Words about Public Singing. Finally, there is a symposium on The Moral Influence of the Drama, the participants being, on the one side, the Rev. Dr. J. M. Buckley, well known as an opponent of the stage, and on the other, John Gilbert, the actor; A. M. Palmer, theatrical manager; and William Winter, dramatic critic.

NUMBER 44 of the *Humboldt Library* is devoted to a republication of Part I of The Dawn of History, an introduction to prehistoric study, edited by C. F. Keary, M. A., of the British Museum; octavo, pp. 46, 15c.

HARPER'S MAGAZINE for June is an unusually varied number, profusely and beautifully illustrated. The frontispiece (illustrating "Faustus"—a poem by S. S. Conant), is from a drawing by E. A. Abbey. Lambeth Palace: "Ye Archbishop's Inne,"—Zadel Barues Gustapson, (with ten illustrations). The Folding. A Poem—Annie Fields. The Hundred Years' War.—T. W. Higginson, (with seven illustrations). A Castle in Spain. A Novel. Part II, (with four illustrations by Abbey). Indian Arts in Metal and Wood.—J. L. Kipling, (with fourteen illustrations. On the Edge of the Marsh. A Poem.—Miss A. A. Bassett. The Home of Hiawatha.—Ernest Ingersoll, (with twelve illustrations). Sunlight Mysteries—William C. Wyckoff, (with nine illustrations). Rus. A Sketch.—Charles Reade. Unuttered. A Poem.—John B. Tabb. The Romanoffs. Part I.—H. Sutherland Edwards, (with thirteen portraits. Death in the sky. A Poem. —George Edgar Montgomery. Faustus. A Poem.—S. S. Conant. Carlsbad Waters.—Titus Munson Coan, M. D. The Mount of Sorrow.—Harriet Prescott Spofford. An Æsthetic Idea. A Story.—A Working-Girl.

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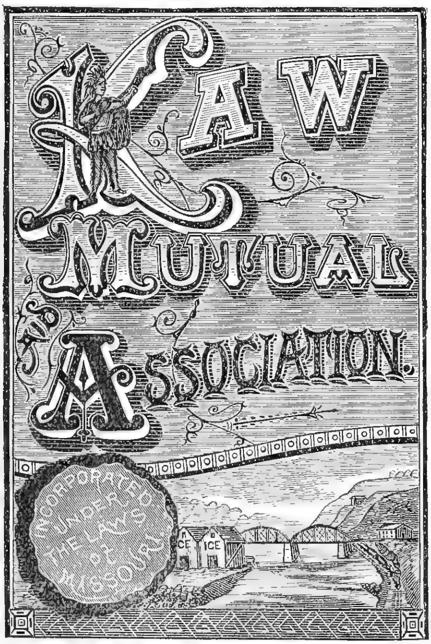

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SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VII. JULY, 1883. NO. 3.

PROCEEDINGS OF SOCIETIES.

THE PROGRESS OF SCIENCE IN THE PAST YEAR.

HON. R. T. VAN HORN.

(*Read at the 8th Annual Meeting of the Kansas City Academy of Science, May 29, 1883.*)

The task undertaken this evening was imposed by your action during my absence, and is one usually requiring wide examination and reference to many authorities. It is fortunate for you and me both, that the original discoveries in science the past year are few, the activity in that department being mainly in the investigation of principles and in improved methods of application of previous knowledge. And it is natural, perhaps, in this utilitarian age, that discovery and improved processes are largely in the direction of the useful and industrial arts.

We may begin with constructive engineering. The most notable event is the completion of the bridge over the east river between New York and Brooklyn, which was formally opened with ceremonies of a character suited to its importance on Thursday last. Its complementary work, the tunnel under the Hudson River, is progressing satisfactorily.

Last year a commission was appointed by the Secretary of the Treasury, to investigate and report upon the theory of Mr. D. T. Lawson, of Ohio, in reference to the explosion of steam boilers. His theory is that boilers explode from the sudden abstraction of steam, which relieving the water in the boiler from pressure, causes it to instantly burst into steam. This sudden change of the superheated water into steam exerts an effect by concussion on all parts of the iron surface very much greater than the ordinary or normal pressure, often to the extent of explosion.

The experiments by the commission have tended in all respects to sustain this theory, as boilers were exploded at pressures far below what they had previously withstood without injury, by providing means by which the steam was suddenly removed from the steam-space in the boiler. Some difference existed in the commission as to whether the trials did not exaggerate the conditions beyond what would be in the practical use of boilers, but the weight of opinion was contrary and the report of all the members was decidedly in favor of the correctness of Mr. Lawson's theory, and there seems to be no doubt of its great value in boiler construction for the future. The remedy he suggests, is an arched diaphragm fixed horizontally in the boiler near the water line and supplied with valves under the control of the engineer; the object being to retard the time of passage of steam from the water-compartment, thus preventing the instantaneous removal of the pressure from the water. This idea also received the approval of the commission.

Considerable attention has been bestowed in the large cities of the country upon what has been considered in some respects an experiment—the cable system of operating street cars. While in San Francisco, last summer, that city being the birth-place of the experiment, I found no doubt expressed as to their complete success there. But they are only employed on the steep grades of the hills of that city, and the question as to their economy on level streets had not been tested. A line, however, has been in operation in Chicago, which has been so satisfactory that it has been very much extended, and a similar roadway has been put down in Philadelphia. As you all know, Kansas City has granted a charter, and the prospects are that our bluff barrier will soon be overcome by this method. It seems to be peculiarly adapted, as in San Francisco, to our broken topography and heavy grades on east and west lines.

In railway building the aggregate of new road for the year is over 11,000 miles, an increase of more than 3,000 miles over the preceding year. But it may be considered the maximum year, as the prospect for 1883 promises a very marked reduction in railway building. But the indications are favorable for a larger mileage of new road for Kansas City than in some years past.

In iron and coal the product has been very large. The year 1881 was notable for the highest figures ever reached in these great factors of industry, and the past year falls but little below. There are evidences, however, that cannot be mistaken that the production has been beyond the demands of consumption, and a very decided diminution may be expected for the present year.

In the precious metals there has been a decrease in the value of the mine product, which, however, is nominal. Of gold our mines produced $31,500,000, and of silver $44,700,000; a decline of $5,000,000 in gold, and an increase of $2,600,000 in silver.

Beet sugar has been sucessfully produced in California, at the Alvarado factory, a most important fact, and it is confidently claimed that the difficulties heretofore attending the development of this industry have been overcome. The introduction of new methods has also greatly encouraged the prospect for the manufacture of soda, which, if as represented, is another material event. And it may be said that the production of glucose has kept pace with its remarkable development in the past. The prospect now is that this industry, so unfortunately delayed in our own city, will be in operation here in the near future.

A very interesting experiment has recently been made, both as to economy in operation and in comfort and safety to life in coal mines. It was made before the British Iron and Steel Institute, by Mr. Moseley, and proposes to do away with the use of gunpowder and other explosives in breaking down coal in the mine, by which the igniting of fire-damp and other dangers attending present methods may be avoided. The substitute proposed is the employment of caustic lime consolidated into cartridges by a hydraulic pressure of forty tons. These cartridges are confined in the bore holes in such a manner that when water is forced in contact with them, the force generated by the expansion of the lime breaks the coal from the roof in ten or fifteen minutes. The coal is broken off in mass, with a greatly reduced wastage, fire-damp incapable of ignition, and the mine, instead of being vitiated, as by explosives, is improved in atmosphere. The experiments show the method to be very successful, and it has been introduced in both England and Belgium.

Students of geology will remember that in the tracings of the moraine of the ice period, a gap has existed in its southern boundary, covering a portion of the Appalachian range in Pennsylvania. Prof. H. C. Lewis announces that he has succeeded in closing that gap for a distance of four hundred miles—in fact completing the line from Cape Cod to the Mississippi Valley.

And it is a curious fact that coincident with this announcement of the completion of the line of the moraine and the apparent final verification of the glacial theory, there should come from a very eminent source a substantial denial of the hypothesis. This is to be found in a volume just issued by Prof. J. D. Whitney, whose name is permanently connected with the geology of the Pacific coast. The work is entitled, "The Climatic Changes of Geological Times," is from the Cambridge press, and based on observations made in the great cordilleras of North America.

The theory of the book is that there has been a constant diminution of precipitation from the pliocene to the present time, which is claimed to be shown even within historic time by the shrinkage of lakes and rivers in South America and the interior basin of Asia. But an outline even cannot be given of an argument that covers 400 quarto pages. The point referred to is made, that only in western Europe and northeastern America was the glaciation so extensive as to demand the assumption of conditions considerably different from the present. The environments of individual glacier districts are discussed, and particularly those of Greenland, Scandinavia and the Ural. Precipitation is now large in Scandinavia and Greenland and small in the Ural, which accounts for the extensive glaciation in the two former and the absence of glaciers past and present in the latter. He does not deny the existence of an ice-sheet, but ridicules the idea of a confluent ice-mass moving in different directions, and attaches great importance to the work of icebergs and rivers. He ignores the erosive powers claimed for glaciers and refers the multitudinous rock-basins of Canada and Finland to chemical decomposition and orographic displacement, asserting that the tendency of streams is to deepen these basins, rather than obliterate them. A wider discussion of these views is promised in a succeeding volume.

In microscopic science the principal event has been the result of experiments by Dr. Koch, of Germany, in the investigation of Pasteur's discoveries in the germ theory of disease. It is the bacterial or parasitic origin of tubercular disease, and consequently of its infectiousness. These discoveries of Dr. Koch were from a multitude of observations in which he demonstrated the invariable presence in tubercular material of myriads of minute organisms, possessing all the characteristics of bacilli, with which he succeeded in inoculating Guinea pigs, rabbits, cats, and other animals with the disease. Not only was this done with tuberculous matter taken directly from diseased animals, but with bacilli which had been taken from cultivation and reproduction in a pabulum extending over a period of six months. These researches are so well fortified that they appear to have met with almost universal acceptance.

The recent storms throughout the country, and the protracted dry season preceding, may make the following fact of interest at this time. While not a discovery to scientific men, yet it has not been generally known that the spectroscope can be used as a weather indicator, by the intensity of the so-called rain-band—the absorption spectrum of aqueous vapor—which occupies a portion of the solar spectrum. Its indications are said to be infallible in predicting the state of the weather for a day or even two days in advance. Spectroscopes for this purpose have been made by opticians, so small that they can be carried in the pocket, and so sensitive and true that a glance through them is sufficient for the experienced observer to forecast the condition of the atmosphere and determine with certainty the coming weather. The principle is this: There is more or less vapor always in the air, and the density of this vapor, more or less, determines what we call wet or dry weather, and the spectroscope shows the condition immediately by its power of discriminating the differently colored rays of which white light is made up. The molecules of water have the power of shutting out certain of those rays and placing them in the order of rainbow colors by the prism and slit of the spectroscope, but transmitting others freely. In looking through a properly adjusted spectroscope at the sky, we see besides the regular series of colors from red to violet, and besides all the thin dark Fraunhofer or solar lines, in one place, that between the orange and yellow of the spectrum, a dark hazy band stretches across it. This is the band of watery vapor. The look should be to the clear sky where it is fullest of light, at a low rather than a high angle of altitude. Any extreme darkness of this band beyond what is usual in the locality of the observer and the season of the year is a sure indication of the abnormal presence and accumulation of rain material, and on the contrary any deficiency in darkness gives probability of dry weather from the absence of moisture to make rain. A little experience is said to be all that is necessary to make a careful observer an expert weather-prophet in a very short time. Prof. Piazzi Smith, Astronomer Royal for Scotland, during August and September last, fully verified the correctness of the predictions made by these instruments.

In the important field of electric research the interest is growing and the inventions claimed are increasing in number. The direction of greatest activity is toward the perfection of the light for domestic purposes—that for large halls and streets having reached a point where it is no longer considered a problem. For private use the incandescent lamp seems to be most desirable and economical.

The most extensive experiment yet made is that by the Edison Company in New York, which has been in operation for the past year in a considerable portion of the lower part of the city. So far, however, the public have not been informed as to cost, the company not having made any statement on that important point. And as it is one very vital to them, we will possibly have to answer this question, as to the public, by either the extension of the system or a failure to enlarge the area lighted.

But it seems to be the concurrent judgment of the best informed authorities on this subject, that the solution of the problem of domestic lighting by electricity depends for general introduction upon the success of experiments now making upon secondary batteries. The secondary battery is to be supplied to each house and during the day charged to saturation from a central station, sufficient for the demand made upon it during the night. The cost by this method, would be very much less than by direct supply, while the current would be free from fluctuations in intensity, which seems impossible by the other method as well as greatly reducing risks and expense of breakage in lamps. These secondary batteries on the Faure system have been in use on railway carriages in both England and the United States. It is, in view of what we know of the genius and ingenuity of inventors, safe to say that obstacles will be removed and the electric light, so desirable in all respects, become a household servant.

The scientific world has never been agreed as to the nature or maintenance of solar heat. Astronomers and physicists, with the tendency of the intellectual age to refer everything beyond our own globe to the phenomena existing here, have as a rule regarded the solar heat as due to combustion of the Sun's matter, maintained by contraction. This theory has led to calculations, from the mass and density of the Sun, as to the ultimate decrease of heat and the extinction of planetary life. Or in other words, that at some period in the future the solar system is to be one of dead worlds circling about a burnt out central orb.

Without stopping to characterize this ignoble conception of the infinite purpose, of a power and wisdom that perfected such a wondrous system amid a universe of suns and systems, it may on this occasion not be improper to say that this theory has been disputed, and that the debate will not go on entirely upon the amount of stoking that may be needed for the solar furnace, or as to where the fuel is to come from—whether its fires are to be fed by its own substance or be supplied with meteoric or cometic material, until the vagrant store is all worked up. Another hypothesis is offered.

Dr. C. W. Siemens holds that interstellar spaces are filled with a gaseous matter—hydrogen, hydro-carbons, oxygen, etc.—in extremely attenuated condition. These gases, he holds, are attracted in enormous quantities to the polar surfaces of the Sun, and as they flow in, pass from this state of tenuity and extreme cold to that of compression and a rise in temperature. That finally on reaching the photosphere of the Sun they burst into flame, giving rise to a great development of heat. That the products of combustion—aqueous vapor, carbonic oxide and anhydride—yielding to the influence of centrifugal force, will flow toward the Sun's equator and thence be projected into space. He holds farther, that these projected gases in combustion are forced back by solar radiation to their original condition by a process of dissociation, and that in this direction, or in this office, that portion of the solar energy supposed by scientists heretofore to be lost by radiation into space can be accounted for. This hypothesis he bases upon experiments by which he has obtained unmistakable evidence of the dissociation of water vapor by the simple action of solar rays.

Whether this is to be more than a mere hypothesis like that it proposes to supplant, must be left for farther investigation and discussion, but it has the great merit over the other of rescuing infinite creation from failure, and supplying forever the means for the maintenance of a system that offers every evidence of perfect wisdom in its existence thus far. It satisfies at least human conception of the power and resources of the infinite mind, so far as eternity of phenomena and law are involved. In this respect Dr. Siemens has rendered a very great service to reverential philosophy and to the reason of man.

It may be of interest in this connection to give the result of Prof. Langley's observations to determine the color of the Sun, carried on for many years at Alleghany Observatory, near Pittsburg, and supplemented last summer by experiments on Mt. Whitney, at an elevation of 13,000 feet. Without detaining you with technical details, it will be only necessary to give the results in Prof. Langley's own words, from a paper read by him before a recent meeting of the British Association at Southampton: "The conclusion then is, that while all radiations emanate from the solar surface, including red and infra-red, in greater degree than we receive them, that the blue end (in the spectroscope) is so enormously greater in proportion, that the proper color of the Sun, as seen at the photosphere is blue—not only 'bluish,' but positively and distinctly blue; a statement which I have not ventured to make from any conjecture, or any less cause than on the sole ground of long continued experiments, which, commenced some seven years since, have within the past two years irresistibly tended to the present conclusion." Comment on mere guessing theory and the facts from this eminent authority is only needed so far as to say that hypothesis is not infallible.

Though perhaps not precisely scientific, as we use the term, and not strictly in place here, yet it may be permitted to refer to the fact that the higher science which we term philosophy, is keeping pace in its discussions and investigations abreast with the physical sciences, interpreting by the light of each new fact, each new form of truth in nature and the symbol it presents to be read.

It is hard to tread in the paths of this field of inquiry without crossing the lines of religious thought and belief, or creed—a department that our Association does not propose to enter. But in the widest sense all these—psychology, biology, and kindred topics—grow out of scientific facts. A truth in nature, the knowledge of which is science, is a whole and universal. The discoveries in electricity, as we have seen, are modifying our views as to the constitution and functions of the Sun itself. And as the Sun is the source of support for all forms of life, it is a legitimate hypothesis to assume that it may have an influence in the origin of life. As what we call electricity is now known to pervade everything in nature, flowing out from, returning and controlling, the suggestion logically arises, whether it does not disclose to us, if not life itself, the law of life in all things. It is not necessary to introduce mere matters of faith or belief as to religion into the question, nor on the other hand should we hesitate to grapple with the problem from anything connected with it. The man who will reject a fact lest it disturb a belief, is of as little use in matters of religion as in science or economy. Had this been so in the past there would have been no science—in fact religion, as we have it in this age, would have been impossible.

In this direction we have had in our own city recently a very significant event—the task undertaken by one of the ablest of modern platform advocates, of reconciling the latest achievments of physical science with the teachings of revelation. The importance of this occurrence is in the fact that scientific truth can no longer be discarded by anybody, but must be accepted when found. All departments of intellectual activity must stand in logical relation to the truth, whatever it be. There is not power enough on the earth to-day, if combined all in one, to crush out the humblest truth, in whatever department it may be found. This is the most important and influential fact of the nineteenth century.

As recognized by the distinguished advocate referred to, underlying all knowledge in this direction is the problem of life, its origin and its destiny, and this was the burden of the argument on the occasion we refer to. If, then, it is the obligation of religious thought to be reconciled with scientific truth, it is not improper for us to follow out the lines of inquiry that truth may suggest. And there was one very marked feature in the argument of the distinguished gentleman referred to, that recognized the very foundation inquiry of this age in philosophical science. It was the question raised by microscopic research with bioplasm —as to living matter. This substance is the same in all forms of life, vegetable and animal. The legitimate scientific deduction from this fact is the query: If this is so, is not all life the same, governed only in its phenomena by the form of matter through which it is expressed?

In this inquiry we do not touch upon religious faith, which is based upon miracle—for this assumed there is an end of investigation—but our inquiry is for the law. It is an axiom of the mind, that nothing can be ascribed to miracle if the cause can be found. And it is the highest conception of science that what is classed as miracle may be, after all, but the supreme manifestation of law. Many things once regarded as outside knowledge and in the domain of the occult have in these modern times been discovered to be as fully the manifestations of law as are the phenomena of water. Religion has its office in the domain of morals, science its function in discovering the nature of things. But a man may be both religious and scientific. If science can demonstrate that man is immortal in its way, surely it is its highest mission as well as duty to do so. And if in so doing it opens new light on other fields it don't hurt humanity, ought not to hurt any man.

The problem is a very simple one, philosophically stated: All manifestations of life are through matter. Taking miracle as claimed in its fullest extent, there is not on record or even from tradition, any revelation to man, except through matter—through man. Accepting fully the "God man," it was through matter, the human organism, that our religion has its sanction. And this matter appeared in form after death and left the earth in material conditions. If this was law, not only as to one, but as to many, as recorded for four thousand years, why should science be proscribed for trying, if it may, to find this lost law? That is the simple question. Is it impious for science to say: If this was the fact for four thousand years, it must have been from a law. And as in all the universe, truth is a whole, why not the law for the last two thousand years? No revelation from God or from beyond the boundary of this life, has ever come to man, except through man—the physical man. Can it ever come in any other way? Religious dogma says no, science says no, and only asks to discover the way, if it can be discovered. There is a law by which life comes through matter. There is a law by which it persists with matter. There is a law by which it severs its relations to matter. Is it then assuming too much to say, that if it ever did come back through matter, as faith holds, there must be a law for that? And if known for two-thirds of the recorded history of humanity, is it not possible still to know it? Why then, in the language of so many travail-burdened seekers after ideals, should it not be let alone—to seek the law in its own way?

Now, this most profound problem of our time is very closely allied with the most fruitful department of physical research—electricity. If not life itself, there is no manifestation of life except through it. It is where there is no life, as we know it, in substances we call dead. It then cannot be life, or life is something more than we recognize it to be. If, then, it is where life is not, but always with life, it must be the medium through which and by which life manifests itself.

And this presupposes that life must be something else—or something not elementarily associated with matter. It then uses matter for purposes of expression. I use the term matter in its natural, not its metaphysical acceptation. And in what has been said there is no difference between science and the advocate we refer to. But it goes far beyond that position in its scope and character—it makes it like any other truth, a unit, a whole—which can be comprehended as of degree, in its manifestations or phenomena. In this aspect there is no necessary difference between the scientist and the man of faith. As the dogma holds, it is above matter, beyond it, behind it—immortal. And as the man of science asserts from the investigation of its phenomena, it is obedient in its manifestations to the form through which it is expressed—or its environment.

Is there anything here to frighten either? On the contrary, is it not a result to enlarge the conceptions of the one and to illuminate the knowledge of the other? And how much more consistent with all the knowledge we have as to all other things in the universe, each of which is a perfect thing in itself—and in harmony with all things else. It rises to our conception of the infinite instead of dividing life into myriads of specialties while its material forms are all upon one general plan. It is this great law which, from the study of comparative anatomy, has caused men to stumble over the dogmas manufactured from revelation, because the one was totally irreconcilable with the other. But here is common ground for all.

The next step is the inquiry, how are we to know this life? Theology tells us that the books are closed, and we must find it from what we have. But the books were closed before Galileo, or Kepler, or Newton were born, and the thunder was the voice of God before Franklin drew its secret from the cloud. And there are still places where this voice is silent and has ever been. The chosen people of heaven never heard this voice of their Jehovah until camped before Sinai where Egyptian aridity was replaced by the warm and vapor-laden currents from the Indian Ocean. The book is open, has been open since the morning stars sang together—open to us if we will read it. And the fundamental truth of all religions—the immortal impulse of humanity—will yet be made plain by the questionings of science. For the lights of reason, philosophy, and religion, all teach us, from every summit of human progress down through the ages—that there is nothing necessary for the well being and development of man and his happiness on the earth, that is hidden beyond his ability to know if he but asks aright. To reach this knowledge of his immortality—to know it—is the highest unfoldment, the consummation of humanity—from which immortality is but stepping over the border between the world of matter and the world of life itself.

In view of the proposed meeting of the British Association for the Advancement of Science, in Montreal, in 1884, a committee consisting of Messrs. H. Carvill Lewis, Edward D. Cope, Persifor Frazer, Angelo Herlprin, and Henry C. McCook, has been appointed by the Academy of Natural Sciences, of Philadelphia, to secure the co-operation of other societies and institutions of the city, in extending an invitation to the American Association for the Advancement of Science to meet in Philadelphia the same year, directly after the Montreal meeting, so as to increase the facilities for communication with the British Association. Similar action has been taken by the American Philosophical Society and the Franklin Institute; and the University of Pennsylvania has offered the use of its halls for meetings.

ENGINEERING.

HYDRAULIC ELEVATORS AND MOTORS.

B. F. JONES, KANSAS CITY, MO.

(*Read before the American Water Works Association, at Buffalo, May 16, 1883.*)

What I have to say in relation to elevators and motors will be mostly in regard to questions that their uses necessarily bring up for settlement at the Water Works office; also to show how I have been able in a measure to overcome some of the many difficulties that have presented themselves, as well as to discuss and seek information as to the best way of meeting others that still have to be dealt with. At the outset, therefore, let me state that I am not an hydraulic engineer, nor have I sufficient mechanical knowledge to undertake the discussion of the construction, or relative merits of either elevators or motors. This I would respectfully suggest as a very proper and interesting topic for a paper at some future meeting by some one of the many eminent engineers of this Association.

The Water Works of Kansas City are comparatively young, and my experience only dates back six or seven years, or since shortly after their completion. At this time it was deemed advisable on account of the probable large revenue to be derived from their use, to encourage the putting in of hydraulic elevators by low water rates. With this end in view a number of contracts were made for their supply at low, special rates for a period of years, and our minimum meter rate was charged in all other cases, regardless of the quantity of water consumed. In most instances these special rates have since been found much too low, parties paying in this way being exceedingly extravagant in the use of elevators. However, the object sought was obtained, and now they are very extensively used. In fact so much has their use increased, that the question is no longer how to encourage their more general adoption, but how to properly govern those that must be supplied. At present our works furnish power to about fifteen passenger and eighty freight elevators, and the number is rapidly increasing.

Before going into details, it seems proper to give, at least a brief description of our water-works, as my observations are to a great extent local.

On account of the peculiar topography of Kansas City, two systems of water supply have been provided, the high ground being supplied by direct pumping, and a pressure of about ninety pounds maintained in the business portion, and the lower part of the city being supplied by gravity, from a reservoir at an elevation of 210 feet, thus giving the business portions of the city, on high and low ground, about the same pressure. By an arrangement of valves, a combination of these two systems is effected, so that the Holly machinery can furnish an increased fire pressure at a moment's notice, into either or both pipe systems. Thus at some points the pressure is extremely high during the progress of fires, causing difficulties that do not exist where the gravity system is used exclusively.

Elevators have become an established institution and in cities of any commercial importance, are regarded as a necessity; hotels, jobbing houses, factories, and office-buildings being considered as far behind the times when not thus provided, as a city without a water-supply or a community without a "boom." The use of elevators has made it practicable and profitable to erect buildings twice as high as were formerly thought of. Perhaps some of the most notable examples of this are in New York City, where such structures as the Mills Block, the buildings of the "Tribune," "Evening Post" and Western Union Telegraph Company, tower high above the surrounding blocks, monuments of architecture that, without this modern invention, would reflect little credit upon their designers. If then, they have become such a firmly established institution, their bearing upon the water-supply of cities is a subject to be carefully considered.

As before intimated, there are many questions involved in the use of hydraulic elevators, that particularly concern towns supplied by direct pumping, and perhaps other places where the supply by gravity is somewhat limited. In a few larger cities supplied by ample reservoirs and mains, some of the difficulties suggested are not serious. Very little power is necessary to perform the actual work of lifting, with either steam or hydraulic elevators, but on account of the peculiar application of the power and the great amount of friction to be overcome, a very considerable power has to be provided. It has been estimated, by good authorities, that not more than one-quarter of the power expended in most cases, is really utilized.

With all hydraulic elevators of which I have cognizance, as much water is required to raise the empty cars as though they were loaded to maximum capacity. Still, to be available for passenger purposes, elevators must have capacity of upward of 2500 pounds, particularly in hotels where the cars are often arranged with separate compartments underneath for baggage. In general use it is exceptional that passenger elevators are fully loaded, on the contrary less than half a load is ordinarily carried, and for this reason it would appear that no actual benefit is derived from at least one-half of the water consumed. In this connection it has occurred to me that passenger elevators could be built at no great additional cost, with two cylinders, small and large, the two piston rods of which could be connected so as to both operate the same cable, either or both furnishing power. The smaller cylinder to be used for light loads, the larger for heavy work, and the two together for full capacity. This independent valve arrangement to be controlled by a separate cable running through the car. Whether this plan is practicable or not must be left to elevator manufacturers, but it seems to me that with the Hale-Otis Elevator, for instance, (which is conceded to be one of the best) it could easily be accomplished. Certainly some such arrangement would effect a great saving of water, and perhaps bring water bills to a point that this class of consumers could afford to pay.

Hydraulic elevators where the water is used over and over again, by being pumped from the discharge to elevated tanks, cut little or no figure in connection with a city's water-supply. When fuel, first cost, attendance of an engineer, and the poor economy of the class of pumps usually employed to perform this work are considered, the cost of operating such elevators is greatly in excess of what it would be if power were supplied direct from water mains, at any reasonable rate. The following remark will then relate almost exclusively to that class of hydraulic elevators supplied with power directly from the water mains.

Let us now consider whether they are a desirable source of revenue, and in this my knowledge does not exceed my actual experience. Few elevator users appreciate the great quantity of water their elevators consume; even in Kansas City, where, on account of the high pressure carried, much smaller cylinders than ordinary are required, it is found that passenger elevators frequently consume 500,000 to 800,000 gallons of water per month, which will make a very considerable bill, at the most liberal rates. I have therefore concluded that the quantity of water was so large that, unless liberal concessions were made, it would be a hardship to consumers to pay their water-bills, and have therefore made a special schedule according to quantity, for elevators and motors; these rates starting below our regular meter rates, and running to the lowest point at which we think we can afford to furnish the water. This schedule brings the rate below what we would receive for almost any other legitimate use of water, and in view of our rapidly increasing consumption, and the probability of soon having to increase all our facilities, it is an open question whether this will continue a desirable source of revenue.

In Kansas City we have elevators of various manufacture: the Hale Otis, Ready, Smith & Beggs, O'Keefe, Kennedy, and perhaps others, each having their peculiarities, but alike demanding large openings in the mains for supply. These large openings are objectionable features with any water-works, and especially so with direct pumping. An occurrence from this cause, about two years ago, is an experience I should not like repeated, but is one that might occur whenever the pressure in the mains is depended upon to throw fire streams. In this instance a large block of buildings occupied by jobbing houses, and having three elevators, was burned down, and the elevator connections broken early in the fire, allowing the water to pour into the cellars in the volume of about twelve ordinary fire streams. This immense quantity of water had to be supplied from a six-inch main, fed only from one end, which left little pressure available for fighting the fire, and as a matter of course failure to subdue the fire promptly was attributed to the water-works. We have since had up hill work to restore confidence as to our ability to throw fire-streams, although we have demonstrated the fact hundreds of times since. From this time we have been gradually cutting down on the size of openings for elevator supply, but under protest of the elevator agents, who have always claimed they should be allowed at least a four-inch opening in the mains, until we have found that under eighty to ninety pounds pressure, two to four one-inch taps will answer the purpose, provided the water-pipes are of ample size. The "water-hammer" produced by the quick-acting valves of elevators has always been objectionable, both in its effect at the pumping-house, and upon water-mains and connections. To obviate this, Engineer G. W. Pearson has suggested the use of very large air-chambers on the elevator supply, and still smaller openings in the mains; his theory being that the air-chambers would not only materially decrease the concussion or "water-hammer" but that they would also act as accumulators of power (or water under pressure) to be drawn from, at each trip of the elevator and replaced when it was at rest. This plan I have never seen put to actual test, but believe it to be entirely practicable, and that we will have to ultimately adopt. All things considered, the plan of operating elevators from tanks in the top of buildings, supplied by a small pipe connected with the water-mains, and arranged with a float-valve to keep the tank filled, I believe to be the best manner of supply, except for the great additional cost of putting up such apparatus. By this arrangement the amount of water consumed is no less, in fact, it would ordinarily be more than with a direct connection with the mains, but it has the advantage of taking the water in the least objectionable manner. Still, if this mode of supply were generally enforced, the large first cost, and additional expense of operating, would undoubtedly deter many from using elevators.

Another evil in connection with the use of elevators, and which, no doubt, is common, is the habit many parties have, of keeping a key or wrench to turn on and off the water at the curb. This we have sought to remedy by embracing in our Plumber's Rules the following: "All elevator connections in addition to the curb-stop for the use of the Water Company must be provided with another valve where the pipe first enters the building for the use of occupants of the building." Without this extra valve it was found almost impossible to keep parties from using the curb-valve. In most cases the persons were responsible, and as there was no intent to defraud the Company by the act, they would claim this privilege as a precaution against the pipes bursting or freezing. This practice was very generally carried on, and was the direct cause in at least two cases of very serious damage. In the instances referred to, the pipes burst between the elevator and the area wall of buildings, and the valves outside had become so worn from frequent use, that they would not operate, allowing the water to literally deluge the basements before the water-main could be turned off.

One of the greatest causes of waste from elevators is the wearing out of the piston-packing, this being particularly troublesome in most of the western cities, where the water supplied is to a large extent from turbid streams, carrying more or less fine sand or "grit," which cuts out the packing of the pistons very rapidly. The only practicable remedy for this is close inspection, to see that the pistons do not allow water to pass, a fact that can be readily determined from the noise made in the cylinder when the elevator is in motion going upward.

I have reserved one of the most annoying features of elevator supply for the last, hoping to work myself into a mood to do the subject justice, but doubt if it can be done in language proper to use before this dignified body. I remember on one occasion the mayor of our city, in discussing a job of plumbing, said that it seemed to him "that even a plumber ought to know something about plumbing." Now it would seem that even elevator agents ought to know something about elevators, but from the following incident, which is but one of many, I am led to believe that they are not infallible, to say the least. Only a short time since one of these very reliable(?) agents reported at our office that he had just attached a new indicator to the elevator of a leading hotel. He was asked: "What does it register?" and promptly replied, "Cubic feet." In this case our inspector had already made an examination, and had correctly reported as follows: "Hale elevator; indicator started at zero February 28th; internal cylinder twelve inches: Travel of piston for complete trip, thirty and a quarter feet; indicator registers for complete trip, 4.

When it is understood that we had for a long time been assuming that elevator agents knew about all there was to know on the subject, a comparison of the statements of this agent and our inspector is somewhat startling. Now let us see what the difference amounted to: At the end of the month the indicator had registered 12,994; calling it cubic feet, this register would equal 97,195 gallons. According to our inspector, this same register would equal 578,233 gallons, or a difference of nearly half a million of gallons for a single month. Our experience with the agents in Kansas City has shown that they will, if allowed, put any kind of an indicator on the most convenient point of any sort of an elevator, without the slightest regard as to what it was intended to indicate; then report it as registering cubic or lineal feet, whichever they find the indicator marked. On the same principle they could as well change the fulcrum of a Fairbank's scale, and then claim it weighed pounds correctly, because pounds were marked upon the bar. We have lately prepared a blank, upon which these agents are required to make a detailed report upon the completion of an elevator before the water will be turned on, which it is hoped will to some extent correct this trouble.

I have come to regard an elevator indicator with a feeling of wonder. Some years ago, when the "planchette" first came out, I remember that it acquired quite a reputation as a particularly erratic piece of mechanism, but for real mystery and innate cussedness, on general principles, commend me to the indicator. Why, I have known an indicator, after registering a nice water bill, deliberately and without provocation commence taking it all off again, by going backward. This crab-like maneuver the agent readily explained by saying the "ratchet had turned over," but even he was unable to show us how to make the bills after these peculiar gyrations. I also find that it is quite a favorite amusement for indicators to stop entirely, like a balky horse, after which no amount of persuasion will bring them to a realizing sense of their duty. Even at the best, these indicators are very apt to get out of order, necessitating greater watchfulness in supplying elevators than for any other purpose for which water is furnished.

Accidents in connection with the use of elevators are common throughout the country, and in Kansas City had, until within a short time, become of altogether too frequent occurrence. The great cause of this, I believe to be due to the fact that the parties who usually operate elevators are the very ones who know the least about them; the corrosion of pistons, crystallization and oxidation of cables, and many other disorders common to elevators, being matters they do not comprehend. The frequency and fatality of these accidents in Kansas City finally led the city authorities to appoint an elevator inspector, who is under heavy bond, and whose duty it is to examine every elevator at least once a month, and to grant license to run only to such as he deems in safe condition. Thus far since the establishment of this office, we have had no serious accidents, which leads me to the belief that in most cases a monthly examination will discover in time the causes of many terrible casualties; also that it is not safe to operate elevators unless so inspected by some competent person.

The hatchways of elevators in large buildings are points greatly feared by firemen. They well know that when a fire once reaches this shaft, it takes but a moment for it to be carried from floor to floor, until the building is soon past saving. Although this great danger is well known, it is the exception rather than the rule to provide elevators with fire-proof hatches. A properly constructed elevator should, it seems to me, be provided with hatches, or better still, built within brick fire-proof walls, with openings to be kept closed when not in use. In this way costly buildings, valuable merchandise, and many lives would be saved from fire every year.

Although considerable has been said on the subject of elevators, I am aware that the ground has not been covered, and that difficulties have been pointed out, rather than remedies suggested. There is much yet to be brought out by the engineers, to whom the subject more properly belongs.

In the meantime, although elevators claim many of the objectionable features in the business of water supply, most of them are not of a nature that should condemn their use; on the contrary I hope that with the joining of our experience there will be an improvement in the methods of their supply. Inasmuch as they must be furnished with water, all that can be done is to adopt such rules, and fix such rates as will compensate in some degree for their objectionable qualities.

Water Motors.—My remarks on this subject I trust will be more to the point than they have been upon the questions already discussed. Certainly my ideas are more decided so far at least as supplying water motors is concerned.

In many respects I believe water motors furnish as nearly perfect power as it is possible to attain. A motor, for instance, properly connected and supplied by the even pressure from a reservoir is probably the most reliable and steady power known, not excepting the most improved and costly steam engines. The convenience and little attendance necessary in operating, make them especially desirable for many purposes. Where only small power is required, or even where considerable power for only occasional use is desired, they are particularly well adapted and can be driven at small expense. Even for greater power they possess advantages over steam engines which, to a considerable extent, compensate for the large water rates that ought to be paid for their supply. These advantages are, in the first cost of a motor, as compared with a steam engine, the saving in attendance and fuel, the convenience and cleanliness, and in some cases a saving in insurance by reason of there being no fire risks attendant upon its use. At just what point steam becomes preferable, however, is a question depending considerably upon water-rates, but to some extent on other circumstances, leaving it largely a question of judgment. As with elevators, there are difficulties involved in their supply that unless carefully guarded make water motors anything but a desirable source of revenue. How often is the argument advanced: "Why, I only use water for a quarter of an inch jet," showing how little people who use motors or elevators or fountains realize the quantity of water they consume. This class of consumers may be placed on one footing, to-wit: a class who, in spite of the fact that they are supplied with water for much less than any other, feel that they are imposed upon, and cannot be made to think otherwise.

Though not as large as for elevator supply, water motors require liberal openings in the mains, and frequently the fault of having too small supply pipes, is sought to be remedied by openings in the water mains much larger than needful. A table prepared by an engineer who had given the matter study, or by some motor manufacturer, showing the size of taps, or openings, for the proper supply of motors, with the various jets, under different pressures, would be of general use to water-works people. In order to use water to the best advantage, the full pressure in the main, so far as practicable, should be had at the jet, but in order to accomplish this it is not necessary to use as large taps as are ordinarily demanded, but to provide supply pipes of sufficient capacity to deliver the water to the point of discharge with the least possible friction. Lately this theory has been put in practice to some extent by us, and the result has shown that in this manner we are able to supply motors through smaller taps than before, and with as satisfactory results.

It is a general practice throughout the country to make annual or monthly rates for water motors, and from my observations I believe I can safely venture the assertion that in three-quarters of the cases the rates charged will not equal fifty per cent of the lowest meter rates in force in these places.

I have made some estimates myself for water motors, basing rates upon the number of hours it was claimed the motors would be in use, and afterward supplied the same motors by meter measurement, and in every case found that at least twice as much water was used as had been estimated. Although estimates were carefully made upon what was believed to be a reliable basis, these repeated similar results have lead me to the conclusion, that the only way to supply motors is to make it an object to the users of them to be economical. In other words, I believe the way to supply water motors is upon an estimate that they will run twenty-four hours per day and 365 days per year, or more properly still, supply them only by meter measurement. At all events this is henceforth my policy, or in other words, "On this rock I stand," believing it the only equitable way out of this difficulty.

That class of motors, or water-engines, operated by water-pressure in close cylinders upon pistons, as with steam in a steam-engine, I believe could be easily supplied by measurement of water without a meter. This could be accomplished by the use of "revolution counters" or indicators, as the amount of water required per revolution could be readily determined, and when once computed the cylinders would measure out the water as accurately as a meter. The only objection to this plan is the expense of counters, which is considerable; and as to indicators, it may have been observed that I have little faith in their reliability. With cheap revolution this class of motors would be free from many of the objections raised in regard to motors generally.

The practical conclusion that I would draw from a consideration of this subject, is that the question of whether the supply of hydraulic elevators and motors is desirable in its effect upon the water supply, is one that hinges so delicately upon their being carefully governed, connected and restricted, that while on the one hand they may be made the source of large profit, and at the same time a public benefit, on the other hand, unless all the details of their supply be carefully guarded by the wisest rules and greatest watchfulness, their capacities for waste are so great and the rates charged necessarily so low, that they may become the greatest source of loss with which we have to contend. I therefore trust that this discussion will be continued until an interest is felt that will result in our all receiving much useful information upon two most important factors of our business.

As this paper has been long for the information contained, I will close with the earnest wish that it may at least be of service in bringing these important, but often neclected subjects, to the attention of this thinking and intelligent body of men, of whom many have had much longer and more general experience in relation to these matters, and whose views when expressed will consequently be of more interest and have greater weight. Thus as a result may we all derive the benefit of whatever useful information there is to be gained by this annual interchange of experiences, in the all-important business of public water supply.

VILLAGE IMPROVEMENT.

ALBERT E. WELLS.

The marked difference between the European and American village is worthy of a passing notice before we go to our immediate purpose. There the gathering in the neighborhood of some baronial castle gave form to the village, while in its younger day, to what afterward became the city. The protector was in many instances the one from whom the citizens most needed protection; but it was easier to satisfy the rapacity of one than many. So they were grouped together, who were dependent on the feudal baron, and held their rights of land and home from him. And convenience of protection was the important consideration in selecting the location. The same motive led to limiting the area of the village; so that the quiet, sequestered home, which in this land is a usual sight, until recent times was unknown to Europe. The village in the olden time meant, I believe, the habitation of the baron's villains, the villains did not mean the rascals but the toilers of the land, who were not to be parted from it.

Neither the motives forming the old village, nor its customs have any perceptible connection with the modern idea of it. They are alluded to only that we may the better understand the older writers who have handled this subject, for it has been a theme of great writers. Virgil, in the pastorals, had occasion to speak of "the restful, untroubled village life." Tiberius in the island of Capri, took greater delight in the affairs of its village life, than in those of the Empire. Lord Bacon regarded it as a thing to be provided for, and made an element of his garden and so governed it as to be an object of beauty in the landscape. From Washington Irving's description of Spanish village life, one would judge that the placing of the village and pretty much all its construction had been the care of some one, thinking more of his own convenience and economy, than of theirs who should live in said villages.

The interval between these writers in the matter of time gave rise to a great many changes; yet the present is but a child of the past, and as such shows its parent's features. It is admitted that in matters of the outward life we are vastly gainers upon the past, but we have lost the charm of effective grouping, and an isolation, which is oppressive, especially to the younger people, has taken the place of such village festivities as are described in the "Deserted Village" and the "Vicar of Wakefield." We gain a greater sturdiness of character, and a greater self reliance by having no neighbors on whom to call for help or amusement. The steady stream of migration from the farms and the country to the cities indicates the desire for a greater attractiveness in the village homes.

The village of the present day and in our land is a great gain upon the past. Of it we now speak. Those of the smaller sort are in main peaceful and thrifty, the homes of a worthy and industrious class, mostly tillers of the soil, or those engaged in works that are dependent on the farmer. The predatory baron has disappeared, and the villagers are not necessarily villains in any sense of that hard word.

A closer grouping might give rise to greater convenience and many added beauties. The little patches of marigolds and roses mingled with grape-vines, pinks, cabbages, and beets that do duty as garden are capable of improvement by a wider separation. If the good housewife's array of flowers had a limited area and that joined by another of about the same size, and so on a row of them, say fifty feet in width by seven hundred in length and then around a square fairly planted with various kinds of trees, the poor posies would not look so lonely, but form part of a scene of beauty, especially if a well-kept green sward bordered the beds and the walks. While a similar array of vegetables in the areas behind the houses would form a scene assuring to the hungry, and provident against the season when no outdoor growth is possible. The new wire fences are a sufficient barrier, if one is needed; upon the front it is better to have an invisible line, whose whereabouts can be determined from a hitching-post beyond the walk and centre-post in the lattice which divides the front yard from the regions that lie beyond. No fence is in any sense an ornament. It may be utilized to hide things more objectionable than itself. The stores and shops should conform measureably at least to such rules of comeliness as not to mar the effect of neatness, which well kept front areas would leave upon the eye. The blacksmith may insist on having a front view from his forge that does not include all the crippled agricultural implements of the neighborhood and a walk that is not the receptacle of old iron. The store would lose none of its attractions if a fountain played in front, and its drainage gave a drinking place to thirsty horses on the outer edge of the walk, instead of the present array of broken boxes and old barrels.

These are easy lines that lie open for the improvement of our present village. The planning of a village, laying it out and building it out of hand has come to be one of the duties of the modern architect. The suburbs of our great cities afford illustrations of their success. An account of one in London some time ago appeared in one of the monthlies, and reference is hereby made to the beautifully illustrated articles in the monthlies for ideas and thoughts on the subject of beautiful gardening applicable to all sorts of life that are represented in our ordinary villages and towns.

Now, what applies to the village, applies to the town in a larger way and requires that greater care should be exercised; for then questions of convenience, health, taste, and wider utility come into consideration. So that towns of from 3000 to 5000 inhabitants would be gainers by having a new laying out of the town plat under the direction of some one competent to the task, in order to make suitable provision for a supply of wholesome water, and proper drainage, and if, as in many places they are now doing, we include the lighting and heating of residences, we would, I believe, have all the things provided for that the town builders expect to do. The Goldmaker's Village, of Chamber's Miscellany, is a great ways behind the the time, and out of place as well, I think, in having all the household work done in common over the same cooking stove and possibly in the same wash-tub. The communistic ideas of Fourier are in a just discredit, while a timely thrift and comeliness may be greatly advanced in these lesser details, by a steady coöperation. And they may chance to have a commercial value, that will make them worthy of the attention of those who scoff at everything above the servilely useful, as unworthy of their regard. As witness the advance in real estate in Stockbridge Mass, brought about largely through the added charms of that village, wrought out by the Laurel Hill Association.

If beautiful adornings had no reflex influence, this whole subject might well be relegated to the limbo of the useless and the worthless; but the better surroundings both indicate and bring about a better inner life; like the author's book that was made more orderly and greatly improved by a revision that was made upon a table of contents gotten up by the author's friend. We all know that neither a table of contents nor a bill of fare will satisfy either thought or appetite; but they give promise of satisfaction. So a well arranged village or town or home of well ordered life and thought within, will render such things easier to all within. If our minds are at ease on the wood and water questions they are by that much the better prepared to take up the music and painting, and Ruskin says, "the more piano we have the less savage we have."

The Olney hymns and other beautiful thoughts of the author could not have found utterance but for the shelter of Mrs. Osborne's beautiful home, whose quiet ordering saved from utter wreck the gifted William Cowper. Sunnyside and the beauties of the Hudson shine upon the pages of Washington Irving. The best conditions for work will ordinarily produce the best work and the most of it. The saved and added mental strength, that lies in these things, is no inconsiderable store.

The mental and moral worth that is shown by and through them is a thing more noticed. It is hardly needful that I should speak of the refinement that shines through the window made beautiful with flowers. The hearts that make room and time for cherishing these speechless beauties cannot be rude, coarse, hard, or unfeeling. The hand that make beautiful the yard is apt to indicate a heart that looks beyond the doorsill of a personal selfishness, and the grouping of such homes would point out the region where a friendly hearted man would love to have his home; where he might expect that neighborly sympathies would expand to his own heart's gain, and community of interests and pursuits lead to improvements in all the common interests of life.

MEDICINE AND HYGIENE.

UNCOMMON DISEASES IN PERU AND BOLIVIA.[1]

EDWIN R. HEATH, M. D.

"VARRUGA DE SANGRE," *Verruca Hæmorragica*, (BLOODY WART).—Prescott in his "Conquest of Peru" mentions a peculiar disease which attacked the Spaniards during their wanderings among the mountains, to which they gave the name "Varrugas," their name for wart, owing to the excresences of the eruption resembling warts.

1 In submitting to your readers the accompanying article I have avoided as much as possible technical names and theories. As a traveler, the facts which might be useful to know are sought after and simply recorded.

Published in a medical journal, this article would need to have been more explicit, and then it would only have reached a certain class of readers.

Only striking specialties have been noticed, yet much might be written on the diseases of those countries which might be useful as determining the geographical distribution of disease. For instance, in the mountains of Bolivia, especially on the eastern slopes, cataracts and opaque corneas are very common, not differing from other places except in their abundance. This subject alone, presented in all its merits, would be valuable to scientists, but this not being a treat ment of the geographical distribution, it and many other similar facts are not touched on.

In 1871–2, when the Callao, Lima & Oroya (now Trans-Andine) R. R. was in course of construction and had its terminus at the present station of San Bartoleme, thirty-nine miles from Lima, with its camps extending some ten miles beyond, the workmen were attacked by severe and distressing pains throughout their entire bodies. At first, the attending physician supposed them to be rheumatic, but their ceasing as soon as the eruption appeared, proved them to be the promonitory symptoms of "varrugas". The eruption consisted of a fungus, spongy outgrowth from which blood oozed upon the least touch and often spontaneously. Their size varied from the size of a pea to two and a half inches long by one in diameter. The roots perforated the derma when external and the muscular coats when on the mucous membranes. The eye-balls, nasal, buccal and vaginal cavities not escaping, and post mortem examinations revealed the mucous and serous coats affected with smaller but similar warts.

There were three varieties, the large, distinct, spongy wart; the confluent undeveloped eruption, resembling variola, with rounded instead of depressed center; and that fine eruption as if millet seed were between the derma and epidermis. The two last were occasional after-effects of the first. A patient having the first, upon recovery, might have the second and, barely better of that, break out with the third, or intervals of from six to twelve months might elapse during which time perfect health was enjoyed. Again one could have either without the other, although none were ever known to have them in the reverse order, and once having they seemed to be protected from a repetition except in the passage from the first to the third as above mentioned. If the eruption did not appear, if they appeared internally, or the first variety was very abundant, fatal hæmorrhages or paralysis occurred. Except for the pains and annoyance from the loss of blood one could attend to his daily duties.

A ravine, some six miles beyond San Bartoleme, bears the name Varrugas. The general disinclination of the native Indian to bathing in cold, mountain streams, and their statement that the varrugas resulted from baths in the stream of that name gave that as its origin, which for a time was believed.

The unprecedented magnitude of the work attracted many visitors, most of whom came with fear of the varrugas, and great care was observed not to touch water, either as a beverage or article for cleanliness. Passengers, arriving at 11 A. M. and leaving at 1 P. M. abstaining from food and drink and shunning water as one attacked by hydrophobia, did not insure them against the disease, many breaking out within two months of their visit to the varrugas region, and often these were the worst cases. Others worked there for years, drinking and bathing, with impunity, in all kinds of water.

A few, after they had returned to the United States or Europe, at the end of one and two years were attacked, so that the period of incubation could be said to vary from six weeks to three years.

Three hundred miles north of Lima on the Pacasmayo, Guadalupe & Magdelina R. R., at the station of Chilete the same disease broke out but less violently.

Varrugas ravine, on the Trans-Andine R. R., is sixty three miles from the coast at an elevation of 5,340 feet; Chilete, on the Pacasmayo R. R., is sixty-five miles from the coast at an elevation of 3,700 feet. The breaking up of the earth and rocks, during the construction of the railroads, apparently filled the air with floating germs or mineral poison which entered the system through the lungs and was then carried to the capillaries where it took root and was nourished by the blood or caused an unusual growth to wash out the poison. As yet the point is unsettled, although all discard the water theory. After the roads were finished and the ground settled the disease disappeared.

At the time the varrugas disease was at its height, a fever resembling sporadic yellow-fever broke out on the Trans-Andine R. R. and by many was considered as one with the varrugas. Dr. Logan, ex-Minister to Chili, while in Chicago, wrote a work on the diseases of the west coast and had classed them as Varrugas or Oroya Fever. Happening to call on him at this time, the author being in the transition stage between the first and second varieties and having no fever nor having had any, proved that the diseases were two and distinct.

"MAL DE SIETE DIAS" (SEVEN DAYS SICKNESS).—On the coast of Peru as far south as the 12th parallel of Lat. anger will so change the milk of a mother that it will cause the death of a child within seven days. Should a mother wish to free herself from the labor of raising her child she lets herself get angry, puts the child to her breast and the end is sure. It is an every day occurrence for a mother to send her child to a neighbor requesting that it be nursed, saying she had been angered by her servants, or children, or some one. In an hour or two the effect passes off and the milk becomes good even though left in the breast and a deadly poison but a short time previous.

"AIRE" (AIR).—By this is understood a change of air that acts perniciously upon the human system, either in perfect health or debilitated by sickness. In the hospital of the Pacasmayo R. R., where from 100 to 180 sick and wounded were cared for, all would be doing well, wounds granulating and painless, convalescents happy in the thought that but a day or two more and they could go to their work. Suddenly, with no change of barometer, or thermometer, or electric tests, the wounds would turn black, gangrenous and painful, and the wards, so silent five minutes before, would be filled with groans, vomitings, and fevers. This would last for three days and then go as it came. At these times one would have the muscles of one side of the face contracted or the head drawn on one side or the body bent back or to one side. The least exposure in a draft at any time would be liable to cause these same effects, but at these times more readily. Often cooks and nurses were made ill, so that no one was free. Six years of careful observation failed to detect the cause. Chemical tests were made, the microscope used faithfully, thermometers, barometers, and magnetic machines watched. The Ocean's temperature and currents, as also the air's temperature, currents, force, direction, and weight noted four times a day, and we are free to confess, we acknowledge the fact, but why we never could detect.

In Peru the climate being such that many sleep out doors, gives opportunity for an occurrence like the following which causes several deaths among children each year. There exists a snake of the boa-constrictor species which lives upon vermin and is protected by the owners of estates for their utility. They, however, are very fond of milk and at night quickly find where the nursing mothers sleep. Noiselessly approaching they coil themselves beside the mother and while they rob the child of its nourishment they keep it quiet by inserting the point of their tail in its mouth, and thus the child wastes away from insufficient nourishment. The author of this was inclined to scoff at the story, but assured of its truth by such men as Dr. A. Arrigoni and Prof. Raimondi we had to accept it and give it believing it to be true.

RING-WORMS, *Herpes Circinatus.*—On the River Madeira, in Brazil, nearly all the workmen on the Madeira & Mamore R. R., were attacked with ring-worms; some lightly, others over the entire body.

GOITRE, "PAPERAS," (GOTTO).—Arriving at the towns on the plains of north-eastern Bolivia we were surprised to find so many cases of Goitre. At least ten per cent of each village had either single or double goitre, the females exceeding the males in proportion of six to one. Both children and grown people—Indian, Negro, or white, all were affected. In a town near Santa Cruz de la Sierra, $\frac{99}{100}$ have it, and some assert that it even attacks animals. As these people live on low lands, far from mountains and snow, many never using water that did not come from wells fed by the rains, it must be acknowledged that the theory of the "snow-water cause" must be discarded. Besides, those who live at the base of the mountains and who might be considered as using water that had once been ice and snow, are entirely free or probably in proportion of one in twenty thousand. These facts, so at variance with the acknowledged belief that in other places holds good, makes it a subject of interest worth more than a hasty thought. The region drained by the Yacuma River lies between two water-sheds which run nearly parallel at that point separated by 200 miles. This region is a low prairie grazing land, and all the water that feeds the river comes from the winter rains, and the most ardent supporter of the snow theory must grant that his theory is at fault. At no time in the life of the female can one say it abounds more than at another, as in some parts. Could the winds bring it from the mountains? The winds come from an opposite direction.

"ESPUNDIA," (MALIGNANT INDOLENT ULCER).—In the Department of Caupolican, in Bolivia, there are some cities of consideration, among which is that of Apolobamba. The pasture lands about that city are insufficient to supply all the cattle needed for beef, hence they are very dear. On the plains of the Department of Beni cattle are abundant and cheap. As a natural consequence there exists a traffic in cattle between those two Departments. The droves pass the River Beni at Rurenabaque in S. Lat. 14° 26′ 21″, thence along the base of the mountains northwest to Tumupasa, then turning west, cross the intervening ridge, descending to the river Tuichi at San Jose, cross it then by dangerous and difficult mountain paths to "Apolo." This latter part must be passed on foot, as no horse or mule can travel there loaded. It is during this passage on foot that the traveler is exposed to the Espundia. At first it appears as a small pimple, generally upon the lower extremities, between the knee and foot. This pimple grows rapidly and is painless. Soon the top decays and drops out leaving a cavity with raw, red, irregular, ragged edges. When the ulcer, if on the lower extremities, has spread to two inches in diameter its further growth is very slow. Many times it breaks out in the nose and then the ulcers on the other parts heal. From the nose it spreads all over the antra, sinuses, mouth, throat, and in places on the face, eyes and ears. The ichorous discharge from the nose and throat is fetid; that from the external ulcers less so. Actual cautery with a red-hot iron will kill it in the start but excision only hastens the formation of an ulcer.

Many fatal cases occur, but the majority heal in five or six years.

Opinions differ as to the cause. Some assure you it is a sting of an insect, some of a nettle, while others claim it to be a mineral poison which passes into the circulation through some abrasion.

The actual cautery by arsenic followed by internal minute doses will cure seventy-five per cent.

GRUBS OF THE OESTRUS FLY.—One of the unpleasant annoyances of a life in the forests about the Amazon and its tributaries is the deposit in the body of eggs by the Oestrus Fly. These eggs soon hatch out worms which grow to one-quarter of an inch in diameter and three-quarters to one inch in length. We have seen birds with their bodies full of these worms. Their usual place of deposit on the human being is the nape of the neck. But this is trifling beside the itching produced by the bites of a minute insect, the "Acarus Scarlata." Wherever there is grass or pasture lands in these low, damp countries this insect is found, but more abundant in the dry season. As soon as it is filled with blood it can be seen as a red speck at the root of the hairs of the body in the folds of the navel and nipples. During the month of its greater abundance none escape without scratching themselves raw, often forming distressing sores. One learns to shun the grass. The public squares and spaces about the houses are carefully kept free from it. Nor are the forests free from pests. One of the duties of a hunter in the Amazon forests is occasionally to strip off all clothing and pick off the small woodticks before they burrow under the skin. Once they make an entrance they must not be pulled off, as it will sever the body from the head, and this is a poison to be avoided. The usual way is to place a lighted cigar or ember near their bodies and the heat causes them to withdraw.

These are not diseases in themselves, but the after effects often prove very difficult to treat successfully.

CORRESPONDENCE.

LETTER FROM CHIHUAHUA.—CONTINUED.

PUEBLO, COLORADO, May 21, 1883.

EDITOR KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY:

After a very interesting and pleasant visit of thirty-six hours, at Chihuahua, we commenced the return trip. Our first halt was made at Albuquerque, New Mexico, where we found many old friends from Kansas and Missouri awaiting our arrival. Omitting all notice of the warm welcome and hospitable attentions received from all sides, we will devote a few lines to mining and industrial matters in Bernalillo County, of which Albuquerque is now the county-seat. Availing ourself, as before, of material furnished ready to hand, we extract from the Report of Commissioner Chas. S. Howe to the Board of Immigration.

"History informs us that soon after the conquest of Old Mexico, the Spaniards pushed up into this region, conquered it and worked on an extensive scale its mines and placers. Ruins of old cities and towns, with their churches, turreted and loop-holed for defense, are scattered all over the country. Many of them are in mountainous regions where the only industry possible was mining. They could not have been built for defense, because the cities are large and some of them must have contained thousands of people. Numerous ruins of smelters are also found, giving indisputable evidence that mines were once worked on a large scale. Two hundred years ago the Indians, who had been enslaved and forced to work these mines, broke out in rebellion and drove the Spaniards from the country. So intense was their hatred toward those places in which they had been forced to labor, that they filled up every old mine so that no traces could be found of them. A number of years after the Spaniards were allowed to return to the country, but only on condition that the mines should never be opened or worked. This condition seems to have been faithfully kept, and for many years mining was wholly abandoned in the Territory. During the early part of this century we hear of some of these old mines being opened and new ones being discovered, but they were never worked to any great extent. The Indians were hostile, transportation was expensive, and the methods of working ore very crude. It is only within a short period that the mines of New Mexico have begun to attract attention.

Bernalillo County contains some of the most valuable of these old Spanish mines. Several districts have already been opened and work enough done to prove their richness. The greatest variety of minerals abound within the limits of the county. Gold, silver, copper, lead, iron, coal, and lime are found in large quantities. Granite and sandstone for building purposes are found in numerous places. Immense masses of crystallized gypsum are found in the southern part of the county. The value of this mineral as a fertilizer and for use in the arts is too well known to need explanation.

On the Rio Puerco, about twenty miles from Albuquerque, several veins of coal have been opened which vary from four to eight feet in width. In Tijeras Cañon one vein is nine feet thick and very pure. Other veins are known to exist in these and other localities, but they have never been opened. There has been no demand for coal here until within a short time and consequently none has been taken out.

Hell Cañon is situated twenty miles east from Albuquerque, on the west side of the Sandia Mountains. This mining district was discovered in the summer of 1879. The ore is decomposed quartz carrying free gold, some silver and copper. The Manzanita is a lode of gold-bearing quartz from fifteen to twenty feet wide. Already a shaft fifty feet deep has been sunk, and a tunnel thirty feet in length dug. The ore runs from $12 to $20 to the ton. One of the best known mines in the camp is the Star, owned by Messrs. Strahan, Thomas and others. It was discovered in August, 1879, and from the first gave proof of great richness. It consists of a free milling quartz ore, and the vein is fully eight feet wide. Assays from this mine have shown from $128 to $164 to the ton. One of the earliest discovered lodes was the Milagros. This was the first to call the attention of miners to Hell Cañon, and it has since fully sustained its reputation. Three miles from the cañon is the Golden Chariot lode, a true fissure vein, with well defined walls. North of the cañon are several galena veins found in a granite formation. One of these, the Indiana, assayed one hundred and seventy ounces silver on the surface. It is not claimed for this district that the ore is extremely rich, but that there is an immense quantity of it, and it is easily worked and milled. Water enough to run several mills can be obtained up the cañon, and the sides of the mountains are well wooded.

Tijeras Cañon cuts its way through the center of the Sandia Mountains, and has long been the principal route from the Rio Grande eastward. It lies only twelve miles from the river and is connected with it by a fine, hard road. The ores are copper, lead and silver. Galena has also been found, some of it rich in silver. This is one of the districts which has just been discovered, but which will soon command attention.

Nacimiento is an organized mining district with a recorder's office. For years the Mexicans and Indians have brought very rich specimens of copper ore from the Jemez and Nacimiento Mountains. It was known that there was a rich body of mineral there somewhere, but no systematic effort was made to discover it until 1880. A fine property was found on the west side of the Nacimiento Mountains. The copper occurs as copper glance and gray copper in the ledges of sandstone. The white and red sandstone runs parallel with the mountain side, and for a distance of ten miles, shows traces of copper. In some places the copper occurs as fossils, mostly of trees, but in others it is in immense lodes of conglomerate. A small amount of silver is found with the copper on the surface, and seems to increase with the depth. The Nacimiento Company now own over a dozen claims, on all of which large deposits are found. On the Eureka a tunnel one hundred feet long has been dug. At a distance of fifty feet from the surface a large vein of conglomerate, twelve feet wide, averaging twenty-five per cent copper, was struck. From that point the tunnel has followed the vein along the dip. This vein can be easily traced for over five hundred feet along the surface, and the indications are that it runs along near the surface for the distance of a mile. The Copper Queen shows a smaller vein, but is much richer. It runs over fifty per cent, and parts of it as high as sixty per cent. In all of these mines there is an abundance of ore that will run forty per cent copper. During the last few months, other prospectors have gone into camp, and over a hundred claims have been staked out. Large veins of fine bituminous coal are found within a short distance of the mines, and wood and water are close at hand. The Nacimiento Company expect soon to have a smelter in operation and be ready to ship bullion by next fall.

The mountains seem to be full of rich veins which only wait the labor of the prospector and miner to be discovered and developed. For the miner and capitalist there can be no better section of country than this.

The next stop was at Trinidad, Colorado, where, as at all previously visited places, we were warmly welcomed. Aside from the generous hospitalities of the citizens, the chief points of attraction are the waterworks and the manufactories, both of which depend largely for their efficiency upon the vast coal supply of the vicinity. This is indeed astonishing, the vein at Engle being full fourteen feet in thickness and yielding thirty cars daily of most excellent quality. We were furnished with the following items by a reliable gentleman, showing the mineral wealth of the region tributary to Trinidad :

There are three workable veins or beds of coal, each from six to fifteen feet in thickness and embracing an area of 1000 square miles. An eight foot vein of sixty per cent iron ore, covering an area of 200 square miles. Bands of six to thirty inches of forty-six per cent iron ore, and aggregating twenty feet in thickness over an area of 800 square miles. Twelve feet in thickness of excellent fire-clay, and two feet of porcelain-clay of an area of 1100 square miles. Thirty feet of building sand stone, superior in weight-supporting quality, cleanliness and beauty, to the celebrated Berea stone of Ohio, over an area of 1200 square miles. Twelve feet of three different grades of fineness of grindstone grit, covering 1000 square miles. A hundred square miles of sandstone of great purity and fineness, conveniently suited for the manufacture of French-plate and other fancy varieties of glass. A two by six-foot vein of seventy-five per cent graphite, thirty miles long, besides terra cotta clays, ochres, limestone, cement rock, and gypsum of superior quality and in large quantities, besides other ores and clays of lesser value.

The coals, irons, fire and porcelain-clays, building and gritstones, consist of different strata over the same area, being of greater or smaller extent according to their position, the higher ones being diminished in extent by erosion and the lower maintaining more completely the area which nature assigned them.

The coal-veins lie horizontal and are remarkably even and regular, not more than twenty inches of irregularity as yet having been discovered, and that a simple wave. The roof of the vein is of sandstone so firm in structure that no timbering is required in the entries. Although timbering has been deemed unnecessary, but very few fatal accidents have occurred in this vicinity. The vein upon which most development has been made is the middle one, which is the largest. The others, however, have been sufficiently opened to verify the fact that they are as pure and valuable as the middle vein. A remarkable feature about this region is that while the two upper coal veins face the south the lower one faces the west.

The veins or beds, being horizontal, are opened by driving in at convenient points where the coal has been worn away in ravines: no shafting or hoisting is necessary. The mines are perfectly dry—consequently there is no damp or foul air so common in other localities.

The coal from the middle and upper beds has superior coking qualities, making coke which is chemically superior to that of Pittsburg, and equal to the Connellsville article, and practically superior to the latter, being firmer and requiring a greater weight to crush it—an important and very desirable feature when heavy ores are to be smelted. It is also unexcelled for the production of illuminating gas. The coal from the lower vein is non-coking, but is superior for domestic purposes and for use in steam-engines, a non-coking coal being more convenient for those purposes.

The mines now open and being worked are as follows:

The Colorado Coal and Iron Company, Engleville, some two and a half miles east of Trinidad. Its output averages 1000 tons per day.

The Trinidad Coal and Coking Company, Starkville, three miles south of Trinidad. Output 800 tons per day.

The Consolidated Stone and Coal Company, two miles south of Trinidad. Output about 100 tons per day.

The Detmer & Ostenburg, about three miles north of Trinidad. Output about 30 tons per day.

The Colorado Coal and Iron Company has 250 ovens in blast at El Moro, four and a half miles from Trinidad, and the Trinidad Coal and Coking Company 50 ovens at Starkville, and are unable to supply more than half the demand for Trinidad coke.

This most memorable tour was concluded by a visit, over the Denver & Rio Grande R. R., to the Royal Gorge or Grand Cañon of the Arkansas, whose grand and picturesque scenery has been described so often that we will, for the sake of brevity, omit it here.

Many incidents and points of interest along the line of this 3,300 mile trip have necessarily been overlooked in this hasty letter, but we shall try to do them justice in future descriptions.

In conclusion, it is eminently proper to say that everything possible was done for the convenience, comfort, and information of the excursionists, by the President of the Association and the officers of the Atchison, Topeka & Santa Fe R. R. and the Mexican Central R. R. and the Denver & Rio Grande, R. R., as well as by the people of the towns where we stopped, and that the whole affair brings up naught but the most pleasurable recollections. C.

THE ATCHAFALAYA.

Helena, Arkansas, June 7, 1883.

Editor Globe-Dedocrat.—Your correspondent interviewed again to-day Col. J. B. Miles, the great river prophet of Helena, upon the much-discussed question of the Atchafalaya in connection with the published remarks of R. S. Elliott, a river engineer of some reputation. Col. Miles said:

"I am glad to find that Mr. Elliott agrees with me in my theory, but he says that I turn to prophecy with sad results, and then goes on to quote Major Stickney, of the Mississippi River Commission, to show the fallacy of my prophecies. This is but another illustration as to how differently people receive the same statement of facts. Mr. Elliott considers Major Stickney's report as fatal to my prophecy or theory. Now, there is nothing in this report at all in conflict with my notions. I already knew the depth of water in the bay, and all the other facts set forth. If Mr. Elliott will study this report he will find that Major S. referred to the present condition of affairs and the present amount of water flowing down the Atchafalaya, which is estimated by Major Harod at 400,000 cubic feet per second, while at the same time he estimates the amount passing down the Mississippi at 1,600,000 cubic feet.

"Now suppose all this water, 200,000 cubic feet per second, was confined to the Atchafalaya at its head, don't you think it would root its way to the Gulf and make a channel for my big steamers at last? I venture to prophesy that it would. When Major Stickney mentions jetties he shows exactly what is needed to make a channel, simply to concentrate the water already there, or to increase the amount. I therefore still make the same assertion or prophecy, that the water flowing down the Atchafalaya will root a channel of the same depth as at the head, or Simmsport, all the way to the deep water of the Gulf. Mr. Elliott thinks the water will spread out over the low lands and the channel be lost. He does not seem to know that the Mississippi has a way of its own of answering this objection, namely by filling up these low lands to the height of its overflow, making natural banks and assisting my rooting operation. If Mr. Elliott will get the engineer's report he will find that about all the slope from the Mississippi to the Gulf is in the first eighty miles, at which point the high water mark is only eight feet above the Gulf level, while the high water mark at the Mississippi is fifty-two feet above the Gulf. This gives a slope of nearly eight inches to the mile for the first eighty miles, and less than one inch from the head of Grand Lake to the Gulf.

"The Atchafalaya overflows its banks almost or quite from its head to the Old River. The consequence of this overflow is shown in the report that the bayou is lined with deserted sugar plantations, the houses and everything else being half covered with sediment. Any one will understand the effect of of this filling, viz.: to raise the banks and as the banks are raised it forces that much more water further down the channel or bed of the stream. I prophesy that this filling will go on until the banks are built up within a few inches of high water mark, and confine all the water to a channel or nearly uniform width from Red River to the Gulf.

"The present width of the Atchafalaya is about 1,000 feet at the head and about 130 feet deep. For the entire Mississippi to go down that way would require a width of about 3,000 feet. The fill in the low lands will increase as the head water increases. This fill will continue until the channel is cut out into the Gulf when the high water mark along the new channel from Red River to the Gulf will be lowered, and the lands along the bank will be high above overflow. Then, indeed, will southern Louisiana become the garden spot of the world. With the entire river turned down the Atchafalaya the difference between high and low water at Red River would not exceed twenty feet, and the lands would be about fifteen feet above overflow, while along the old channel by New Orleans the water would be on a level with the Gulf, affected only by the tide, and would be salt water. It would be a lake, 320 miles long, half a mile wide, and the water never above the present low water mark.

"But what is to become of New Orleans? I answer that it must go. The shipping port should be at the head of steamship navigation. This, in my opinion, would be at the mouth of Red River, or above. In my opinion, the fate of New Orleans is sealed.

"Now, Mr. Elliott admits my statement in regard to the filling up of the bed of the Mississippi below Red River. If it has filled so that a rise of three feet below high water at Red River makes the highest water known at New Orleans, how do you expect to wash out that channel again? It could only be done by closing Atchafalaya, which is now estimated to carry off one-fifth the water that previously went down the Mississippi. It would be necessary to raise the levees high enough to hold this extra water, or it would not scour out. This would require levees below Red River ten, if not fifteen, feet higher than they are now, and who proposes to build any such levees? The proposition of the River Commission to divorce Red River and Atchafalaya from the Mississippi would be worse still, as the filling of the bed below Red River would be much more rapid even than now, and the levees would have to be raised higher eventually than if the attempt was made to close the Atchafalaya.

ANTHROPOLOGY.

THE MAN OF THE FUTURE.

E. KAY ROBINSON.

The Man of the Future—that mysterious being who will look back across a dim gulf of time upon imperfect humanity of the nineteenth century with just such kindly and half incredulous scorn as we now condescend to bestow upon our own club-wielding, ape-like ancestor—will be a toothless, hairless, slow-limbed animal, incapable of extended locomotion. His feet will have no division between the toes. He will be very averse to fighting, and will maintain his position in the foremost files of time to come solely upon the strength of one or two peculiar convolutions in his brain. This may seem to be a poor prophecy; but it differs from most prophecies in being a mere logical deduction from accomplished facts.

Only in very recent times has the extent of our scientific knowledge been sufficient to justify even the genius of a Darwin in attempting to evolve a rational scheme of the past; and it is not suprising, therefore, that the idea of using that knowledge like a two-edged knife to cut forward into the future, as well as backward into the past, should not have occurred to our men of science as yet. A little inspection of the weapon, however, will show that it is equally handy for either purpose: for dissecting the coiled-up thread of the destiny of species, as for cutting through the tangled web of their origin. From the same plentiful materials of the present it should not be more difficult to write an account of the descendants than of the descent of Man. The task, however, in its entirety, demands another Darwin. Meantime others less gifted may venture to sketch in a rough outline of the Man of the Future with his bald scalp and empty gums.

Of course it may be objected at the outset that Darwin's theory of the Origin of Species stands itself still in need of scientific demonstration. To those to whom such a contention commends itself, no reply shorter than three volumes is possible, and to them these few paragraphs are not addressed. I may take it therefore for granted that, although the logical buttresses of some of Darwin's theories are plainly built of materials too flimsy to support the weight placed upon them and some few are completely undermined and useless, nevertheless no man of thought can honestly deny that his genealogy of the human race is in the main reconcilable with fact, with science, and with religion in the highest acceptation of that term. Nor, after a moment's consideration of the arguments hereafter to be adduced, should any honest thinker find difficulty in going further and admitting with me that Nature, like Janus of old, has two faces, one looking forward as significantly into the Future, as the other backward into the Past. If by minute inspection of the recent footprints of changes that are now passing over the world, one philosopher was guided to proclaim whence those changes started, surely another philosopher of equal powers could tell us, at least as clearly, whither they are going? For it must not be imagined that Darwin's self-appointed mission of tracing Nature backward to its source was in any especial way facilitated by the scanty relics of the actual past that geology has unearthed. As a matter of fact the strongest arguments *against* his theories of gradual evolution, such as the sudden appearance of distinct species in particular strata, and many other similar difficulties, have been furnished by geologists. His Origin of Species is written entirely in the living characters of the present. Old types are indeed introduced here and there by way of comment and illustration, but if the Dinotherium and the Mastodon were still slumbering the sleep of the extinct Unknown, in company with the undiscovered ape-like animal, the "Missing Link" of popular imagination, the descent of man would have been no more difficult to trace. It was from lions and peacocks, toads and insects—various renderings in aberrant modern types of the same old story of evolution and development—that Darwin compiled the volumes that have revolutionized modern philosophy and modes of thought. It could not have been otherwise. The organic remains of geology would have been as useless to guide him through the free realms of thought he traversed, as the name of his own street corner to teach him the geography of Europe. The interval that has elapsed since woolly elephants browsed along the site of the Strand, mysteriously long as it appears to us, would occupy merely the last page of the latest volume of the interminable History of Man. It is indeed a fragment of the original, but so mutilated and imperfect a fragment as to be incomparably inferior to the innumerable translations and modifications of the text printed on loose sheets and scattered over the globe wherever an animal or fish is found, wherever a bird or insect flies. By collecting and deciphering these isolated sentences, Darwin has reproduced, in due proportion, but vague outline, the whole of the mighty work; and where the original geological fragment tallied with his translation he said so, and where it did not tally, he said so. But he was in no way indebted for his knowledge of the past to a study of the past. From the present attitude of Nature he inferred whence it had come, and we can guess whither it is going.

It will be remembered that Darwin's theory of the evolution of different species receives strong confirmation from the parallel changes which each individual of those species undergoes in growth from the embryo to maturity. The human embryo, for instance, has a hairy skin; a brain with convolutions similar to those of an ape; a great toe projecting like a thumb from the side of the foot, a single pulsating vessel instead of a heart, and a tail longer than its legs. These characteristics disappear long before birth; and thus each human individual before coming into the world exemplifies in his own person the development of his species from some lower animal—lower even than the ape—and furnishes solid collateral evidence of the truth of the theory founded by Darwin upon a comparison of the affinities and differences of allied species as they exist at present. But just as each individual, before becoming subject by birth to the influence of surrounding circumstances, reproduces the character which his species wore before those surrounding circumstances had produced any effect, so each individual, after having passed beyond maturity under the influence of surrounding circumstances, foreshadows the character which his species will wear when those circumstances have produced their full effect. If, then, by following Darwin's method of comparing the affinities and differences of existing species, a new theory of the evolution of the future is built up, and it is then found that each individual during his passage from maturity to old age undergoes the same changes that are predicted for the species, there would be good *prima facie* evidence in favor of the correctness of the theory; and this evidence is not wanting.

There is, of course, this difference between a retrospective and a prospective theory of evolution: that the latter can only be carried forward for a short way, only so far in fact as the present incompleted stage of the journey reaches. After that we cannot even conjecture in which direction the next new departure may be taken. In looking back upon the lines of descent which different extant species have followed, we see a number of converging lines, and can place our finger upon the point of intersection and say, "There was the common parent of all these species." In looking forward, on the other hand, we can only see the divergence of the lines, and have no fixed points in the landscape to guide us as to their ulterior destination. Hence in pointing out the path that evolution of the future *must* follow, we can only speak with assurance of a very little distance, and with doubt of a few steps more. Unforeseen circumstances and oblique influences cannot fail to arise to turn each species aside from the course it is now following. With this explanation I may restate the proposition that the man of the future will be a toothless, hairless animal, incapable of extended locomotion. His feet will have no divisions between the toes. He will be very averse to fighting, and will maintain his position in the foremost files of time to come, solely upon the strength of a few peculiar convolutions in his brain. Compared with the stately broad-winged possessor of "vril," this picture of the coming race is not flattering, but it is at least more probable. More details might easily be added, but those which have been enumerated are sufficient for the purpose, and are so obviously the inevitable results of changes already partially accomplished, that few words will be necessary to support them.

The different parts of the human frame as it exists now have been evolved or modified by the action of the two great principles that have always regulated the development of species. Every organ and every ornament that man possesses has been acquired by natural or by sexual selection, and when either of these forces is weakened or removed, or when the necessity for such organs or ornaments is no longer sufficient to counterbalance the loss of the power employed in their production, then they commence at once to disappear. This is the case with human teeth. The early ancestors of man were furnished, as the male gorilla is to-day, with magnificent grinding teeth for crushing hard fruits, and huge canines for fighting with other males for the possession of the females. A trace of this remains in the more powerful dentition of savage races, who stand a short distance nearer to our common ape-like ancestor. Civilized human-beings, on the other hand, have absolutely no use for canine teeth, which are therefore found to be small in proportion to the civilization of their possessors; and for the rest of the teeth they are eminently unsuited for the work they have to perform. This is sufficiently plain from their early decay and the artificial means which have to be employed in order to retain them even to maturity. The so-called "wisdom teeth" are even now being lost. They are the last to appear, and the first to go, and even while we have them are unemployed. The rest will follow them probably two at a time, and their places will be supplied no doubt by a hardening of the gums, which cannot fail to be imcomparably more convenient and suitable to the viands of civilized life.

Long hair, beard, mustache and whiskers are all sexual ornaments acquired by man to charm and allure the opposite sex, just as the canine teeth were acquired to fight for a similar purpose. But neither is sexual selection so powerful now, nor are these hairy ornaments so important as they used to be. Marriage is no longer settled by the strength of magnificent hairiness of the suitor. Wealth will cover the bald head; intellect is more valued than whiskers, and the length of a rent roll counterbalances the shortness of a beard. A woman too, who has but a scanty supply of that ancient "pride of a woman"—long hair, can eke it out by fraud and art, nor need she go unwedded on that account. Neither men nor women therefore who happen to be ill-furnished with hair are now as formerly, handicapped in the race of life and unlikely to leave children to inherit their defects. On the other hand, they gain a distinct advantage at the outset, inasmuch as no vital force is in their case wasted in the production of useless ornaments. There is, moreover, a mysterious law of correlation of growth between the hair and the teeth. Throughout the animal world strong and luxuriant hair is accompanied by regular and durable teeth; and a hairless breed of dogs exists which is equally conspicuous for the absence of its teeth. Hence, it might have been expected that civilization would affect the hair as much as the teeth, and infallibly tend to suppress all hirsute adornments, as not being sufficiently necessary to the welfare of the individual to repay the cost of their production. Experience confirms this view; for as the teeth are small, soon lost, and two of them, at least, capricious in appearance, so bald heads in the prime of life, smooth cheeks and beardless chins among men and women conspicuous for the absence of natural locks, are common in civilized countries; while savage tribes, who have more lately left, or still remain in, that state of society in which individual strength and personal ornament are demanded by the principles of natural and sexual selection, have stronger teeth and retain more of their original wealth of hair.

With respect to his locomotive limbs civilized man has lost some faculties and is losing others. The prehensile power of the great toe, inherited from our ape-like ancestor, and still obvious in the human embryo, is retained in part by savage races; but of necessity lost by those human beings who habitually inclose their feet in the boots and shoes of civilized life. Indeed, the separation of the five toes under such circumstances is no longer necessary, and will not permanently survive. Already the percentage of persons who have two or more of their toes united throughout their length is surprisingly large.

In that particular form of endurance, again, which enables a man to travel long distances on foot, the savage is, as was to be expected, immensely superior to his civilized brother. And increased facilities of artificial locomotion, by rendering the use by the latter of his lower limbs more and more unnecessary, will reduce them in time to a comparatively rudimentary condition. Finally, the readiness of our ancestors, and of our savage contemporaries, to fight with one another is no longer profitable, but absolutely pernicious, in the struggle for civilized existence. There is no necessity nowadays for frequent personal combats and struggles of life and death. On the contrary, a man who is violent and pugnacious will, as a general rule, be more often imprisoned or slain in the prime of life than his more pacific neighbors, and will therefore leave fewer children to inherit his fighting spirit. Thus the constant process of elimination of combative men will continue, without any compensating advantage in the struggle for existence, arising as heretofore from success as a warrior. The man of the future, therefore, will not only be toothless, bald-headed, and incapable of extended locomotion with his imperfectly developed feet, but he will also be particularly averse to engaging in personal conflict—a lover of peace at any price.

Now it would, as was remarked above, furnished a strong confimation to this theory if it were found that each individual of the human species, during his passage from maturity to old age, presented in his own person any of these several changes predicted for the species. That he does so in a remarkable degree cannot be denied. Taking up our position in imagination at that point which is called the prime of life; as representing the highest point of development attained by man in the present, and looking back, we can in his person trace the career of his species throught the fiery age of semi-civilized youthful nations, the period of unbridled love and fearless war, and through the uncivilized period of boyhood, with all the restlessness, impudence, and love of discordant noises that distinguish savages, to the mere embryo, with its hairy skin, separate great toe, and long tail like a monkey, and with the single pulsating vessel which serves for a heart to animals far lower than the apes. Turning round and looking forward, on the other hand, we can see the latter period of life when man has lost two of his teeth and much of his love of locomotion; and the final period, when he has become a toothless, bald-headed, stiff-limbed animal, incapable of extended locomotion, nervous and timid—an old man in fact. If it should enter into the head of any future novelist to write another circumstantial account of "The Coming Race," it is to be hoped that he will make use of the above materials, which, if less picturesque than "vril" and wings, are, as I have said before, at least more consonant with nature.—*The Nineteenth Century.*

ORIGIN OF THE WHITE MAN.

E. B. TYLOR.

There may be remains of Stone Age whites, but there are no certain remains of white savages of a low order. We may well doubt if there ever were any white savages; it is more likely that the white men were developed late in the race-history of the world from ancestors already far on in civilization; in fact, that this civilization, with its improved supply of food, its better housing and clothing, its higher intellectuality, was one main factor in the development of the white type. Here, however, it must be remembered that there is not a white race in the sense in which there is a Carib race or an Andaman race. It includes several race-types, and even the same languages, such as English or German, may be spoken by men as blonde as Danes or as dark as Sicilians. The fair-haired Scandinavian type has something of the definiteness of a true race; but as one travels south there appear, not well-defined sub-races, but darkening gradations of bewildering complexity. The most reasonable attempt to solve this intricate problem is Prof. Huxley's view that the white race is made up of fair whites of the Northern or Scandinavian type and dark whites, who are the result of ages of mixture between the fair whites and the darker nations, though it is perhaps hardly prudent to limit these dark ancestors to one variety, as he does.

If now we can not trace the white man down to the low level of primitive savagery, neither can we assign to him the great upward movement by which the barbarian passed into civilization. It is not to the Aryan of Persia nor to the Semitic of Syria that the art of writing belongs which brought on the new era of culture. The Egyptian, whose hieroglyphics may be traced, passing from picture into alphabet, had his race allies in people of North Africa, especially the Berbers of the north coast—people whom no elasticity of ethnological system would bring into the white race. Of the race-type of the old Babylonians, who shaped likewise rude pictures into wedge-phonetic signs, we know but little as yet; at any rate, their speech was not Aryan, and the comparisons of Lenormant and Sayce have given some ground for connecting it with the Turanian language, belonging to a group of nations of whom one, the Chinese, had in remote antiquity worked out a civilization of which the development of an imperfect phonetic-writing formed part. If the great middle move in culture was made, not by any branch of the white race, but by races now represented by the Egyptian and the Chinese, it is not less clear that these nations came to the limit of their developing power. The white races had in remote antiquity risen high in barbaric culture when their contact with the darker nations who invented writing opened to them new intellectual paths. The Greeks found in the ancient Egyptian theology the gods of the four elements, but they transferred this thought from theology to philosophy and developed from it the theory of elements and atoms, which is the basis of modern chemistry. They found the Babylonians building terraced temples to the seven planets in the order of their periods, and this conception again they transferred from religion to science, founding on it the doctrine of planet spheres which grew into mathematical astronomy. It may moderate our somewhat overweening estimate of our powers to remember that the white races cannot claim to be the original creators of literature and science, but from remote antiquity they began to show the combined power of acquiring and developing culture which has made them dominant among mankind.—*Nature.*

ENGINEERING.

A GLANCE AT THE HISTORY OF RAILROADS IN MISSOURI.

HON. GEORGE C. PRATT.

The year 1830 is called the railroad era. The adhesion of the driving-wheel of the locomotive to the iron rail, necessary to give the requisite tractive force, had then been demonstrated; the rapid generation of steam by means of the multitubular boiler, had proved that high speed was attainable, and the track had been made sufficiently substantial to bear the strain of rapidly moving heavy machinery. During that year the Liverpool & Manchester road was opened to the use of locomotive power; Peter Cooper's trial engine, the Tom Thumb, appeared on the Baltimore & Ohio, and the West Point foundry of New York turned out a serviceable engine called The Best Friend of Charleston, for the South Carolina road. During the same year, ground was broken in Missouri for a tram-road from New Franklin, in Howard County, to the Missouri River.

On the 20th of April, 1836, a railroad convention met in St. Louis, at which a plan was agreed upon for three railroads, radiating from that city northwest, west, and southwest; a committee was appointed to memorialize Congress for a grant of public land to aid in their construction, and it was recommended that the faith and credit of the State be pledged to the amount of $10,000,000, for the same purpose. The Hon. John B. Clark, Sr., of Howard County, and the Hon. James S. Rollins, of Columbia, were members of that convention. Rollins offered the resolution in regard to the land grant, and was made chairman of the committee to draw up the petition to Congress. In the autumn of the same year, the Louisiana & Columbia Railroad line was surveyed by Lieut. Guion, of the U. S. Army, assisted by an engineer named Webster. On the completion of this survey to Columbia, the engineering party were treated to a supper and ball given at the house of Gen. Richard Gentry, who was killed the very next year, while in command of the Missouri volunteers, at the battle of Okechobee in Florida. So far as is known to the writer this is the first instrumental survey of a railroad line ever made in the State. A copy of Guion's report may be found in the library of Major Rollins, in a bound volume of old pamphlets. It is possible that the survey of the Marion City & Missouri Railroad may have been anterior to this, but no documentary proof thereof has been discovered. (See Laws of Missouri, 1836–39, page 253).

The General Assembly elected that year chartered sixteen railroad companies, and the one elected in 1838, created a "Board of Internal Improvements," consisting of five members, and the office of State Engineer, under whose direction the Meramec. Osage, Grand, and Salt Rivers were surveyed for slack water navigation, and a line was run for a railroad from St. Louis to the Iron Mountain. This last survey was made by Major Morel, the State Engineer, in 1839, and has been erroneously claimed to have been the first railroad survey made in the State. (See Report of Thomas Allen, President St. Louis & Iron Mountain Railroad for 1874).

It was not, however, until July 4, 1851, that the work of railroad construction actually commenced in Missouri. On that day ground was broken on the Pacific Railroad in St. Louis, Luther M. Kennett, Mayor of the city, casting the first shovel of earth. Austin A. King, Governor of the State, had been invited to perform that service, but failed to be present. Within the next four years the North Missouri, the Iron Mountain and the Hannibal & St. Joseph Companies also commenced work During the fifteen years following the St. Louis convention there had been a lively discussion of the subject of Internal Improvements, and particularly in the canvass preceding the election of 1848. Both the last message of the retiring governor, at the close of that year, and the inaugural address of the incoming governor made special reference to it. Our position was this: We wanted railroads, and did not have the money wherewith to build them. Foreign capital could be had only on the credit of the State and land mortgages. The only course to be pursued therefore, in order to obtain the thing desired, was the one pointed out by the St. Louis convention in 1836, and we adopted that course. The Pacific Railroad Company had been organized in March, 1850, with Thomas Allen as President. Individual citizens, the city and County of St. Louis, and counties along the line of the road manifested a willingness to subscribe liberally to the capital stock of the company, and in February, 1851, the State loaned its credit to that company to the amount of $2,000,000, and to the Hannibal & St. Joseph Company to the amount of $1,500,000. This first grant of State aid to railroads was soon followed by others, and during the next six years, our legislatures authorized loans to seven different companies, amounting to $24,950,000, of which $23,701,000 in State bonds bearing six per cent interest, was legally delivered to and used by the companies; to the Pacific Company $7,000,000, the Southwestern branch $4,500,000, the North Missouri $4,350,000, the Iron Mountain $3,501,000, the Hannibal & St. Joseph $3,000,000, the Platte Country $700,000, and the Cairo & Fulton $650,000. One bill passed in December, 1855, appropriated $11,000,000, in one lump, which bill being vetoed by Governor Price, the legislators took the total responsibility on themselves and passed the bill over his head.

In making these loans of State credit to railroad companies, care was taken to provide such means as were thought to be amply sufficient to secure the State against any possible loss. Such were the provisions under which State bonds were delivered to the companies, only to the amount of their own capital derived from other sources, previously expended; the creation of fund commissioners to look after the sale of the State bonds and the application of their proceeds; the appointment of a "Board of Public Works," consisting of three members, to supervise the operations of the companies in the construction of their roads; and especially the creation of statutory liens upon the roads in favor of the State. The obligations under these liens were peculiar. The State did not loan money to the companies, except some small amounts which were repaid, nor bind them to repay her any money. She loaned them her bonds, on which they could raise money, and the obligation on their part was to return these bonds to the State, and while they were outstanding, to pay to the holders of them, the interest as it accrued, and the principal at maturity. In default of either of these payments, the governor might sell their roads and apply the proceeds to this purpose. The Missouri Pacific Company had borrowed $7,000,000 of these bonds, sold them and used the proceeds in building her road. Being afterward desirous of procuring a release of the State's lien upon her property she bought up five millions of the bonds, turned them over to the State, and obtained an entire release from the whole obligation, by act of the legislature; the consideration for the loss of the two millions being (we presume) considered by the body to be good and sufficient. In the case of the Hannibal & St. Joseph Company, it was provided by an act approved February 20, 1865, ten years after the last loan had been made to this company, and six years after its road had been completed from Hannibal to St. Joseph, that the cancellation of the State's lien upon its property might be effected by the payment to the State of money instead of bonds, provided the amount paid were sufficient to indemnify the State for "All liabilities incurred by reason of having issued her bonds and *loaned the same* to said company."

Under this policy adopted by the State, and with the aid of liberal subscriptions to the capital stock of the companies by counties, municipalities and individuals, supplemented by grants of lands from Congress, we inaugurated and prosecuted railroad building until interrupted by the civil war in 1861, ten years after we had commenced the work of construction. At this time we had 800 miles in operation, but only one of the roads had been completed through to its projected terminal point. After the war, it was found that the credit of railroad property in Missouri had so appreciated that money could be raised by mortgages upon such property without difficulty, and even on mortgages upon projected lines of road to which liberal local subscriptions could be had. Our companies were therefore anxious to extinguish the State's lien upon their lines, in order that they might mortgage them for larger sums to other parties, and, by means of sales and statutory releases, these liens were cancelled on all the unfinished roads, for the alleged purpose of expediting their completion. In connection with these statutory releases, a very fortunate piece of legislation occurred. I refer to the so-called exemption acts of March, 1868, by the effect of which seven of the principal companies became bound by *contract* with the State, witnessed by their certificates filed in the office of Secretary of the State, to be subject, after March, 1878, to all laws fixing rates, then in force or thereafter to be enacted. This measure saved us from that which cost other States long years of litigation. At the same time new lines of road were being projected in all parts of the State, to which local subscriptions, in enormous amounts, were every where made, until a check was placed upon this reckless expenditure by the financial crisis of 1873, which suspended railroad building for a time and gave us an opportunity to review the situation. We then had 2,850 miles of road completed, and 700 miles more of graded but unfinished lines, very little of which last has been or ever will be utilized.

The amount of means furnished by us and which actually went into the construction of these lines did not vary much from $50,000,000. This includes State aid and subscriptions of counties, cities, townships and individual citizens of the State. But in closing up the liens upon the roads we had recovered back into the State treasury five millions from the Pacific Company, about half a million more from the other companies, and if we add to that the three millions since received from the Hannibal & St. Joseph Company, and about a half million more received by counties and individuals from the sale of railroad stocks included in these original subscriptions, it makes the total receipts nine millions. But this nine millions recovered back, falls very far short of the amount of interest that had been paid by the State previous to 1873, in consequence of the failure of the companies to meet it, so that if the account could have been closed out with cash at that time on the same basis upon which this estimate is made, our 2,850 miles of road would have cost us considerably more than the original $50,000,000; probably not less than $60,000,000, which is over $21,000 a mile. Of course this amount has since increased and will continue to increase by the amount of interest paid, until the last railroad debt is cancelled. At the same time we had allowed the ownership of the roads to pass into other hands; but we wasted no regrets on that, as we had undertaken their construction, not for the purpose of holding them as property, but because we wanted the *use* of them.

The enormous shrinkage in values, consequent upon the financial crisis of 1873, whereby the selling price, not only of the products of our labor, but in some instances, that of our real property also, fell to one-third of what it had been during the previous decade, coming upon us at a time when we were oppressed by an enormous load of debt, both public and private, created universal consternation, distress and bankruptcy. By bitter experience we learned that however much a debtor's paying capacity may shrink in hard times, his debts do not shrink. In this case they were actually augmented by unskillful management of finance by the Federal Government. Moreover, neither taxes nor transportation charges were reduced, nor was it clearly apparent that either of them could be reduced without clogging the wheels of local government or of commerce. In this dire emergency, our people exhibited a degree of wisdom and of nerve rarely witnessed in any community. We ordered the assembling of a constitutional convention, we passed a legislative enactment limiting railroad rates on our chief articles of export, such as grain and live stock, on some imports of prime importance, such as salt, lumber and agricultural implements, and on passengers; and we created a Board of Railroad Commissioners to exercise a general supervision over the subject of railroad transportation. These three measures, viewed in the transcendently brilliant light of their successful results, exhibit an extraordinary capacity for self-government unsurpassed by any people, and furnish material for one of the brighest pages of history that ever adorned the annals of any commonwealth. The Constitutional Convention boldly struck at the root of the evil of public debts by prohibiting their creation in the future, and of excessive taxation by limiting the rate thereof. On this subject I will quote a few paragraphs from an article written at the request of a gentleman in another State, and published there, four years after the adoption of the constitution framed by that Convention.

"This constitution was framed under circumstances, although not peculiar to Missouri, yet so grave and ominous as to challenge the attention of reflecting minds throughout the commonwealth. The State, the counties, the cities, and towns, had gone recklessly into debt, mainly for the purpose of securing the building of railroads, and more of these had been constructed than the commerce of the State could supply with a paying business. There was a mile of railroad to every 625 inhabitants in the whole State, and in the forty-four counties north and east of the Missouri River, there was a mile of railroad to every 400 people and to every fourteen square miles of territory. According to one of the best authorities it takes 825 inhabitants to the mile to make a railroad earn a living in the United States. In some cases where local subsidies had been granted in amount equal to the total cost of construction, the roads so subsidized were found to be mortgaged for $30,000 a mile. The waste of public treasure had been frightful, and the amount of public debt was appalling. The Federal debt was $50 per capita, the State debt $10 more, the county debts as high as $40 more, amounting, in some counties, to $100 a head on the rural population, while the urban populations carried additional burdens varying from $5 to $60 a head. The lowest possible public debt on any community in the State was therefore $60 per capita, and the average was somewhere between that and $150, while the assessed value of all property based on the high prices of preceding years averaged only $300 per capita. At the same time the selling price of property had depreciated to seventy-five and fifty, and in the case of some products of labor, as low as twenty-five per cent of what it was when these debts were created, whereby the burden of the latter was double or even trebled, and made equal in extreme cases to the average value of property per capita. No free people will long carry such a burden. Its very enormity of weight suggests the necessity of dropping it at once, to avoid being crushed beneath it.

"It was under these circumstances that the Constitutional Convention assembled in the summer of 1875, and with these facts before it, that the subject of the limitation of legislative power was entered upon. The legislative branch of the government had sanctioned the creation of this insupportable load of debt. Its power had therefore been misused in this respect and should be restrained. The resulting evils already indicated that repudiation (at least in the mild form of compromise) would, in some instances, be certainly resorted to, and that the consequent reduction of the standard of public morals, carrying with it a depraved sentiment in respect to obligations between man and man in their private capacity, must necessarily follow. These evils must therefore be arrested, and the plan adopted was to cut off their source, prevent a further accumulation of the burdens which had caused them, and thus relieved of the fear of any future increment of burdens, we would be free to grapple with those already existing.

"Therefore, in the constitution prepared by this convention, and afterward adopted by the people, provisions were inserted which effectually prevented the creation, thereafter, of any public debt whatever, except for certain specified purposes; and so limited the rates of taxation for State, county, or municipal purposes, that except for the liquidation of the debts, these rates can never reach one and three fourths per cent on the valuation of city property, nor three fourths of one per cent on country property. To the tax payers of Missouri the adoption of this constitution came like a burst of sunshine at noon to the storm-tossed mariner who had lost his reckoning; or like a touch of firm bottom to the foot of the exhausted swimmer. Four years have elapsed since that event occurred, and results already prove that the State has been thereby rejuvenated, and enabled to commence a new and more vigorous growth."

Since that article was penned, three years more have elapsed, and each year has added cumulative evidence that the new and more vigorous growth then begun has far outstripped the most sanguine anticipations of the writer. In the accomplishment of these results, the two other measures which I have mentioned, have also borne their part, and have contributed more largely than was expected from our imperfect law of rates, and the limited powers conferred upon the railroad commissioners. Viewing the situation from the standpoint of the present, we find our State debt in such condition as promises entire extinction within a few more years, our other public debts very materially reduced, and our private debts except those on railroad property almost entirely liquidated. At the same time our paying capacity has so largely increased that, except in a very few counties, neither public nor private debts are now felt to be a burden. The numerous farm mortgages have mostly been cancelled, and farmers are mainly out of debt. The extension of railroad facilities throughout the state is progressing more rapidly than at any former period, the number of miles having increased to 4,500 at the close of 1882. The total business of all the roads in the State has increased from upward of $14,000,000, in 1877, to nearly $28,000,000, in 1882. During the same time, the average receipts per mile of road have increased fully fifty per cent, and the receipts per train mile are far in excess of the cost of transportation. Whilst this rapid growth of our railroad mileage has been going on, without any expense to us, and this enormous increase of railroad receipts, and these evidences of railroad profits have been developing, it also appears, that under the operation of our law of rates, which went into effect in March, 1878, and through the labors of the commissioners in enforcing that law, the rates we have paid since that date have been fully twenty-five per cent less than they were before or would have been since, but for the action of the commissioners. This reduction has affected a clear saving to the people of the State, as shown by the late message of his excellency, Governor Crittenden, averaging $5,000,000 a year, and amounting, for the five years during which this law has been in force, to $25,000,000.

These are some of the magnificent results, which we may honestly claim to have been, in great measure, brought about by the cool intrepidity and wise statesmanship exhibited by our people and by our public servants, in adopting the measures which have so certainly and so completely relieved us of our load of debt and delivered us from our perilous position, rendered still more perilous than I have described it, by the fact, that we had been precipitated into the whirlpool of that financial revulsion which bankrupted nearly all of us who had sufficient credit to become borrowers, while yet battling against that blinding storm of overwhelming misfortunes, consequent upon a civil convulsion which annihilated our surplus capital, paralyzed production and disfranchised a majority of our tax-payers. That we have, under such an accumulation of adverse circumstances, achieved a result so entirely successful, may well fill our hearts with gratitude to the Supreme Arbiter of the fortunes of States, with a just and honorable pride in the commanding position which Missouri has nevertheless, already attained, and with exultation at our happy lot in being numbered among her citizens.

In conclusion, let us contemplate for a moment, that crowning glory of Missouri, the splendid financial position occupied by our State government; let us point to it as an example to be imitated by our minor political corporations, and hold it up as a beacon-light to guide our railroad corporations into that restful haven whither our ship of state is gently gliding, immunity from debt. If it be good policy for our State to pay off its debt, and thus relieve us from the interest tax to which we are now subject, it is also good policy for counties, cities and towns to do the same; and the policy is a better one, when applied to business coporations, because, when their only liability is a stock account, of only one class, all the capital invested in them is represented and equally represented in the management; and good management might become the rule, instead of being the exception. To say that this policy will not some day be adopted by railroad companies, is to impugn the business sagacity of the owners of railroad property; and to doubt the possibility of holding these mammoth corporations within the restraints of statute law is to abandon all idea of government by law.

The very fact that human ingenuity has evoked from chaos this gigantic combination of forces, which is now causing the world of trade to tremble beneath its ponderous tread, is itself an assurance that human genius will also teach us how to curb this embodiment of concentrated power, and train it to work quietly in the service of commerce.

JEFFERSON CITY, MO., June 1, 1883.

ASTRONOMY.

TIME OBSERVATIONS.

W. W. ALEXANDER.

The correct measurement of time is not only one of the most important parts of practical astronomy, but it is one of the most direct benefits conferred on mankind by the science; it enters, in fact, so much into every affair of life, that we are apt to forget there was a period when that measurement was all but impossible.

Among the contrivances which were to the ancients what clocks and watches are to us, may be mentioned the clepsydræ, or water clocks, sun-dial, hour-glass, etc. About the year 780, B. C., clepsydræ of the most elaborate construction were common; but while they were in use, the days, both in summer and winter, were divided into twelve hours, from sunrise to sunset, and consequently the hours in winter were shorter than in summer. The clepsydra, therefore, was almost useless, except for measuring intervals of time, unless different ones were employed at different seasons of the year.

The sun-dial also is of great antiquity, being referred to as in use among the Jews 730 B. C. This was a great improvement upon the clepsydra, but at night and in cloudy weather it could not be used of course. To understand the construction of a sun-dial, let us imagine a transparent cylinder having an opaque axis; both axis and cylinder being placed parallel to the axis of the earth. If the cylinder be exposed to the Sun, the shadow of the axis will be thrown on the side of the cylinder away from the Sun, and as the Sun appears to travel round the earth's axis in twenty-four hours, it will equally appear to travel round the axis of the cylinder in the same time, and will cast the shadow of the cylinder's axis on the side of the cylinder as long as it remains above the horizon.

All we have to do, therefore, is to trace on the side of the cylinder twenty-four lines fifteen degrees apart ($15 \times 24 — 360$), taking care to have one line on the north side. When the Sun is south at noon, the shadow of the axis will be thrown on this line, which we may mark XII; when the Sun has advanced one hour to the west the shadow will be thrown on the next line to the east, which we may mark I, and so on. The distance of the Sun above the Equator will evidently make no difference in the lateral direction of the shadow. In practice however, we do not want such a cylinder; all that is necessary is a projection called a "style," parallel to the axis of the earth, like the axis of the cylinder, and a dial; the inclination above a level here will be 39° 06′ at the north end of the style.

The principle of both clocks and watches is that a number of wheels, locked together by cogs, are forced to turn around, and are prevented doing so too quickly. The force which gives the motion may be either a weight or spring; the force which arrests the too rapid motion may proceed from a pendulum, which at every swing locks the wheels, or from some equivalent arrangement.

In both clocks and watches we mark the flow of time by seconds, such that sixty make a minute, sixty of which make an hour, twenty-four of which make a day. Those who are not astronomers are quite satisfied with this, and a day is a word with a certain meaning. The astronomer, however, is compelled to qualify it—to put some other word before it—or it means very little to him, because the term day may mean either the return of a particular meridian to the same star or to the Sun again. The term as it is commonly used, means neither the one nor the other, because long ago, when it was found that in consequence of the motion of the earth not being uniform in its orbit round the Sun, the days, as measured by the Sun, were not equal in length, astronomers suggested, with a view of establishing a convenient and uniform measure of time for civil purposes, that a day should be an average for all the days in the year. So our common day is not measured by the *true Sun*, as a sun dial measures it, but by what is called the *mean*, or average, *Sun*.

For a long time after watches and clocks were made with some degree of accuracy, it was attempted to make them keep time with the sun dial, and for this purpose they were regulated at short intervals, and ignorant persons would blame the clock-maker for making an imperfect machine that would not keep time with the sun-dial.

Having said so much of solar days, both apparent and mean, let us next consider the starting points of these reckonings. We have first the apparent solar day reckoned from the instant the true Sun crosses the meridian through about twenty-four hours, till it crosses it again. Second—The mean solar day reckoned by the mean Sun in the same manner. Both these days are used by astronomers. Third—The *civil day* commences at the preceding midnight, is reckoned through twelve mean hours only to noon, then recommences, and is reckoned through another twelve hours to midnight. The civil reckoning is always twelve hours in advance of astronomical. Sidereal time is reckoned from the first point of Aries, and is the only time that can be taken without several corrections. When the mean Sun occupies the *first point* of *Aries*, which it does at the vernal equinox, the time by the mean and sidereal clocks will be the same. This happens at no other time of the year.

A sidereal clock represents the rotation of the earth as referred to the stars, its hour-hand performing a complete revolution through the twenty four sidereal hours between the departure of any meridian from a star and its next return to it. At the moment a star whose right ascension is oh. om. os , is on the meridian of Kansas City, the sidereal clock ought to show oh. om. os., and at the succeeding return of the star, or the equinox to our meridian, the clock ought to indicate the same time again. I have a sidereal clock at No. 1416 Holmes Street, set and regulated by stellar observation made every clear night, with a forty-eight inch transit of two and three-fourth inch aperture. This instrument is powerful enough to take the passage of a star invisible to the naked eye. Time taken from ten or more stars all agree to the fourth part of a second. This proves the time to be that near correct. This time I reduce to local, or "city" time, using the tables of the American Ephemeris or Nautical Almanac, which gives the sidereal time at mean noon to the hundredth part of a second. A clock set by this time will be kept at the above number, also at No. 16 east 7th Street, and corrections in seconds as near as can be made by a pocket chronometer. This time-taking is mainly for the benefit of the public.

Among the lead ng jewelers of the city there is a difference of five to ten minutes. This renders it impossible to make prompt appointments, or even to regulate a good time-piece.

This irregularity in "city time" should cease. With a view to this end I have spared no pains to find the truth. The meridian adopted is Main Street, at the intersection of 7th, the difference caused by longitude from the eastern to the western limits of the city is ten seconds.

SUN AND PLANETS FOR JULY, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's R. A. for July 1st is 6h. 41m. Increasing about four minutes every day, it is 8h. 42m. July 31st. Its north declination during the month changes from 23° 7′ on the 1st to 18° 15′ on the 31st. It may be remarked that the R. A of Sirius, the brightest of the fixed stars, is 6h. 40m., and its declination 16° 33′ S. So that on July 1st this star souths one minute before noon; and 39° 40′ south of the Sun. A transit instrument of low power is sufficient to observe it. The transit is a valuable and exceedingly interesting piece of apparatus. An amateur of moderate mechanical ingenuity may construct one for himself with a few dollars expense.

The Moon occults Saturn on the 1st, about 5 P. M., and Mercury about twenty-four hours afterward; but both phenomena will be difficult to observe—being in day-time and near the horizon. The Moon will again pass very near Saturn on the 29th, about 4 o'clock in the morning. They will be in the east near three hours high, and may be observed with a small glass. The planets are all morning stars most of the month, except Uranus. It is slowly approaching the star Beta in Virgo, and will come up with it in October.

Venus and Mercury will appear like pretty twin stars near together during the first week of July; Venus being north of Mercury. They will be nearly an hour above sun-rise point in early twilight. Mars is about two hours above Venus and a little more south, but too small and dim to be of much interest. It will be near Saturn—1½° N.—about the 20th.

On July 5th, the Sun passes directly between the earth and Jupiter, making an occultation of the planet which lasts about ten hours. After that Jupiter is a morning star, and may be seen just above the sun-rise point, in the latter part of the month. Saturn is near three hours higher that Jupiter, being a little above, and to the left of Aldebaran, the bright red star in Taurus; and about ten degrees below the Pleiades. It is, therefore, in pretty good position for morning observation. Neptune is still above and farther south—occupying a blank region in Taurus; and can hardly be identified without a good equatorial telescope. In the morning of the 26th Venus and Jupiter will be near together—like a fine double star—Venus to the north. New Moon takes place July 4th, about 9 A. M. An interesting display of sun-spots has been visible in June, and will likely be more or less so in July.

PHYSICS.

ABSOLUTE ATTRACTION OF MATTER.

EDGAR L. LARKIN.

It is known that all worlds within range of the most powerful telescopes are dominated by attraction. They are subject to the law of gravity, and attraction is the grand motor of the machinery of the universe. If we desire to measure a force we must have a unit of measurement, and the object of this note is to find an absolute unit of attraction; to learn how much matter exerts so much attractive energy. The only plan possible, is to find the quantity of matter in the earth, and thus ascertain the strength of attraction exerted by it.

Having found this, it then becomes a simple question to determine the gravity exerted by any sphere whether one inch or 1,000,000 miles in diameter, whether the sun or a croquet-ball. It has been found by repeated experiments, and by different methods, that the density of the whole earth is 5.66, that of water=1. One cubic foot of distilled water at 60° F., weighs 62.321 pounds, which multiplied by 5.66=352.73 pounds. Since the earth's volume is known, its mass becomes a mere question of arithmetic, and is: 6,743,610,190,383,705,901,809 tons.

That is,—if we cut up the earth into balls, bring each, one at a time to the surface, weigh, and replace it whence it came, then if their weight should be 1 ton each, their number would be as above; while the diameter of each would be 2.21 feet =2 feet 2½ inches.

PROBLEM:—*How much matter must each of two spheres contain, whose centres are one mile—5,280 feet apart, to be able to attract each other with an intensity of 1 avoirdupois pound, both spheres to be isolated in infinite space?*

Given the amount of matter in the earth, also its size, we learn its attractive force. It has been agreed to by some nations to call the attraction exerted by the mass of the earth on 27.727384 cubic inches of distilled water at 60° F.; or upon 3.559356 cubic inches pure iron, 1 pound avoirdupois.

The diameter of a sphere of iron having this bulk is 1.9 inches. We now have given two spheres—one 7916.3185 miles in diameter, and the other 1.9 inches, together with the amount of attraction of each upon the other, which is 1 pound; also the distance between their centres which is 3958.15925 miles, from which data the question must be solved. And we proceed to discuss the case by means of the most elementary forms of analysis to avoid needless difficulties in the way of students. We have adopted the *mean* diameter and radius of the earth.

It is proven in the higher mathematics that the force of gravity exerted by a sphere on a mass at any distance, is the same as would be if the entire mass of the sphere were concentrated at its centre. Now let us place enormous platform scales (Fairbank's?) on the earth's surface, and place the little ball of iron on its platform and observe its weight, which will be seen to be 1 pound. We will see the necessity of using large scales to weigh the small ball as we proceed. Conceive the scales rigidly fixed in space by some power external to the earth, and let the earth become motionless upon its orbit.

Imagine the earth to shrink and subside to a sphere only two miles in diameter, both its centre and also the scales remaining in space in their original positions 3958.15925 miles apart. Then will the ball of iron still weigh 1 pound, because the earth, now two miles in diameter, will have its original mass, though of inconceivable density; and will attract with the same intensity as when expanded.

It is demonstrated by analysis that: Every particle of matter attracts every other with a force *directly* proportional to mass, but *inversely* proportional to the square of distance. That is: The greater the distance between two bodies the less is their mutual attraction. It follows then that the ball on the scales has a weight which we know to be diminished in the ratio of the square of the distance from it to the earth's centre. As our problem relates to a distance of one mile, we assume the earth to have dwindled to a sphere whose radius is one mile, which brings its surface to a distance of a mile from its centre. Thus: 3958.15925 less 1=3957.15925 miles, whose square is 15,659,110. Let us now move the scales to the surface of the sphere and weigh the little sphere of iron. Behold! its weight is 15,659,110 pounds! What scales must we have to determine its weight? Indeed! both ball and scales would be crushed by the appalling force of gravity. We have now arrived at the fact that a sphere having a radius of one mile, and mass equal to that of the earth exerts sufficient attraction to make one terrestrial pound weigh 15,659,110 pounds. Hence, that the iron should weigh one pound, the large sphere must be diminished in mass so that it will only contain the $\frac{1}{15659110}$ part as much matter, wherefore: 6743610190383705901809 divided by 15,659,110=430,650,924,991,447 tons =861,301,847,982,894,000 pounds.

Whence it appears that a sphere containing that number of pounds, whose centre is one mile distant from a globe of iron whose diameter is 1.9 inches, exerts gravity imparting to it a weight of one pound; while the small also attracts the large sphere with an intensity of a pound, the sum of the attraction of both globes being two pounds. But the condition of the problem is that both bodies be of equal mass, and still attract each other with the force of a pound.

It is clear that matter must be taken from the large to the small sphere to equalize masses and attraction. Accordingly, let us take one pound from the great and add it to the small sphere. Then the small would attract the large with a force equal to two pounds, and *vice versa;* because by a law of nature we know that action and reaction are equal and opposite. Both globes would develop an energy of four pounds, which is foreign to the problem. Looking into this question closely, we see that if we remove matter from one point to another, its attraction on its original position is lessened in the ratio of the *square* of the *distance*.

Since in this case distance is a constant, gravity is unable to vary from that cause; hence it must vary in the ratio of *square root* of mass. Therefore we must extract the square root of 861,301,847,982,794,000 which is 928,063,494 pounds or 464,032 tons. Two globes in space whose centres are a mile apart, and whose matter if brought to the earth's surface and weighed, would each weigh 464,032 tons, will attract each other with a force of one pound, the energy of both spheres being two pounds: a pine stick one mile long capable of sustaining a weight of two pounds would if placed between them prevent their approach. We may be surprised that such vast masses only a mile distant, should develop such weak force in view of the colossal power demonstrated in relation to solar attraction on the earth, in the June (1883) number of this Review. We therein demonstrated that the Sun exerts upon the earth an attractive energy of over 4,000 quadrillion tons! Surprise, however, will disappear when the immense mass of the Sun is considered.

Of course, the words ton and pound are here used relatively to the earth; for the whole sphere, which on the earth's surface would weigh 464,032 tons, 'weighs' only one pound when isolated in space as in the problem. Here is a table of diameters of globes of several kinds of matter to contain 464,032 tons if weighed on scales on the surface of the earth.

MATERIAL.	DIAMETERS.
Water	298 Feet.
Air	2841 "
The Earth	171 "
Hydrogen	6948 "
Platinum	109 "

From this, it may be seen that two globes of hydrogen of required mass could not have their centres one mile distant, as their surfaces would collide; while the platinum balls would have plenty of room. And such is this mysterious energy—attraction, of whose nature nothing is known. It is inherent in all matter, and since the spectroscope informs us that the stars are made up of materials like those in the Earth and Sun, we say the dominion of gravity is as wide as the universe. Because gravity tends to draw all separated masses to one common centre, the whole sidereal structure would collapse and form one solid mass in its centre gravity, were not attraction balanced by an opposing energy. Such power is the centrifugal tendency evolved by circular motion. Therefore, the sidereal heavens is either tending toward destruction, or is in regular revolution about a centre. The deduction of late astronomy is that it is in rotation; and even now, astronomers are almost ready to locate the centre in infinite space, which from the law of gravity may not contain matter, but is far more likely to be void.

New Windsor, Ill., June 17, 1883.

STORAGE BATTERIES.

[*Report of Prof. Henry Morton on the Storage Batteries of the Electrical Power Storage Company, Limited, of London.*]

Having made a series of careful tests and measurements of the electrical storage batteries manufactured by the Electrical Power Storage Company, Limited, at their works at Millwall, London, England, I find the following results in reference to their capacity to store and retain energy, afterwards delivered by them as electric current.

In the first place as to the *capacity* of these batteries in thus *storing* electricity, and its relation to the weight and bulk of such battery or reservoir.

The cells with which I have made my experiments are of the pattern called "one horse-power" cells, because they will contain, when fully charged, an amount of energy equal to fully 1,980,000 foot pounds, or one horse-power for one hour.

These cells are externally rectangular wood boxes, twelve and a half inches high, eleven and a half inches wide and five and three-quarter inches thick.

Two of them side by side, as they would stand when in use, occupy about one cubic foot of space.

Each cell contains sixteen plates, whose united weight is forty-eight pounds, and with the lead-lined box and liquid, the entire weight of the cell when in use, is seventy-nine and a half, or say eighty pounds.

One of these cells full charged will yield, as I have found by careful experiment, a current of 32.5 amperes at the beginning, and 31.2 amperes at the close of a continuous discharge for nine hours.

This amounts to 286.5 ampere hours of current, and if even short interruptions or periods of repose occur in use of the current a yet larger total amount can be obtained.

An Edison incandescent lamp of high resistance, giving a light of sixteen candles, requires a current of .73 of an ampere to supply it. Such a current, therefore, as these batteries yield for nine hours at a time, will suffice for forty-four such lamps.

To secure sufficient electro-motive force or propelling power to overcome the resistance of these lamps would, however, require about fifty of such cells, so that a battery of fifty of these cells connected in series, would operate forty-four lamps for nine hours, or for even a longer time in the aggregate, if the use were interrupted, as it would be in practice. If fewer lamps were used with the same battery, they would be operated for a proportionately longer time.

Thus eleven lamps would be supplied by a fifty cell battery for thirty-six hours of continuous action; or as lights are commonly used in private houses, on the average for five hours each night, such a battery once charged, would operate eleven lamps for a week.

To express the relation between weight of battery and power of maintaining a light, we might, therefore, say that for each lamp operated for nine hours, one and a seventh cells of battery would be required, or a weight of about ninety pounds of battery. This would be for each hour of burning each lamp, ten pounds of battery.

This makes a very simple rule for calculating the weight of battery required for any number of lamps for any time. Thus, suppose we wish a battery to operate twenty-five lamps for five hours each night, the battery being recharged during the day. We have 25x5x10=1,250 pounds as the weight of battery required.

Comparing the efficiency of this storage battery with that of other similar arrangements, such as the Faure battery, measured and reported upon by M. Tresca, of the "Conservatoire des Arts et Metiers," it shows a marked superiority. Thus in M. Tresca's experiments a cell weighing ninety-five pounds yielded a current representing 793,791 foot-pounds of energy where your battery yields, as I have stated above, 1,826,168 foot-pounds and only weighs eighty pounds.

Your battery, therefore, yields more than twice the energy and weighs almost one-fifth less.

Even the experiments made some time afterwards by Professors Ayrton and Perry, on other Faure accumulators, though the conditions were rendered as favorable as possible by distributing the discharge over three periods of six hours each on three successive days, do not show a much better result. In this case the weight of the battery *plates* only is given, and that eighty-one pounds. Reducing the results proportionally for batteries whose plates weigh forty-eight pounds, I find that by the experiments of Professors Ayrton and Perry each cell of this weight should give 853,333 foot-pounds of energy.

This again is less than half the amount of energy which I have repeatedly obtained from your battery.

Passing next to the efficiency of your batteries as regards their delivery of nearly the same current as was used to charge them, I have found that the loss in this relation is less than 10 per cent. In other words, in my experiments I have obtained from these batteries 90 to 91 per cent. of the current used to charge them. This far exceeds the results obtained by M. Tresca with the Faure batteries.

Tresca reports that he recovered only 60 per cent. of the current used to charge the battery, and Ayrton and Perry found the loss in charging and discharging to be "not greater than 18 per cent."

In this, however, is included the loss due to the fall of electro-motive force in the discharge as compared with the charge. This I find to be on the average less than $\frac{2}{10}$ of a volt, which would bring the total loss of available energy obtained from the battery, as compared with that expended in charging it, to 18 per cent.

Lastly comes the very important question as to the retention of charge during a long time. To test this I charged three cells and locked them in a closet on February 1st, where they remained until February 16th, when I began discharging them at the rate of 32 amperes, continuing this rate of discharge on the next day. I thus obtained 266.7 ampere hours of current.

Comparing this with the 286.5 ampere hours of current obtained from the other cells which I discharged soon after charging them, shows a loss of 7 per cent. caused by standing for sixteen days.

The above measurements and comparisons show that this storage battery has attained a degree of efficiency which will render it applicable to a number of uses. Thus, for example, on steam-boats, by the use of such storage batteries, the irregular and occasionally interrupted motion of the main engine might operate a relatively small dynamo-electro machine so as to charge the batteries during the entire twenty-four hours, and the current from these batteries would then supply light with perfect steadiness during the relatively brief time in which it is required. In this way the cost of supplying and running a special and large engine, which would be needed for operating the same lights directly without the storage battery, would be avoided, and also the necessity for extreme steadiness in running the dynamo, and all risks of extinction of the lights, from a momentary interruption of motion in any part of the machinery would be removed, as the battery would secure an absolutely steady and continuous supply of current no matter how little regular might be the action of the engine or dynamo-electric machine.

Again, in larger buildings the engine used to operate the elevator or to do any other work, if of sufficient power, could charge the storage battery without interrupting its regular work, and thus supply the light needed at a minimum cost for special machinery and skilled supervision.

In private houses where the running of a large engine with extreme smoothness and absolute certainty during the hours when light is needed, would be out of the question, a small engine operated at convenient intervals, and with no need of regularity or of fixed hours, would accomplish all that was required if a storage battery was employed with it.

I am informed that these storage batteries have been successfully applied to the running of street cars, and in view of the fact that they will contain almost 2,000,000 foot-pounds of energy for each eighty pounds of dead weight, I should consider the prospect in this direction most encouraging.

In short it seems to me that there is manifestly a wide field for the profitable employment of this greatly improved form of the electric storage battery.—*Van Nostrand's Magazine.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The large rainfall which characterized the second decade of May has been followed by heavy precipitation till the present date—June 20th.

There have been no specially severe storms at this station and the same is generally true through the State, and the damage from wind and floods have been less than usual this year in Kansas.

Winter grains are fast approaching the harvest and are in good order so far. Likewise at present date the corn is coming forward rapidly, with promise of a large crop. These facts are so intimately connected with meteorology that they do not appear out of place in this record.

The prevailing winds have been south, and no very warm weather occurred till the middle of June.

The highest barometric pressure was June 3d, 29.140, reduced 30.096; the lowest barometric pressure was June 11th 28.680, reduced 29.524.

The highest temperature 92°, June 20th; the lowest temperature 38°, May 21st.

Slight frosts occurred May 21st and 22d.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	May 20th to 31st.	June 1st to 10th.	June 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	..	..	..	..
Max	.	..	..	..
Min. and Max	..	..	..	..
Range	..	..	..	..
TRI-DAILY OBSERVATIONS.				
7 a. m.	54.6	62.2	69.6	62.1
2 p. m.	70.7	77.1	83.0	76.9
9 p. m.	60.6	64.3	72.6	65.8
Mean	61.9	67.3	74.1	68.2
RELATIVE HUMIDITY.				
7 a. m.	.907	.948	.909	.92
2 p. m.	.718	.769	.739	.74
9 p. m.	.691	.920	.861	.82
Mean	.771	.880	.833	.83
PRESSURE AS OBSERVED.				
7 a. m.	28.95	28.94	28.92	28.94
2 p. m.	29.05	28.91	28.90	28.95
9 p. m.	28.94	28.93	28.82	28.90
Mean	28.98	28 93	28.91	28.93
MILES PER HOUR OF WIND.				
7 a. m.	16.0	8.5	16.2	13.6
2 p. m.	20.1	15.3	14.0	14.8
9 p. m.	12.4	9.9	13.4	11.9
Total miles	3785	2736	3639	10160
CLOUDING BY TENTHS.				
7 a. m.	3.2	6.2	3.9	4.4
2 p. m.	4.3	4.6	6.0	5.0
9 p. m.	5.5	5.2	4.0	4.9
RAIN.				
Inches	2.70	2.38	2.52	7.60

ANTI-CYCLONIC STORMS.

PLINY EARLE CHASE, LL.D.

The science of meteorology may, for many good reasons, be regarded as a peculiarly American science. William Ferrel's discussion of the motion of fluids and solids relative to the earth's surface, which was first published in the summer of 1856, placed the laws of cyclonism and anticyclonism on a solid mathematical basis. He showed that, in the northern hemisphere, all moving bodies are constantly subjected, in consequence of the earth's rotation, to a deflection towards the right hand. Hence all atmospheric surface currents which are mainly governed by a downward pressure, tend to curve in the direction of the hands of a watch, or successively through north, east, south, west. All surface currents which are mainly governed by an upward pressure, tend to flow in an opposite direction, or through north, west, south, east.[1] The heavy winds are called anticyclonic; the light winds, cyclonic.

1 This will be evident, if we imagine ourselves to be lying in the current and facing the direction toward which the pressure tends.

There can be no descending currents in one place without ascending currents in another; therefore, in every atmospheric disturbance, there must be simultaneous cyclonic and anticyclonic winds. Such disturbances originate either in an unusual cooling and condensation, or in an unusual heating and expansion of air. In the former case the inflow, in the upper regions of the atmosphere, will produce an increased pressure. In the latter, the outflow will produce a diminution of pressure. In the restoration of equilibrium, currents of warm air are often brought into contact with colder currents. If the currents are both saturated with moisture, or if they contain more vapor than can be retained under the temperature of the mixed currents, precipitation takes place, in the form of rain, hail, or snow. This precipitation reduces the weight of the atmospheric column and the barometer falls. Accordingly, there is a constantly increasing tendency to cyclonism about storm centres, and there has been a very prevalent disposition to look upon all storms as of cyclonic origin.

A little reflection, however, will show that the initial mixture of currents may be due to either of the causes above mentioned; either to the flow of warmer air into a cold depression at the top of the atmosphere or to a flow of cold air, at the earth's surface, towards a region of low barometric pressure. In the former case, the initial superficial currents are determined by a downward pressure and they are, therefore, anticyclonic; in the latter they are determined by an upward pressure and are cyclonic.

A careful study of the weather-maps shows that the heaviest rains and snows occur in advance of the centres of low barometric pressure, or in the rear of the centres of high barometric pressure. If storms began in the cyclonic currents, the reverse should be true; the greatest effect following the low centre and preceding the high centre.

The frequent failures of forecasts, during the past winter, seem to have been mainly due to a misinterpretation or a misconception of these facts, to which the writer first called attention in 1871 (Proc. Amer. Phil. Soc. XII, 40). They were subsequently embodied in the "Suggestions" of the Signal Service Bureau, and the officers of the Bureau communicated to the public journals some remarkable evidences of anticyclonism in storms of great magnitude.

Loomis's subsequent discussions of the Signal Service observations have furnished abundant additional evidence of a like character, and have shown the great frequency of anticyclonism at the beginning, and during the continuance of showers and of storms of all kinds.

The limit between anticyclonic and cyclonic tendencies, may be approximately assumed to be midway between the centres of high and low barometric pressure. All cloudiness or precipitation between the limit and the high centre, represents anticyclonic influence; all between the limit and the low centre represents cyclonic influence. Local cyclonism sets in soon after precipitation begins, and the anticyclonic influence is thus partially hidden; but a critical examination of the weather maps will show that the prevailing currents of the region often continue to be anticyclonic until the rain or snow is nearly, or quite over. The evidences of storm breeding and stormy anticyclonism will be more still striking, it the changes of barometric pressure are studied in connection with the beginnings and subsequent growth of cirrus, cumulus, and nimbus clouds, as well as with the rainfall and the final breaking up of cloudiness.

There are good reasons for believing that such study, systematically and thoroughly continued under the direction, and with the facilities of the Signal Service Bureau, would raise the successful verification of the Washington forecasts to an average of at least ninety-five per cent.—*Journal of the Franklin Institute.*

IMPROVEMENT OF THE NATIVE PASTURE-LANDS OF THE FAR WEST.

N. S. SHALER.

It is a well-known fact, that the greater part of the United States west of the meridian of Omaha is unfit for tillage. Here and there, there are strips of land, which have a larger rainfall, that may be brought under the plough; and along the rivers there are narrow belts of land that may be made tillable by irrigation. A portion of this region is utterly barren; but a large part of it—probably not far from one million square miles of the whole area, or an area nearly one hundred times the surface of Massachusetts—bears a scanty crop of grasses. The natural use of this region is already recognized: its sole worth is for the pasturage of cattle and sheep. Already a great herding industry has been created in this region, —one that has an important bearing on the food-supply of this country and of Europe. The only limitation on the great extension of this industry is found in the scantiness of the herbage and the inadequacy of the water-supply. The latter evil is probably remediable, in most cases at least, by wells or by storage reservoirs, which shall retain the abundant waterfall of the rainy season. I propose to offer some suggestion concerning the possibility of bettering the herbage of forage-plants.

All the grasses that now grow in that region make a scanty herbage. I am informed by stock-raisers that the best "ranges" require from fifteen to twenty acres to a head of horned cattle, and that from this unusual goodness the "ranges" decline in value, until, in many districts, a hundred acres is required to supply a beast. The wide extent of the ranges necessary to afford pasturage to herds of profitable numbers makes the supply of water more difficult than it otherwise would be.

It seems to me possible that the pasturage of this region might be materially improved by the introduction of grasses and other forage-plants indigenous to regions having something like the same conditions of climate. My reasons for hope in this matter are substantially as follows: the experience of settlement in this country shows that the grasses are more easily feralized than any other of our domesticated plants; several of them show a willingness to escape to the wilderness; so that there is hope that a careful selection in various lands might afford some other species that would run wild on our dry plains and mountains. European experiments in naturalizing grasses have been fairly successful, as in the case of grasses to protest dunes from the action of the wind.

There are many regions in the world where grasses have developed to suit just such conditions as we have on our plains; and in some of those regions the period for the process of development to go on has been far longer than in North America. In North America it has been but a single geological period since the vegetation of the plains and Rocky Mountains was well watered; while in Australia it seems likely that the dryness of the climate has been in existence from rather a remote past. The same is probably the case in the northern parts of Asia and in South Africa. Good effects from the introduction of foreign forage plants may be hoped for, if the only result were an increase in the variety of the herbage on the plains. With the poorest grasses there are generally wide interspaces between the tussocks of high-growing species. If these intervals could be filled with other forage-plants, the consequence would be a greater amount of food to the acre.

In the effort to naturalize foreign species of forage-plants, attention should be paid to all forms of plants that can afford pasturage or browsing. There are many forms that would be likely to do well along the streams, that might not succeed so well in the open country.

The regions that are likely to furnish plants calculated to flourish in a region of low rainfall include a large part of the earth's surface. Those that would succeed in Dakota are not likely to do well in Texas or Arizona. For the northern region, the uplands of northern Asia or of Patagonia are the most promising fields of search; while, for the middle and southern fields, the valley of the La Plata, southern Africa, Australia, and the Algerian district, may be looked to for suitable species.

The experiment is naturally one for the federal government to undertake, but it need not be costly. Three experimental stations—one in the northern part of Nebraska, one in Texas, and one in Arizona—would serve the needs of a thorough trial. Ten thousand dollars per annum at each station should meet all the expenses of a sufficient trial; at least, until it was proven that the experiment would be successful. If we add the expenses of a travelling student of wild forage-plants (perhaps another five thousand dollars), we would have a sufficient basis for practical work. If the result should be to increase by only one-tenth the beast-maintaining power of our wild lands, the effort would be worth many millions per annum to the nation. When we consider that the introduction of the species of Poa which receive the name of "blue-grass" has manifolded the pasturage-value of the regions where it flourishes, it is evident that the project is worth consideration.—*Science.*

ARCHÆOLOGY.

STEATITE QUARRIES AND UTENSILS.

G. C. BROADHEAD.

Dr. Charles Rau in Smithsonian Contribution, 1876, says that vessels consisting of hard kinds of stone occur rarely east of the Rocky Mountains. In the Atlantic and Middle States vessels of "potstone" (Steatite) have often been met with. They differ in quality of workmanship as well as shape. He figures a bowl-shaped vessel from Wyoming Territory, and says that by far the best have been found in the Californian Islands, some of them measuring over a foot in diameter, and nicely made and of very regular shape, as one from Los Pueblos, Santa Barbara Co., Cal. Dr. Rau also alludes to the Steatite tubes found in Tennessee, nicely polished and six inches in length.

In Vol. VII Geological Survey W. of 100th Meridian, Prof. F. W. Putnam and Dr. C. C. Abbott communicate much interesting matter concerning the finds in California. Plate VI has fifteen figures of steatite and serpentine vessels from Southern California. The specimens were chiefly obtained by Dr. Paul Schumacher from the islands of Santa Cruz and Santa Catalina. Old Soapstone quarries have been found in Virginia, near Washington, near Providence, Rhode Island, and in New Jersey.

A sketch on page 121 of Schumacher's Report in Vol. VII Geological Survey W. of 100th Meridian, shows the manner of quarrying out the steatite pot forms. It was worked around with a chisel of flint on slate and gradually loosened beneath, then smoothed and hollowed out. Steatite, Serpentine and sandstone have been chiefly used for making these vessels. Pages 117 to 124 inclusive in this volume are devoted to Dr. Paul Schumacher's Report. On the Island of Santa Catalini he discovered an ancient quarry of Steatite and Serpentine, the Steatite is usually of a greenish-gray color, sometimes showing hexagonal prisms in stellated groups, with pearly lustre and greasy touch. In some ledges it is more micaceous. At the quarries Dr. Schumacher found pots and fragments as well as tools and unfinished articles. Several quarries are named including one fifteen feet in diameter and five feet deep. Dr. S. concluded from the numerous outcrops and remains of workings that he had found the main factory of the *Ollas* of the Californian aborigines.

This stone has been in use since the times of Theophrastus and Pliny.

The stone of Siphus and Corno was hollowed in a lathe and formed into culinary vessels, was the variety of talcose rock called Potstone (*Lapis Ollaris*). These quarries were worked in ancient times.

Von Cotta on rocks defines Chlorite-Schist and Potstone as a Schistose aggregate of Chlorite, usually combined with quartz, sometimes also with feldspar, mica and talc, of a greenish color and scaly appearance. Talc-Schist is chiefly Talc with some quartz and feldspar, and of a greasy feel. The so-called French chalk is massive steatite; it is milk-white with a pearly lustre. The U. S. Geological Reports contain nothing bearing upon steatite in New Mexico.

Since the above was in type we have received the following note from Professor Otis T. Mason, of Columbian College, Washington, D. C., upon the same subject.—[ED. REVIEW.

"The substance of which the ancient pot, of which you sent me a fragment, was made, is a coarse variety of steatite or soapstone, a mineral that does not crack in the fire. It is, therefore, the very best substitute for pottery. Indeed, for the aborigines it was much better, since they did not have the appliances for thoroughly baking their clay. The subject of the natural sources of the minerals used in aboriginal arts has been one of absorbing interest to many archæologists, notably, Dr. George Fischer, of Freiburg, in Germany. At one time it was thought that all copper found in graves came from Lake Superior, all soapstone from Pennsylvania, and all mica from somewhere else. The settling of the country and a better acquaintance with geology are constantly bringing to light new sources of supply. I think the occurrence of steatite in the locality mentioned in your note, Central New Mexico, is new."

TERTIO-MILLENNIAL ACQUISITIONS.

Major David J. Miller returned yesterday, June 7th, from a trip down the country to Albuquerque on official business and thence to Socorro in the interest of the Tertio-Millennial Association in quest of objects of value and interest for exhibition at the approaching great exposition in this city. He went at the instance of the committee on antiquities, of which he is secretary. The principal objects obtained and which we believe are to be exhibited under the auspices of the Historical Society of New Mexico, are the following:

A fine oil-painting 6x4 feet, executed, it is supposed, during the time of San Carlos V, of Spain, sent it is said from Madrid to Mexico, and donated from Mexico to some one of the early churches in New Mexico, and now in the possession of Prof. Charles Longuemare, at Socorro.

An ivory statue, in good preservation, representing the Virgin Mary with the infant Jesus, about seventeen inches high. From analogy and calculation, it is thought it was made about the twelfth century from tusks of animals of that period.

An oil painting on elk skin, made in Mexico at least 200 years ago, 6x5 feet in size, representing the apparation of our Lady of Guadalupe, a principal character in the Catholic Church.

A fine oil-painting, the Adoration, 3½x2½ feet, oval, in possession of the churches many years and well preserved.

A fine oil-painting of General Manuel Armijo, the last governor of New Mexico under the Mexican Government, representing him life-size and in full dress as civil and military governor of New Mexico, the only such picture extant, now in possession of Hon. Santiago Baca, at Albuquerque.

Major Miller heard of numerous other objects in other parts of southern New Mexico, worthy of place at the exposition, but could not then go to where they are. We trust his committee will arrange to obtain them. Professor Longuemare will bring with him, besides, an immense amount of ores from the Socorro County mines, his collection of native precious stones in the rough, and many curious articles found among the ruins of the ancient people of New Mexico.

BOTANY.

AN ÆSTHETIC HOUR WITH MY HERBARIUM.

MARY E. HOLMES.

" Ye field-flowers! the gardens eclipse you, 'tis true,
Yet, wildlings of Nature, I dote upon you;
I love you for lulling me back into dreams
Of the blue Highland mountains, and echoing streams.
Not a pastoral song has a pleasanter tune
Than ye speak to my heart, little wildlings of June.
What landscapes I read in the primrose's looks,
And what pictures of pebbled and minnowy brooks
In the vetches that tangled the shore:
Earth's cultureless buds! to my heart you are dear!"

Thus sang the British poet and satirist, Thomas Campbell, 'ere the objects of his youthful enthusiasm had faded away, and his harp had been unstrung by domestic affliction. These wildwood tokens in my herbarium, these tassels in their tawny bloom, refresh one with the song of April brooks, and I greet them with a gladder welcome than when from the woodland shadows, the wild gardens of the prairie, or from the sheltering rock I plucked them.

This little plant, with its finely cut leaves, pearly white petals, and purplish brown anthers, reminds me of many a childhood's ramble on the Western Reserve. It is the *Erigenia bulbosa*—Daughter of Spring—is its fanciful name, and from this folio sheet, it suggests the carol of the robin and the song of the blue-bird as distinctly as they trilled a dozen years ago. Here is the downy Wind-Flower *Anemone patens*, *var. Pulsatilliana*, "little gosling" the prairie children call it,—a sturdy youth,

"For cold blew the bitter, biting north
Upon its early, humble birth,
Yet cheerfully it glinted forth
Amid the storm."

and clad in its silvery, silken hair it lifts its unassuming head in humble guise, long before its many cleft leaves arise from their frosty beds. On this sheet is the Trailing Arbutus, *Epigea repens,*—a pleasing reminder of an incident in the early history of our nation. When the dreary winter of 1620 was passing away, above the brown leaves so dry and dead, this little herald of spring was the first to greet the Pilgrims with its rosy hue and sweet perfume. "God be praised," said the fathers, "this is the promise of a future harvest; behold our May flower here," and this pretty plant thus christened "the May flower" upon the bleak shores of New England, has ever been sacred to love and hope.

There is a cluster of Bluets, *Houstonia cerulea,* with their pale blue faces and bright yellow eyes,—some of them, hoary from very age, donning the pure white,—all gathered from yonder meadow, where they form a rich tapestry fit for the gods to walk upon. These are gaudy Painted Cups, *Castilleja coccinea,* the admiration not alone of those untaught botanists, the Aborigines, who, in their wierd fancy believe the great Manitou has scattered these ragged, painted tufts as symbols of the warriors' feathers to be worn in the blissful hunting grounds, but of the amateur botanist who finds herself puzzled by the brilliant crests of the floral bracts, and watches and wonders till her own iris wears their blazing hue. The next is the American Senna, *Cassia Marilandica,* with its six to nine pair of oblong lanceolate leaflets, the wedge-shaped gland at the base of the petiole, and its bright, yellow flowers. The leaves of this plant with those of its cousins german, the *C. acutifolia* and *C. elongata,* natives of Africa, are the senna of commerce, so largely used by pharmacists. Closely allied to the Cassia is this Sensitive Plant, *Mimosa pudica,* with its pinkish flowers in globular heads, and digitate, primate leaflets, a native of Brazil, but often adorning our conservatories. Notice the knots at the several joints of the leaves; these are a sort of Leyden jar, an undefined electrometer, so sensitive to external pressure, the trembling of the ground, or surface irritation, that a single leaflet, a pair or more, as well as the entire leaf, will quickly announce any disturbance.

It is sometimes pleasant for us, when our faith is low, and we are conscious of our own ignorance and weakness, to have a lesson palpable, occult for daily study, to be strengthened by Nature as well as revelation, and perhaps no plant in all my herbarium has been to me such a simple object lesson as this one. For years it has been such a reminder that with a feeling quite akin to friendship, not to say reverence, it has been cultivated at my window, where I could not fail to have the lesson presented to my eyes. It is only the *Echinocystis lobata,* the wild Balsam Apple, *alias* Wild Cucumber, but from day to day it sends out its delicate tendrils, as if conscious not only of its need of support, but *certain* of finding it. It finds it, then strengthening and tightening its hold, it lifts itself up an inch, more or less, and the whole plant is stronger. It can now withstand a storm which before would have prostrated, or at least rudely marred it, and thus from day to day it lives a life of faith,—more, its beautiful and numerous monœcious racemes of greenish white flowers are the blessings beautifying the whole. The lesson to me is an impressive one, and ever new and helpful; the tendrils of faith are unnoticed by the world's casual observers, but the delicate flowers—the blessings—meet a ready appreciation.

This Gentian, *Gentian crinita*, with its solitary four-cleft corolla, gathering as it were into its fringe-edged chalice, the reflection of the pure autumnal sky, and bluer still by its draughts of nightly frost, has a language quite different from the Echinocystis—"Hope blossoming within the heart"—a continuance, and Gentius, the ancient Illyrian King could not have chosen a better genus to perpetuate his name. It is one of the few medicinal herbs which in the science of medicine, proves the survival of the fittest, for its history can be traced direct for 2000 years, and it is as useful and beautiful to-day as then, whether crowned with its yellow flowers on the plains of Illyria or the cerulean blue of our own country. I turn to the *Chrysanthemum roseum*, and over it broods the legend of the Moorish lady with jeweled hand and glittering necklace, clad in colors rare, threads of rose inwrought with gold. Under the dulcet tones of the guitar she sleeps and dreams of her lover, "who cometh not again," for she sees him die, and with a shriek she awakens to find the pledge of love sent home, two ringlets in a love-knot. As she swoons and dies, the red chrysanthemums upon her brow grow white as snow, and thus it is that the white chrysanthemum, whose odor, like that of many other flowers, is sweetest when crushed, is now an emblem of love that never dies. Nature holds out many a jewel for our adornment, her silent pictures fall into the tapestry of our life's work, and the language of flowers often comes to us pregnant with inspiration. So when with faint heart and sluggish indifference, I dreamily wish for some inheritance, the Mistletoe, *Phoradendron florescens*, meets me, unwrecked by fierce winds or scorching heats, maintaining its place, whether upon the topmost bough, pendant from some under-surface, or growing horizontally from the side of the tree, with its resolute cry "I surmount all difficulties."

"Thou must be true thyself,
If thou the truth would teach;—
Thy soul must overflow, if thou
Another's soul would reach.

"Speak truly, and thy word
Shall be a fruitful seed;
Live truly, and thy life shall be
A great and noble deed."

ROCKFORD SEMINARY, ILL., April 17, 1883.

BOOK NOTICES.

THE GOLDEN CHERSONESE: By Isabella L. Bird. Octavo, pp. 483, with illustrations and map. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson.

Mrs. Bishop certainly excels most travelers in selecting interesting travel-grounds and presenting their salient features attractively. She also has a faculty of picking up new items even in old fields and serving them up tastefully. Her previous books, such as "Unbeaten Tracks in Japan," "A Lady's Life in the Rocky Mountains," "The Hawaian Archipelago," etc., are well known evidences of these qualifications, and this latest volume is no exception.

The Golden Chersonese, known to the earlier geographers as *Cherronesus Aurea*, and to later ones as the Malay Peninsula, has been sung by Milton and other poets, described by Ptolemy, and its identity with the Ophir of Solomon discussed by many writers, but its actual metes and bounds are clearly understood by but comparatively few. The derivation of the word Chersonesus sufficiently indicates that it is a peninsula, and yet it is more generally than otherwise understood to be an archipelago, while the average reader rarely identifies it as Malacca.

It is nearly or quite as large as Lower California, but has twelve times as many inhabitants, or, about 375,000. It is rich in minerals, iron-ore of 60 per cent purity being used for macadamizing the roads, tin having been found in vast quantities in placers, and gold so abundantly, especially in the past, as to have given rise to the theory above alluded to that the country is the original "Ophir." The natives are so jealous of foreigners that but little is known of its internal government, geography, history, or natural products, and not more than half of its immense area has been explored. Consequently these letters of Mrs. Bishop's carry with them more than the ordinary piquancy and interest of travelers' stories in general.

It is difficult to point out the best chapters where all are good, sprightly and attractive. The reader will not regret giving a few hours to a perusal of the whole book.

FRENCH FOREST ORDINANCE OF 1669: Compiled and translated by John Croumbie Brown, LL.D., Edinburgh. Oliver & Boyd, 1883.

This celebrated ordinance, promulgated by Louis XIV, of France and Navarre, in 1669, though probably the basis and foundation of all forest-preserving laws that have followed since, has never before appeared in English dress. Professor Brown, in giving it and an account of the previous treatment of forests in France, has rendered a special service to the bibliography of forestry which all persons and countries interested should not be slow to acknowledge. He is devoted to this subject and as an evidence of his unselfishness in the cause, proposes to employ without deduction all the proceeds of sales of this volume and that upon "The Forests of England," which we noticed in the April number of the REVIEW, in the publication of some similar work, several of which he has in contemplation. The perusal of this ordinance will prove to most readers a very curious and interesting occupation, and one which will amply repay them for the time bestowed upon it.

TOPICS OF THE TIME, Vol. I, No. I: Edited by Titus Munson Coan. 12mo. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; Cloth 60c, Paper 25c.

The above named enterprising publishers have commenced a series of essays by the best writers of the day, to be issued monthly under the general title of of *Topics of the Time.* The first number is devoted to "Social Problems," comprising World-Crowding, by Robert Griffin; Europe in Straits, from *Blackwood's Magazine;* Secret Societies in France, by Jehan de Paris; Home Rule and Secession, by J. Woulfe Flanagan; A Democrat on the Coming Democracy, by Henry Laboucherie; The European Terror, by Emile de Laveleye; The Nationalization of the Land, from the *Edinburgh Review;* A Politician in Trouble about his Soul, by Auberon Herbert.

The grouping of topics by volumes is the distinguishing feature of the present series, thus giving the reader a comprehensive view of the discussions of which they form a part. The next volume will be entitled Studies in Biography, comprising a sketch of the lives of Gambetta, Swift, Miss Burney, Wilberforce and other prominent figures in history.

THIRD BIENNIAL REPORT OF THE KANSAS STATE BOARD OF AGRICULTURE. Wm. Sims, Secretary. Octavo, pp. 710. Kansas Publishing House, Topeka, 1883.

This is the third of these handsome volumes which, in our judgment, have done so much more to promote the growth and development of the resources of Kansas than anything else. It includes the years 1881 and 1882, and embraces the reports of appointed officers, together with statistical exhibits, colored outline map of the State, sectional map of each county showing their relative size and location, railroads, water-powers, coal mines, etc.

The Geological Report is made by Professor O. St. John and comprises some thirty pages. Professor J. H. Carruth, of the Kansas University, makes a report of "Additions to the Catalogue of Kansas Plants." Professor John W. Robson one upon "Practical Botany—Its Relations to Agriculture." Professor E. A. Popenoe one upon "Entomology." Professor Hawn furnishes a very complete Meteorological Record for 1881 and 1882. Professor G. H. Failyer, of the Kansas Agricultural College, contributes an article upon "Scientific Agriculture." Professor G. W. Hoss describes in full the School System of Kansas, and D. B. Long, the State Fish Commissioner, makes a report upon "Fish Culture."

This valuable and comprehensive volume concludes with a chapter upon the public lands, Government, State, and railroad, now offered for sale, with amounts, prices, land offices, etc. No better means of developing the resources of the State than this can be devised, and it would be well for Missouri if some similar plan should be adopted.

Authors and Publishers: Octavo, pp. 96. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson.

This is sent out as a manual of suggestions for beginners in literature, and comprises a description of publishing methods and arrangements, directions for the preparation of manuscripts for the press, explanations of the details of book-manufacturing, instructions for and examples of proof-reading, samples of printing in various sized type, the United States Copyright Law, and information concerning international copyright, general hints for authors, etc.

No book of the kind that we have ever seen covers the whole ground so well and it will be found useful to all classes of writers and interesting to most readers.

The American Citizens' Manual, Part II; By Worthington C. Ford. 8vo. pp. 184. G. P. Putnam's Sons, New York, 1883.

In Part I of this work the author considers the functions of the government, with special reference to National, State, and local Governments, the electorate, the civil service, etc. In Part II he discusses the questions of personal rights, protection to property; the function of the Federal Government, its war-power, foreign relations, regulation of commerce, naturalization laws, post-offices, post-roads, Indian policy, disposition of public lands, etc. Also the functions of State governments as regards corporations, education, charitable institutions, State finances, etc.

It is an exceedingly valuable work for citizens of all classes, whether native-born or naturalized, and would make an excellent class-book for older students in our schools and colleges.

EDITORIAL NOTES.

THE Kansas City Academy of Science has recently purchased the valuable and extensive collection of fossils, minerals, archæological relics, shells, birds and insects, made by Judge E. P. West during a number of years past. The Academy has also taken larger rooms, purchased some new cases for its enlarged collection and will soon have its library and museum in order for the use and benefit of its members and the public.

WE were visited on the 20th of June by Dr. Steven bowers, of Falls City, Nebraska. The Doctor was for several years engaged in archæological explorations on the Pacific Coast, part of the time under the direction of the Smithsonian Institution, and has written some valuable papers for the REVIEW and other scientific magazines, besides sending a large number of highly prized specimens to the National Museum. He will soon return to California, from where he promises to send an occasional article for the benefit of our readers.

THE article upon "Steatite Quarries and Utensils," by Professor Broadhead, and the note by Professor Otis T. Mason on the same subject, were written in reply to an inquiry by us, whether the finding of a steatite pot in Central New Mexico, lately, was in any respect peculiar, the writer having never before heard of any similar find, either of the manufactured article or of the substance itself in position in that region.

THE Tertio-Millennial Celebration of the settlement of Santa Fé, which commences this week, will be a highly interesting affair, and those persons who have never visited that portion of our country should take advantage of this opportunity to observe the manners and customs of a people and a civilization that are fast passing away and being merged in those of to-day. Railroads and Yankees are the antipodes of archæology and the antique, and it will be but a little while before all traces of the Aztec life will utterly disappear from New Mexico.

THE article on the History of Railroads in Missouri, in the present number, was written by Hon. Geo. C. Pratt, member of the State Board of Railroad Commissioners, and is the most complete and readable condensation of the subject that has yet been published.

PROFESSOR S. H. TROWBRIDGE, of Glasgow, Mo., who has spent many years teaching Natural History, is now devoting himself to supplying schools, colleges, or individuals with suitable collections of illustrative specimens. We know of no man in the west more able or better prepared to do this satisfactorily.

PROFESSOR R. T. BOND, of Glasgow, Mo., in remitting for the REVIEW says, "I prize it very highly and wish you much success in its publication."

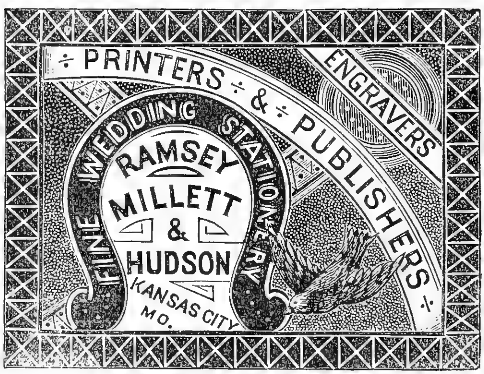
ITEMS FROM PERIODICALS.

THE *Atlantic Monthly* for July, 1883, presents the following attractive table of contents: A Roman Singer, I, II, F. Marion Crawford. Some Phases of Idealism in New England, O. B. Frothingham. A Prelude, Maurice Thompson. En Province, I, Henry James. Something Passes, Edith M. Thomas. Tompkins, P. Deming. Service, E. R. Sill. Oxford in Winter, Harriet Waters Preston. Newport, I, II, George Parsons Lathrop. Boomtown, Frank D. Y. Carpenter. Municipal Extravagance, Arthur Blake Ellis. Mr. Washington Adams in England, II, Richard Grant White. Sylvan Station, Caroline E. Leighton. American Fiction by Women. Jones Very. American Economics. The Freedom of Faith. Dobson's Fielding. The Contributors' Club. Books of the Month.

THE *Journal of Education*, which keeps fully up to the times in all educational matters, east or west, says that the Supreme Court of Missouri has decided that the expenditure by the St. Louis Board of its revenues, for the purpose of admitting and instructing in their schools children under the age of six years, is a use of its funds not authorized by the State constitution, but forbidden. This practically forbids public kindergartens in the City of St. Louis. The same court has decided that the teaching of the arts, sciences, and languages, other than English, is authorized by law.

THE *Magazine of American History* for June, has been received. It is now edited by Mrs. Martha L. Lamb, and published by the Historical Publication Society, 30 LaFayette Place, New York, monthly $5.00 per annum.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VII. AUGUST, 1883. NO. 4.

ASTRONOMY.

ECLIPSES FROM 1800 TO 1900.

WM. DAWSON, SPICELAND, IND.

It has been my intention to give in the catalogue below the date of every eclipse of the 19th century; though I think it possible that one or two very small ones may not have been found. I am satisfied that no one of much size or importance has been omitted. Most of those from 1800 to 1850 were determined by the Saros, though several were calculated by a more tedious and accurate process—as a check on Saros determinations, and to find some particulars which the Saros cannot give. The eclipses of 1800, of course, are not counted in this century, but given as a sort of convenience.

The dates given are intended to be the nearest hour of *Washington Time*, though it is probable that some in the early part of the century may be rather more than an hour from the time of actual occurrence. A catalogue in Chamber's astronomy, is the basis for many in the last half of the century. Those of 1866 to 1885 inclusive, were copied from the Nautical Almanac with the addition of the Node, which in all cases, I have given mainly to ascertain (at thought) the direction of series of eclipses, especially solar ones. Those at the descending node tend northward; while those at the ascending node go south.

In glancing over the table we soon observe that eclipses generally occur two or three in a month's time, then no more for nearly half a year. More than three can never occur at the same node; and it takes nearly six months for the Sun to pass half round—from one node to the other. Thus there are always two eclipse seasons in a year; and when one occurs near the first of January a third one sets in near the close of December. It will also be noticed that they return about twenty days earlier each year—caused by the nodes falling back on the ecliptic—being in April and October in 1800; and mostly in January and July in 1805. So in eighteen years and eleven days they go through the full circle of the ecliptic and return to April and October; but ten or eleven days later in the months. Here we see an indication of the Saros, the use and application of which were described in the REVIEW for March, 1882. You may take either of the eclipses of 1800 and find that it recurred every eighteen years and ten or eleven days through the century, excepting the lunar eclipse of October 2d, which disappeared, or *wore off*, in 1872, November 14th.

The eclipse of 1835, June 10th, was the first one of a new series. So was that of July 28, 1870. A series of solar eclipses "wore off" in 1859, Feb-uary 2d, near South Pole (being at the "A. N.") The eclipse of 1890, June 3d, is the last of that series—until it comes round again in about 13,000 years. Thus a set of eclipses begins, or one ends, on an average of about every Saros. The size or magnitude, given in the table, is the largest that the eclipse appears anywhere on the earth. A central eclipse of the Sun with its partial eclipse each side of the Central Line extends over a belt of the world 4,000 to 5,000 miles wide, and about 10,000 miles long—bearing northeasterly when it occurs at the A. N., and southeasterly when at the D. N. When two places are named in the column "where visible," for the Sun they indicate, approximately, the beginning and end of the Central Line; and for the Moon, the middle meridian of the hemisphere in which it is visible.

It may be observed that no United States *year* of the century produced seven eclipses. But an eclipse of the Sun occurred 1804, December 31, 8 P. M., which was January 1st, 1 A. M., 1805, in England. Now, there were six eclipses after this one in that year—making seven eclipses (the greatest number that can ever be in one year) in 1805 in the eastern hemisphere; but only six in the same year of western hemisphere time. There were nearly seven eclipses in 1823—the last one occurring about four hours after New Year's day, 1824, Washington time. But about five hours, or 75°, west of Washington, it was still 1823 when the eclipse took place. So there was a narrow belt of Central Pacific—probably including Sandwich and Society Islands—where seven eclipses occurred in its year 1823. In the first fifty years of the century there were 199 eclipses; and 196 in the last fifty years—395 in all.

ECLIPSES FROM 1800 TO 1900 A. D.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1800	Moon.	April 9th,	Noon.	0.3	D. N.	Asia.
"	Sun.	April 23d,	4 P. M.	Ann.	A. N.	Oregon.
"	Moon.	October 2d,	5 P. M.	0.3	A. N.	Europe.
"	Sun.	October 17th,	7 A. M.	Ann.	D. N.	South of Cape Good Hope.
1801	Moon.	March 29th,	11 P. M.	Total.	D. N.	United States.
"	Sun.	April 12th,	9 P. M.	0.6	A. N.	Nova Zembla.
"	Moon.	Septemb'r 22d,	4 A. M.	Total.	A. N.	Western America.
"	Sun.	October 7th,	3 P. M.	0.3	D. N.	Antarctic Continent.
1802	Sun.	March 4th,	1 A. M.	Total.	A. N.	Indian Ocean.
"	Moon.	March 19th,	4 A. M.	0.6	D. N.	Western America, Pacific.
"	Sun.	August 27th,	10 P. M.	Total.	D. N.	North Pacific.
"	Moon.	Septemb'r 11th	3 P. M.	0.8	A. N.	Western Asia.
1803	Sun.	February 21st,	7 P. M.	Total.	A. N.	Central Pacific.
"	Sun.	August 17th,	1 A. M.	Ann.	D. N.	Black Sea to New Guinea.
1804	Moon.	January 26th,	6 P. M.	0.4	D. N.	Europe.
"	Sun.	February 12th,	9 A. M.	Ann.	A. N.	West Indies, Turkey.
"	Moon.	July 22d,	11 A. M.	0.9	A. N.	China, Sumatra.
"	Sun.	August 5th,	Noon.	Total.	D. N.	Patagonia.
"	Sun.	Decemb'r 31st	8 P. M.	0.3	A. N.	South Pole.
1805	Moon.	January 15th,	4 A. M.	Total.	D. N.	Western America, Pacific.
"	Sun.	January 30th,	3 P. M.	0.15	A. N.	Russian America.
"	Sun.	June 26th,	6 P. M.	0.5	D. N.	Eastern Siberia.
"	Moon.	July 10th,	Noon.	Total.	A. N.	China, Sumatra.
"	Sun.	July 25th,	Midnight.	0.7	D. N.	South of Cape Good Hope.
"	Sun.	Decemb'r 20th	8 P. M.	Total.	A. N.	South Pole.
1806	Moon.	January 4th,	10 P. M.	0.9	D. N.	South America.
"	Sun.	June 16th,	11 A. M.	Total.	D. N.	Ohio, New York.
"	Moon.	June 30th,	1 P. M.	0 1	A. N.	Eastern Asia.
"	Sun.	December 9th,	Midnight.	Ann.	A. N.	North Australia.
1807	Sun.	June 5th,	10 P. M.	Ann.	D. N.	Sandwich Islands.
"	Moon.	Novemb'r 15th	3 A. M.	0.3	D. N.	United States, Pacific.
"	Sun.	Novemb'r 29th	Noon.	Total.	A. N.	Cuba, Gibraltar.
1808	Moon.	May 10th,	2 A. M.	Total.	A. N.	United States.
"	Sun.	May 25th,	2 A. M.	0.9	D. N.	Australia.
"	Sun.	October 19th,	3 P. M.	0.2	A. N.	South Pacific.
"	Moon.	November 3d,	4 A. M.	Total.	D. N.	Western America.
"	Sun.	Novemb'r 17th	Midnight.	0.6	A. N.	Northern Asia.
1809	Sun.	April 14th,	Noon.	0.8	D. N.	British America.
"	Moon.	April 29th,	7 P. M.	Total.	A. N.	Europe and Africa.
"	Sun.	October 9th,	5 A. M.	Ann.	A. N.	Southern Africa.
"	Moon.	October 23d,	5 A. M.	0.9	D. N.	California.
1810	Sun.	April 3d,	8 P. M.	Total.	D. N.	North Pacific.
"	Sun.	Novemb'r 28th	Noon.	Ann.	A. N.	South America.
1811	Moon.	March 10th,	2 A. M.	0.2	A. N.	United States.
"	Sun.	March 24th,	9 A. M.	Total.	D. N.	S. America, South'n Africa.
"	Moon.	September 2d,	7 P. M.	0.3	D. N.	Africa, Europe.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1811	Sun.	Septemb'r 17th	1 P. M.	Ann.	A. N.	United States.
1812	Sun.	February 12th,	6 P. M.	0.3	D. N.	Eastern Siberia.
"	Moon.	February 25th,	Midnight.	Total.	A. N.	Eastern United States.
"	Sun.	March 13th,	2 A. M.	0.5	D. N.	South of Australia.
"	Moon.	August 22d,	10 A. M.	Total.	D. N.	Japan, Australia.
"	Sun.	Septemb'r 5th,	1 P. M.	0.3	A. N.	Greenland.
1813	Sun.	February 1st,	9 A. M.	Ann.	D. N.	South Europe, Florida.
"	Moon.	February 15th,	4 A. M.	Total.	A. N.	Eastern Pacific.
"	Sun.	July 27th,	10 A. M.	Total.	A. N.	South Atlantic.
"	Moon.	August 11th,	8 P. M.	0.9	D. N.	Europe, Africa.
1814	Sun.	January 21st,	10 A. M.	Ann.	D. N.	Brazil.
"	Sun.	July 17th,	1 A. M.	Total.	A. N.	Hindostan, Borneo.
"	Moon.	Decemb'r 26th	10 P. M.	0.6	A. N.	United States.
1815	Sun.	January 10th,	10 A. M.	Ann.	D. N.	South Atlantic.
"	Moon.	June 21st,	10 A. M.	Total.	D. N.	Pacific.
"	Sun.	July 6th,	6 P. M.	Total.	A. N.	British America.
"	Moon.	Decemb'r 16th	11 A. M.	Total.	A. N.	Japan.
"	Sun.	Decemb'r 30th	11 A. M.	0.4	D. N.	Near South Pole.
1816	Sun.	May 26th,	8 P. M.	0.8	A. N.	East of Australia.
"	Moon.	June 9th,	7 P. M.	Total.	D. N.	Africa.
"	Sun.	Novemb'r 19th	8 A. M.	Total.	D. N.	Southern Spain.
"	Moon.	December 4th,	5 P. M.	0.5	A. N.	Europe.
1817	Sun.	May 15th,	11 P. M.	Ann.	A. N.	East Indies.
"	Sun.	November 8th,	Midnight.	Total.	D. N.	Australia.
1818	Moon.	April 20th,	7 P. M.	0.2	D. N.	England, Africa.
"	Sun.	May 4th,	12 P. M.	Ann.	A. N.	Southeastern Siberia.
"	Moon.	October 14th,	1 A. M.	0.2	A. N.	United States.
"	Sun.	October 28th,	3 P. M.	Ann.	D. N.	Cape Horn.
1819	Moon.	April 10th,	7 A. M.	Total.	D. N.	Central Pacific.
"	Sun.	April 24th,	5 A. M.	0.7	A. N.	Greenland, Siberia.
"	Moon.	October 3d,	Noon.	Total.	A. N.	Central Asia.
"	Sun.	October 18th,	11 P. M.	0.3	D. N.	Near South Pole.
1820	Sun.	March 14th,	6 A. M.	Total.	A. N.	South Atlantic, S. Africa.
"	Moon.	March 29th,	Noon.	0.7	D. N.	India, Indian Ocean.
"	Sun.	September 7th,	6 A. M.	Ann.	D. N.	North Europe, North Asia.
"	Moon.	Septemb'r 21st	11 P. M.	0.9	A. N.	United States.
1821	Sun.	March 4th,	3 A. M.	Total.	A. N.	Southeast Africa.
"	Sun.	August 27th,	9 A. M.	Ann.	D. N.	West Africa.
1822	Moon.	February 6th,	2 A. M.	0.3	D. N.	United States.
"	Sun.	February 22d,	5 P. M.	Ann.	A. N.	Northwest America.
"	Moon.	August 2d,	5 P. M.	0.8	A. N.	Africa.
"	Sun.	August 16th,	6 P. M.	Total.	D. N.	Southern Pacific.
1823	Sun.	January 12th,	4 A. M.	0.02	A. N.	South Pole.
"	Moon.	January 26th,	1 P. M.	1.73	D. N.	China.
"	Sun.	February 10th,	11 P. M.	0.20	A. N.	Northern Europe.
"	Sun.	July 8th,	1 A. M.	0.33	D. N.	Southern Siberia.
"	Moon.	July 22d,	7 P. M.	1.5	A. N.	Atlantic, Africa.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1823	Sun.	August 6th,	9 A. M.	0.5	D. N.	South of Cape Horn.
1824	Sun.	January 1st,	4 A. M.	Ann.	A. N.	Indian Ocean.
"	Moon.	January 16th,	4 A. M.	0.78	D. N.	America.
"	Sun.	June 26th,	5 P. M.	Total.	D. N.	Western United States.
"	Moon.	July 10th,	8 P. M.	0.1	A. N.	Africa.
"	Sun.	Decemb'r 20th	8 A. M.	Ann.	A. N.	Atlantic, Africa.
1825	Sun.	June 16th,	5 A. M.	Ann.	D. N.	Africa.
"	Moon.	Novemb'r 25th	Noon.	0.2	D. N.	Sumatra, China.
"	Sun.	December 9th,	7 P. M.	Total.	A. N.	North Central Pacific.
1826	Moon.	May 21st,	10 A. M.	Total.	A. N.	Pacific Ocean.
"	Sun.	June 5th,	10 A. M.	Ann.	D. N.	South Atlantic.
"	Sun.	October 30th,	11 P. M.	0.1	A. N.	Near Cape Horn.
"	Moon.	Novemb'r 14th	Noon.	Total.	D. N.	China, Sumatra.
"	Sun.	Novemb'r 29th	9 A. M.	0.7	A. N.	Greenland.
1827	Sun.	April 25th,	8 P. M.	0.9	D. N.	North of Behring Strait.
"	Moon.	May 11th,	3 A. M.	Total.	A. N.	Western United States.
"	Sun.	October 20th,	1 P. M.	Ann.	A. N.	Southeast of Cape Horn.
"	Moon.	November 3d,	1 P. M.	0.8	D. N	Russia, Indian Ocean.
1828	Sun.	April 14th,	4 A. M.	Total.	D. N.	Hindoostan.
"	Sun.	October 9th,	1 A. M.	Ann.	A. N.	Australia, Cape Horn.
1829	Moon.	March 20th,	8 A. M.	0.2	A. N.	Eastern Pacific.
"	Sun.	April 3d,	5 P. M.	Total.	D. N.	South Pacific.
"	Moon.	Septemb'r 13th	2 A. M.	0.4	D. N.	United States.
"	Sun.	Septemb'r 27th	8 P. M.	Ann.	A. N.	Central Pacific.
1830	Sun.	February 24th,	1 A. M.	0.3	D. N.	Eastern Siberia.
"	Moon.	March 9th,	8 A. M.	Total.	A. N.	Japan.
"	Sun.	March 24th,	9 A. M.	0.5	D. N.	Cape Horn.
"	Moon.	September 2d,	5 P. M.	Total.	D. N.	Eastern Europe.
"	Sun.	Septemb'r 16th	8 P. M.	0.4	A. N.	Siberia.
1831	Sun.	February 12th	1 P. M.	Ann.	D. N.	New York, Massachusetts.
"	Moon.	February 26th	Noon.	0.9	A. N.	China, Sumatra.
"	Sun.	August 7th,	5 P. M.	Total.	A. N.	South Pacific.
"	Moon.	August 23d,	4 A. M.	0.9	D. N.	Pacific Ocean.
1832	Sun.	February 1st,	5 P. M.	Ann.	D. N.	Sandwich Islands.
"	Sun.	July 27th,	8 A. M.	Total.	A. N.	Brazil.
1833	Moon.	January 6th,	3 A. M.	0.5	A. N.	California.
"	Sun.	January 20th,	5 P. M.	Ann.	D. N.	South Pacific.
"	Moon.	July 1st,	7 P. M.	0.9	D. N.	Europe, Africa.
"	Sun.	July 17th,	1 A. M.	Total.	A. N.	Eastern Asia.
"	Moon.	Decemb'r 26th	5 P. M.	Total.	A. N.	Europe.
1834	Sun.	January 9th	6 P. M.	0.41	D. N.	Near South Pole.
"	Sun.	June 7th,	3 A. M.	0.8	A. N.	Indian Ocean.
"	Moon.	June 21st,	2 A. M.	Total.	D. N.	United States.
"	Sun.	Novemb'r 30th	2 P. M.	Total.	D. N.	United States.
"	Moon.	Decemb'r 15th	Midnight.	0.6	A. N.	United States.
1835	Sun.	May 27th,	6 A. M.	Ann.	A. N.	South Atlantic.
"	Moon.	June 10th,	5 P. M.	0.05	D. N.	Russia, Africa.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE	WHERE VISIBLE.
1835	Sun.	Novemb'r 20th	7 A. M.	Total.	D. N.	S. America, S. Atlantic.
1836	Moon.	May 1st,	2 A. M.	0.2	D. N.	United States.
"	Sun.	May 15th,	8 A. M.	Ann.	A. N.	England.
"	Moon.	October 24th,	8 A. M.	0.2	A. N.	Japan, Australia.
"	Sun.	November 8th	10 P. M.	Ann.	D. N.	South of Australia.
1837	Moon.	April 20th,	2 P. M.	Total.	D. N.	Asia.
"	Sun.	May 4th,	1 P. M.	0.7	A. N.	Hudson's Bay.
"	Moon.	October 13th,	6 P. M.	Total.	A. N.	Europe, Africa.
"	Sun.	October 29th,	6 A. M.	0.3	D. N.	Near South Pole.
1838	Sun.	March 25th,	4 P. M.	Total.	A. N.	South Pacific.
"	Moon.	April 9th,	7 P. M.	0.7	D. N.	Western Asia.
"	Sun.	Septemb'r 18th	1 P. M.	Ann.	D. N.	British America, N. Atlantic
"	Moon.	October 3d,	6 A. M.	0.9	A. N.	Central Pacific.
1839	Sun.	March 15th,	10 A. M.	Total.	A. N.	Guinea.
"	Sun	Septemb'r 7th,	4 P. M.	Ann.	D. N.	Central Pacific.
1840	Moon.	February 17th	9 A. M.	0.3	D. N.	Japan, Australia.
"	Sun.	March 3d,	Midnight.	Ann.	A. N.	Siberia.
"	Moon.	August 13th,	1 A. M.	0.6	A. N.	United States.
"	Sun.	August 27th,	2 A. M.	Total.	D. N.	Indian Ocean.
1841	Sun.	January 22d,	Noon.	0.02	A. N.	South Pole.
"	Moon.	February 5th,	9 P. M.	Total.	D. N.	United States, Atlantic.
"	Sun.	February 21st,	6 A. M.	0.2	A. N.	Greenland, Russia.
"	Moon.	August 2d,	5 A. M.	Total.	A. N.	Pacific.
"	Sun.	July 18th,	9 A. M.	0.3	D. N.	Baffin's Bay to Germany.
"	Sun.	August 16th,	4 P. M.	0.5	A. N.	Antarctic Continent.
1842	Sun.	January 11th,	Noon.	Ann.	A. N.	South America.
"	Moon.	January 26th,	2 P. M.	0.8	D. N	Asia.
"	Sun.	July 7th,	Midnight.	Total.	D. N.	Eastern Europe.
"	Moon.	July 22d,	4 A. M.	0.3	A. N.	Pacific.
"	Sun.	December 31st	3 P. M.	Ann.	A. N.	Southern Pacific.
1843	Sun.	June 27th,	2 P. M.	Ann.	D. N.	Marquesas Island, Bolivia.
"	Moon.	December 6th,	8 P. M.	0.3	D. N.	Europe.
"	Sun.	Decemb'r 21st	2 A. M.	Total.	A. N.	China, Niphon.
1844	Moon.	May 31st,	5 P. M.	Total.	A. N.	Europe, Africa.
"	Sun.	June 15th,	5 P. M.	0.9	D. N.	South Pacific.
"	Sun.	Novemb'r 10th	6 A. M.	0.1	A. N.	South Pacific.
"	Moon.	Novemb'r 24th	7 P. M.	Total.	D. N.	Atlantic.
"	Sun.	December 9th,	7 P. M.	0.7	A. N.	Russian America.
1845	Sun.	May 6th,	3 A. M.	0.7	D. N.	Siberia.
"	Moon.	May 21st,	10 A. M.	Total.	A. N.	China, Australia.
"	Sun.	October 30th,	8 P. M.	Ann.	A. N.	South Australia.
"	Moon.	Novemb'r 13th	8 P. M.	0.9	D. N.	Eastern Atlantic.
1846	Sun.	April 25th,	Noon.	Ann.	D. N.	Mexico, West Indies.
"	Sun.	October 20th,	3 A. M.	Ann.	A. N.	South Africa, Indian Ocean.
1847	Moon.	March 31st,	4 P. M.	0.2	A. N.	Europe, Africa.
"	Sun.	April 15th,	1 A. M.	Total.	D. N.	Indian Ocean.
"	Moon.	Septemb'r 24th	10 A. M.	0.4	D. N.	Japan, Australia.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1847	Sun.	October 9th,	4 A. M.	Ann.	A. N.	Egypt, East Indies.
1848	Sun.	March 5th,	9 A. M.	0.2	D. N.	Northern Europe.
"	Moon.	March 19th,	4 P. M.	Total.	A. N.	Europe, Africa.
"	Sun.	April 3d,	5 P. M.	0.6	D. N.	South Pacific.
"	Moon.	Septemb'r 12th	Midnight.	Total.	D. N	United States.
"	Sun.	Septemb'r 27th	4 A. M.	0.5	A. N.	Russia.
1849	Sun.	February 22d,	9 P. M.	Ann.	D. N.	North Pacific.
"	Moon.	March 8th,	7 P. M.	0.8	A. N.	Atlantic.
"	Sun.	August 18th,	1 A. M.	Total.	A. N.	Indian Ocean.
"	Moon.	September 2d,	Noon.	0.7	D. N.	China, Australia.
1850	Sun.	February 14th,	1 A. M.	Ann.	D. N.	Hindostan.
"	Sun.	August 7th,	4 P. M.	Total.	A. N.	Sandwich Islands.
1851	Moon.	January 17th,	Noon.	0.5	A. N.	China, Australia.
"	Sun.	January 31st,	Midnight.	Ann.	D. N.	Indian Ocean.
"	Moon.	July 13th,	2 A. M.	0.7	D. N.	Western America.
"	Sun.	July 28th,	10 A. M.	Total.	A. N.	North Atlantic.
1852	Moon.	January 7th,	1 A. M.	1.3	A. N.	United States.
"	Sun.	June 17th,	11 A. M.	0.7	A. N.	Cape Horn.
"	Moon.	July 1st,	10 A. M.	1.5	D. N.	Japan, Australia.
"	Sun.	Decemb'r 10th	11 P. M.	Total.	D. N.	Siberia, Japan.
"	Moon.	Decemb'r 26th	8 A. M.	0.7	A. N.	Japan, Australia.
1853	Sun.	June 6th,	2 P. M.	Ann.	A. N.	Society Islands, Peru.
"	Moon.	June 21st,	1 A. M.	0.2	D. N.	United States.
"	Sun.	Novemb'r 30th	2 P. M.	Total.	D. N.	Sandwich Islands, Brazil.
1854	Moon.	May 11th,	11 A. M.	0.2	D. N.	China.
"	Sun.	May 26th,	5 P. M.	Ann.	A. N.	Ladrones, United States
"	Moon.	November 4th	4 P. M.	0.1	A. N.	Russia, Madagascar.
"	Sun.	Novemb'r 20th	5 A. M.	Ann.	D. N.	Paraguay, Australia.
1855	Moon.	May 1st,	Midnight.	1.6	D. N.	United States.
"	Sun.	May 15th,	9 P. M.	0.8	A. N.	Siberia.
"	Moon.	October 25th,	3 A. M.	1.6	A. N.	Western America.
"	Sun.	November 9th	3 P. M.	0.4	D. N.	Southwest of Cape Horn.
1856	Sun.	April 4th,	Midnight.	Total.	A. N.	Australia, New Zealand.
"	Moon.	April 20th,	4 A. M.	0.8	D. N.	Pacific.
"	Sun.	Septemb'r 28th	11 P. M.	Total.	D. N.	North Asia.
"	Moon.	October 13th,	6 P. M.	0.9	A. N.	Western Asia.
1857	Sun.	March 25th,	6 P. M.	Total.	A. N.	Australia, Mexico.
"	Sun.	Septemb'r 18th	1 A. M.	Ann.	D. N.	Greece, India, New Guinea
1858	Moon.	February 27th	5 P. M.	0.3	D. N	Russia, Egypt.
"	Sun.	March 15th,	7 A. M.	Ann.	A. N.	West Indies, Russia.
"	Moon.	August 24th,	9 A. M.	0.5	A. N.	Japan, Australia.
"	Sun.	September 7th	9 A. M.	Total.	D. N.	Chili, South Africa.
1859	Sun.	February 2d,	8 P. M.	0.01	A. N.	South Pole.
"	Moon.	February 17th	6 A. M.	1.6	D. N.	Pacific.
"	Sun.	March 4th,	2 A. M.	0.3	A. N.	Greenland.
"	Sun.	July 29th,	5 P. M.	0.3	D. N.	Eastern Siberia.
"	Moon.	August 13th,	10 A. M.	1.6	A. N.	China.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1859	Sun.	August 28th,	1 A. M.	0.6	D. N.	South of Cape Good Hope.
1860	Sun.	January 22d,	7 P. M.	Ann.	A. N.	South Pacific.
"	Moon.	February 6th,	10 P. M.	0.8	D. N.	Brazil, Newfoundland.
"	Sun.	July 18th,	8 A. M.	Total.	D. N.	Labrador, Spain.
"	Moon.	August 1st,	Noon.	0.4	A. N.	China, Sumatra.
1861	Sun.	January 10th,	11 P. M.	Ann.	A. N.	Australia.
"	Sun.	July 7th,	8 P. M.	Ann.	D. N.	Java, Society Island.
"	Moon.	Decemb'r 17th	4 A. M.	0.2	D. N.	Eastern Pacific.
"	Sun.	December 31st	9 A. M.	Total.	A. N.	Carribean Sea, Greece.
1862	Moon.	June 12th,	1 A. M.	1.2	A. N.	United States.
"	Sun.	June 27th,	2 A. M.	0.92	D. N.	South Indian Ocean.
"	Sun.	Novemb'r 21st	2 P. M.	0.06	A. N.	Near South Pole.
"	Moon.	December 6th,	3 A. M.	1.41	D. N.	California.
"	Sun.	Decemb'r 20th	Midnight.	0.70	A. N.	Siberia.
1863	Sun.	May 17th,	11 A. M.	0.6	D. N.	Greenland.
"	Moon.	June 1st,	6 P. M.	1.2	A. N.	England, West Africa.
"	Sun.	Novemb'r 11th	4 A. M.	Ann.	A. N.	Cape Good Hope, Tasmania
"	Moon.	Novemb'r 25th	4 A. M.	0.9	D. N.	Eastern Pacific.
1864	Sun.	May 5th,	7 P. M.	Total.	D. N.	Borneo, Sandwich Islands.
"	Sun.	October 30th,	11 A. M.	Ann.	A. N.	Gallipagos, C. Good Hope.
1865	Moon.	April 10th,	Midnight.	0.1	A. N.	United States.
"	Sun.	April 25th,	10 A. M.	Total.	D. N.	S. Pacific, C. Good Hope.
"	Moon.	October 4th,	6 P. M.	0.3	D. N.	Europe, Africa.
"	Sun.	October 19th,	Noon.	Ann.	A. N.	Slave Lake, Cape Verd Il.
1866	Sun.	March 16th,	5 P. M.	0.21	D. N.	Eastern Siberia.
"	Moon.	March 30th,	11 P. M.	1.42	A. N.	United States.
"	Sun.	April 15th,	1 A. M.	0.66	D. N.	South of Australia.
"	Moon.	Septemb'r 24th	9 A. M.	1.62	D. N.	Japan, Australia.
"	Sun.	October 8th,	11 A. M.	0.57	A. N.	Iceland.
186,	Sun.	March 6th,	5 A. M.	Ann.	D. N.	Gibraltar, Tobolsk.
"	Moon.	March 20th,	4 A. M.	0 81	A. N.	Sandwich Islands.
"	Sun.	August 29th,	8 A. M.	Total.	A. N.	South Atlantic, Patagonia.
"	Moon.	Septemb'r 13th	7 P. M.	0.70	D. N.	Europe, Africa.
1868	Sun.	February 23d,	9 A. M.	Ann.	D. N.	South Pacific, Egypt.
"	Sun.	August 17th,	Midnight.	Total.	A. N.	Arabia, North Australia.
1869	Moon.	January 27th,	8 P. M.	0.46	A. N.	United States.
"	Sun.	February 11th	8 A. M.	Ann.	D. N.	Cape Horn, C. Good Hope
"	Moon.	July 23d,	9 A. M.	0.57	D. N.	Pacific.
"	Sun.	August 7th,	5 P. M.	Total.	A. N.	Iowa, North Carolina.
1870	Moon.	January 17th,	10 A. M.	1.66	A. N.	Japan, Australia.
"	Sun.	January 31st,	10 A. M.	0.48	D. N.	Near South Pole.
"	Sun.	June 28th,	7 P. M.	0.63	A. N.	Southeast of Australia.
"	Moon.	July 12th,	5 P. M.	1.69	D. N.	Europe, Africa.
"	Sun.	July 28th,	5 A. M.	0.07	A. N.	East Siberia.
"	Sun.	Decemb'r 22d	7 A. M.	Total.	D. N.	Spain, Black Sea.
1871	Moon.	January 6th,	4 P. M.	0.69	A. N.	Europe, Africa.
"	Sun.	June 17th,	9 P. M.	Ann.	A. N.	Northwest Australia.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1871	Moon.	July 2d,	8 A. M.	0.35	D. N.	Pacific Ocean.
"	Sun.	Decemb'r 11th	11 P. M.	Total.	D. N.	Hindoostan, N. Australia.
1872	Moon.	May 22d,	6 P. M.	0.12	D. N.	England, Guinea. [Islands.
"	Sun.	June 5th,	10 P. M.	Ann.	D. N.	Hindostan, Pekin, Sandw'h
"	Moon.	Novemb'r 14th	11 P. M.	0.03	A. N.	United States.
"	Sun.	Novemb'r 30th	2 P. M.	Ann.	A. N.	Friendly Islands, C. Horn.
1873	Moon.	May 12th,	6 A. M.	1.44	D. N.	Pacific Ocean.
"	Sun.	May 26th,	4 A. M.	0.90	A. N.	Greenland, Siberia.
"	Moon.	November 4th	11 A. M.	1.43	A. N.	China, Australia.
"	Sun.	Novemb'r 19th	11 P. M.	0.51	D. N.	Near South Pole.
1874	Sun.	April 16th,	8 A. M.	Total.	A. N.	Near South Pole, S. Africa.
"	Moon.	May 1st,	11 A. M.	0.83	D. N.	China, Australia.
"	Sun.	October 10th,	5 A. M.	Ann.	D. N.	Western Siberia.
"	Moon.	October 25th,	2 A. M.	1.05	A. N.	United States.
1875	Sun.	April 6th,	1 A M.	Total.	A. N.	Cape Good Hope, S. China
"	Sun.	Septemb'r 29th	8 A. M.	Ann.	D. N.	New York, South Africa.
1876	Moon.	March 10th,	1 A. M.	0.30	D. N.	United States. [land.
"	Sun.	March 25th,	4 P. M.	Ann.	A. N.	Sandwich Islands, Green-
"	Moon.	September 3d	4 P. M.	0.35	A. N.	Europe, Africa.
"	Sun.	Septemb'r 17th	5 P. M.	Total.	D. N.	New Guinea, Cape Horn.
1877	Moon.	February 27th	2 P. M.	1.67	D. N.	Persia, Indian Ocean.
"	Sun.	March 14th,	11 P. M.	0.30	A. N.	Northeastern Europe.
"	Sun.	August 8th,	11 P. M.	0.39	D. N.	Russian America.
"	Moon.	August 23d,	6 P. M.	1.76	A. N.	London, Guinea.
"	Sun.	September 7th	9 A. M.	0.64	D. N.	Southwest of Cape Horn.
1878	Sun.	February 2d,	3 A. M.	Ann.	A. N.	South Pole, Tasmania.
"	Moon.	February 17th	6 A. M.	0.84	D. N.	Pacific Ocean.
"	Sun.	July 29th,	4 P M.	Total.	D. N.	Behring Straits, Cuba.
"	Moon.	August 12th,	7 P. M.	0.60	A. N.	London, Guinea.
1879	Sun.	January 22d,	7 A. M.	Ann.	A. N.	La Plata, South Africa.
"	Sun.	July 19th,	4 A. M.	Ann	D. N.	Guinea, Australia.
"	Moon.	Decemb'r 28th	11 A. M.	0.16	D. N.	China, Australia.
1880	Sun.	January 11th,	6 P. M.	Total.	A. N.	Ladrone Islands, California
"	Moon.	June 22d,	9 A. M.	1.07	A. N.	China Australia.
"	Sun.	July 7th,	8 A. M.	Ann.	D. N.	South Atlantic.
"	Sun.	December 1st,	10 P. M.	0.04	A. N.	Southeast of Cape Horn.
"	Moon.	Decemb'r 16th	10 A. M.	1.39	D. N.	China, Australia.
"	Sun.	December 31st	9 A. M.	0.71	A. N.	Greenland.
1881	Sun.	May 27th,	7 P. M.	0.74	D. N.	All round North Pole.
"	Moon.	June 12th,	2 A. M.	1.36	A. N.	United States.
"	Sun.	Novemb'r 20th	Midnight.	Ann.	A. N.	Central near South Pole.
"	Moon.	December 5th	Noon.	0.98	D. N.	Siberia, Indian Ocean.
1882	Sun.	May 16th,	3 A. M.	Total.	D. N.	Guinea, Persia, China.
"	Sun.	Novemb'r 10th	6 P. M.	Ann.	A. N.	New Guinea Ils., Easter Ils.
1883	Moon.	April 22d,	Noon.	0.09	A. N.	Siberia, Indian Ocean.
"	Sun.	May 6th,	5 P. M.	Total.	D. N.	Near Sidney, near Lima.
"	Moon.	October 16th,	2 A. M.	0.28	D. N.	United States.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1883	Sun.	October 30th,	7 P. M.	Ann.	A. N.	Japan, Hawaii.
1884	Sun.	March 27th,	2 A. M.	0.14	D. N.	Spitzbergen.
"	Moon.	April 10th,	7 A. M.	1.44	A. N.	New Zealand, Aleutian Ils.
"	Sun.	April 24th,	10 A. M.	0.75	D. N.	South Atlantic.
"	Moon.	October 4th,	5 P. M.	1.53	D. N.	Eastern Europe, Africa.
"	Sun.	October 18th,	7 P. M.	0.64	A. N.	Behring Strait.
1885	Sun.	March 16th,	1 P. M.	Ann.	D. N.	California, Greenland.
"	Moon.	March 30th,	Noon.	0.89	A. N.	China, Sumatra.
"	Sun.	September 8th	4 P. M.	Total.	A. N.	N. Zealand, S. of C. Horn.
"	Moon.	Septemb'r 24th	3 A. M.	0.79	D. N.	Eastern Pacific.
1886	Sun.	March 5th,	5 P. M.	Ann.	D. N.	Torres St., Gulf of Mexico.
"	Sun.	August 29th,	8 A. M.	Total.	A. N.	Honduras, South Africa.
1887	Moon.	February 8th,	5 A. M.	0.4	A. N.	Pacific Gcean.
"	Sun.	February 22d,	3 P. M.	Ann.	D. N	South Pacific.
"	Moon.	August 3d,	4 P. M.	0.4	D. N.	Europe, Africa.
"	Sun.	August 19th,	1 A. M.	Total.	A. N.	Norway, North Pacific.
1888	Moon.	January 28th,	6 P. M.	1.2	A. N.	Germany, Sahara.
"	Sun.	February 11th	5 P. M.	0.5	D. N.	Near South Pole.
"	Sun.	July 9th,	2 A. M.	0.6	A. N.	South Indian Ocean.
"	Moon.	July 23d,	1 A. M.	1.0	D. N.	United States.
"	Sun.	August 7th,	1 P. M.	0.1	A. N.	Western Siberia.
1889	Sun.	January 1st,	3 P. M.	Total.	D. N.	Behring Strait, Hudson Bay
"	Moon.	January 16th,	Midnight.	0.7	A. N.	United States.
"	Sun.	June 28th,	4 A. M.	Ann.	A. N.	S. Africa, S. Indian Ocean.
"	Moon.	July 12th,	4 P. M.	0.5	D. N.	E. Europe, Madagascar.
"	Sun.	December 22d	8 A. M.	Total.	D. N.	Venezuela, Abyssinia.
1890	Moon.	June 3d,	2 A. M.	0.1	D. N.	United States. [Pegu.
"	Sun.	June 17th,	5 A. M.	Ann.	A. N.	Cape Verd Ils., Smyrna,
"	Sun.	Decemb'r 11th	10 P. M.	Ann.	D. N.	Mauritius, N. Z., Tahiti.
1891	Moon.	May 23d,	2 P. M.	1.3	D. N.	China, Australia. [Russia.
"	Sun.	June 6th,	11 A. M.	Tot'l(?)	A. N.	Russian Am., North Pole,
"	Moon.	Novemb'r 15th	7 P. M.	1.4	A. N.	England, Guinea.
"	Sun.	December 1st,	7 A. M.	0.5	D. N.	South of Cape Good Hope.
1892	Sun.	April 26th,	5 P. M.	Total.	A. N.	South Pacific.
"	Moon.	May 11th,	6 P. M.	0.9	D. N.	Germany, Ethiopia.
"	Sun.	October 20th,	1 P. M.	Ann.	D. N.	Greenland.
"	Moon.	November 4th	11 A. M.	1.0	A. N.	China, Java.
1893	Sun.	Ap.il 16th,	9 A. M.	Total.	A. N.	Easter Ils., Guiana, Egypt.
"	Sun.	October 9th,	4 P. M.	Ann.	D. N.	Sandwich Island, Peru.
1894	Moon.	March 21st,	9 A. M.	0.2	D. N.	Japan, Australia.
"	Sun.	April 5th,	11 P. M.	Ann.	A. N.	Egypt, China, Pacific.
"	Moon.	Septemb'r 14th	11 P. M.	0.2	A. N.	United States.
"	Sun.	Septemb'r 28th	Midnight.	Total.	D. N.	Madagascar, New Zealand.
1895	Moon.	March 10th,	10 P. M.	1.6	D. N.	Maine, South America.
"	Sun.	March 26th,	5 A. M.	0.4	A. N.	Northern Europe and Asia.
"	Sun.	August 20th,	7 A. M.	0.3	D. N.	Siberia.
"	Moon.	September 4th	1 A. M.	1.5	A. N.	United States.

YEAR.		DATE.	TIME.	MAGNITUDE.	NODE.	WHERE VISIBLE.
1895	Sun.	Septemb'r 18th	5 P. M.	0.7	D. N.	South of Australia.
1896	Sun.	February 13th	11 A. M.	Ann.	A. N.	Extreme South Atlantic.
"	Moon.	February 28th	2 P. M.	0.8	D. N.	Turkestan, Indian Ocean.
"	Sun.	August 8th,	Midnight.	Total.	D. N.	West Siberia, Ladrone Ils.
"	Moon.	August 23d,	2 A. M.	0.7	A. N.	United States.
1897	Sun.	February 1st,	3 P. M.	Ann.	A. N.	New Caledonia, Guiana.
"	Sun.	July 29th,	11 A. M.	Ann.	D. N.	Galapagos, South Africa.
1898	Moon.	January 7th,	7 P. M.	0.1	D. N.	England, Guinea.
"	Sun.	January 22d,	3 A. M.	Total.	A. N.	Fezzan, Socotra, N. China.
"	Moon.	July 3d,	4 P. M.	0.9	A. N.	Russia, Madagascar.
"	Sun.	July 18th,	3 P. M	Ann.	D. N.	South America.
"	Sun.	Decemb'r 13th	7 A. M.	0.02	A. N.	Southwest of Cape Horn.
"	Moon.	Decemb'r 27th	6 P. M.	1.3	D. N.	Germany, Ethiopia.
1899	Sun.	January 11th,	6 P. M.	0.7	A. N.	Russian America.
"	Sun.	June 8th,	3 A. M.	0.7	D. N.	North Europe, North Asia.
"	Moon.	June 23th,	10 A. M.	1.5	A. N.	Japan, Australia.
"	Sun.	December 2d,	8 A. M.	Ann.	A. N.	Central South Pole.
"	Moon.	Decemb'r 16th	8 P. M.	0.96	D. N.	Eastern Atlantic.
1900	Sun.	May 28th,	10 A. M.	Total.	D. N.	Mexico, Azores, Egypt.
"	Sun.	Novemb'r 22d	2 A. M.	Ann.	A. N.	Guinea, South Australia.

EXPLORATION.

THE ARCTIC RELIEF EXPEDITION OF 1883.

The following are the instructions of Gen. Hazen, the Chief Signal Officer, to Lieut. E. A. Garlington, who is to command the Arctic relief expedition to Lady Franklin Bay:

You are aware of the necessity of reaching Lieut. A. W. Greely and his party with the expedition of this year. The necessity cannot be overestimated, as Lieut. Greely's supplies will be exhausted during the coming fall, and unless the relief ship can reach him he will be forced with his party to retreat southward by land before the winter sets in. Such a retreat will involve hardship, and the probable abandonment of much valuable public property, with possible loss of important records and life.

For these and other reasons which will occur to you, no effort must be spared to push the vessel through to Lady Franklin Bay.

In the event of being obstructed by ice in Smith Sound or Kennedy Channel, you are advised to trv to find a passage along the west coast, which, besides being usually the most practicable, will afford better advantages for sighting and communicating with any party sent out by Lieut. Greely. To make communication surer, your party must be able to readily send and receive messages by flag or heliograph and other means, and the necessary articles should be kept in readiness for instant use when communication is possible.

Should the vessel be unable to get through the ice to Lady Franklin Bay or to reach the west coast at points above Cape Sabine, it will be of great importance that Lieut. Greely should know of the efforts being made to relieve him, and of the plans for doing so. You will endeavor, therefore, to convey such intelligence, and omit no means of informing him or any of his party of the situation. Should any landings be made at prominent points on either coast during the efforts to get through the ice, you will leave a short record of the facts, with such information as it is desirable to convey, so deposited and marked as to render it discoverable by parties traveling southward. If such landings be made at points where caches of provisions are located, you will, if possible, examine them, and replace any damaged articles of food, leaving of course a record of your action.

If it should become clearly apparent that the vessel cannot be pushed through, you will retreat from your advanced position and land your party and stores at or near Lifeboat Cove, discharge the relief vessel with orders to return to St. Johns, N. F., and prepare for remaining with your party until relieved next year. As soon as possible after landing, or in case your vessel becomes unavoidably frozen up in the ice pack, you will endeavor to communicate with Lieut. Greely by taking personal charge of a party of the most experienced and hardy men equipped for sledging, carrying such stores as practicable to Cape Sabine, whence a smaller party, more lightly equipped, still headed by yourself, will push as far north as possible, or until Lieut. Greely's party is met. In this and other matters you will follow closely the instructions of Lieut. Greely dated August 17, 1881, a printed copy of which is furnished you herewith.

The men not employed in the expeditions will lose no time in preparing the house for the whole party and in securing the stores preparatory to the arrival of Lieut. Greely.

You will be furnished with two observers and an outfit of scientific apparatus and will be guided in their use by instructions herewith. The character and amount of the meteorological and other scientific work to be accomplished by your party is enumerated in inclosed memoranda.

In addition to the medical officer, enlisted men, and Mr. Beebe, taken from this city, you will employ three hardy ice men at St. Johns, who have been already selected by the United States Consul there under my directions, and in Greenland such Esquimaux as you may require.

It is important that a careful and complete record of events should be made, and in case your party does not return this year that a full report be sent by the vessel on her return to St. Johns. Each member of your party will be required to keep a private diary, which will be open to the inspection of the Chief Signal Officer only in case it should be necessary.

Whenever a junction is effected with Lieut. Greely you will report to him with your party for duty.

Should any important records or instruments have been left behind by Lieut. Greely in his retreat they may be recovered by the steamer to be sent in 1884.

It is believed that with the stores and supplies sent last year, which are at St. Johns, N. F., and at the Greenland ports, a list of which is herewith furnished, and which you will gather on your way northward, together with the provisions and articles supplied this year, everything needful will have been furnished for safety and success. I believe and expect that you will zealously endeavor to effect the object of the expedition, which is to succeed in relieving your comrades, since upon your efforts their lives may depend, and you cannot overestimate the gravity of the work intrusted to your charge.

A ship of the United States Navy, the Yantic, will accompany you as far as Littleton Island, rendering you such aid as may become necessary and as may be determined by the captain of that ship and yourself when on the spot.

NORDENSKJOLD'S THEORY.

Professor Nordenskjold sailed yesterday from Gothenburg on his tenth Arctic expedition. He was born in Finland just fifty years ago. Half his lifetime has been spent in Arctic exploration or in making preparations for it.

The Sofia, which has been lent by the Swedish Government, is a small steamer, carefully fitted for the work she has to do, which is not specially dangerous. None of the Vega staff accompany their old leader to Greenland, though science is well represented on board the Sofia. Nordenskjold is supported by Dr. Nathorst as geologist and paleontologist, Herr Kolthoff for birds and insects, Dr. Hamberg as hydrographer, Dr. Berlin as surgeon and naturalist in general, and Herr Forsstrand as preserver of specimens. As ice-master one of the boldest Norwegian skippers has been selected, Johanesen, who in his walrus schooner has sailed far beyond the north point of Novaya Zemlya. The crew consists of twenty-four men.

His main object is to penetrate into the heart of Greenland, in order to test his theory that the permanent ice is really only a band surrounding the interior, which in summer, at least, is literally a land of greenery. In this trying journey Nordenskjold will be accompanied by at least one of his staff and ten of his crew, and will be equipped with all the appliances requisite for ice-travelling. In providing this equipment he has been guided not only by the experience of Alpine climbers, but by the knowledge he acquired twelve years ago, when in company with Palander, he succeeded in penetrating thirty miles inland from the head of Auleitsivik Fjord, his starting point in the present expedition. About thirty or forty miles from the coast the interior seems to rise suddenly like a huge wall of ice, cleft here and there, fortunately, by valleys, by means of which the expedition will be able to reach the uneven plateau of the interior. The first forty miles are likely to be the most trying; the coast region is cut up by gaping crevices and broad rivers in the midst of rugged hills of ice, and these will necessitate long *detours*. The rivers, as a rule, terminate in magnificent waterfalls, which plunge suddenly into what seem to be bottomless abysses of ice. In his former journey Nordenskjold attained a height of about 2,000 feet, and east and north the country seemed to rise gradually, and presented the appearance of a billowy sea suddenly frozen. Auleitsivik Fjord, from which the expedition will start on its journeys, opens just below Disco Island, and penetrates a considerable distance into the land. At this point Greenland is about its broadest, so that the line of exploration has been well chosen to test the theory which has prompted the expedition. This theory was no new one on the part of Nordenskjold, for as long ago as his former expedition in 1870 he seems to have come to the conclusion that Heber's "icy mountains" were confined to the regions of the Greenland coast, surrounding a land comparatively free from ice, and even wooden in its southern parts. If Nordenskjold succeeds in confirming his hypothesis it will be one of the triumphs of science.

It will be after the return from this inland journey, probably in the early part of September, that the expedition will make an attempt to land on the southeast coast to search for remains of the old Norse colonies founded here 900 years ago. While the Danes were harrying the coasts of Saxon England, eighty years before William the Norman landed at Pevensey, Red Erik, outlawed in Iceland, set out to seek the land which Gunbjorn had seen far to the westward 100 years earlier. This land he found, and made it his home, and colonized it with his kinsmen and friends, who reared their villages and farm-houses and churches over a great stretch of the southwest coast. At their most flourishing period these old Norse colonies probably numbered 10,000 inhabitants. Even in Red Erik's time adventurous spirits sailed still further west, and planted outlying settlements on the shores of Vinland, Helluland and Markland; the first Europeans probably who set foot on a land on which centuries later their kinsmen were to rear one of the greatest nations on the face of the earth. For the old Norse Vinland was in all probability the modern Massachusetts, while Markland and Helluland have been identified with Nova Scotia, Newfoundland and perhaps Labrador. It seems strange that spirits so enterprising and adventurous, the countrymen of the Vikings who kept Europe in terror, from the Orkneys to the Mediterranean, who mastered England, and ultimately gave her a dynasty and an aristocracy, should have let these momentous discoveries pass into oblivion, should have finally turned their backs upon a land of unbounded promise and settled down in contentment on the ice-bound shores of Greenland. The truth is that the Norsemen at home never seem to have realized the vast importance of the discoveries of their venturesome kinsmen, and although, as we have said, the population increased to 10,000, the communication with Iceland and Norway soon became fitful, and after the fourteenth century we hear little of them.

We have, however, a brief written in 1448 by the Pope to the Bishop of Norway, treating of the pitiful condition of the inhabitants of Greenland, who, thirty years before, had been attacked by the hostile fleet, which carried off people of both sexes into captivity. With much plausibility, these invaders are conjectured to have come from the British Islands. By the latter half of the fifteenth century all communication with the mother country had ceased, and when John Davis rediscovered Greenland in 1585 no other but Esquimaux people were found anywhere on the coast. Traditions, however, still exist among the Greenlanders as to the first white visitors, and from these and the Sagas it is evident that latterly frequent collisions took place with the natives, and the probability is that the remnant of the colonists was absorbed by the Esquimaux. Bishops of Greenland still continued to be appointed down to the sixteenth century, but these never made any efforts to reach their diocese. As we have said, Nordenskjold maintains, contrary to the received opinion, that the remains of Osterbygd, much the larger settlement, are to be found to the east of Cape Farewell; whether he is right or wrong, any addition to our knowledge of the condition and fate of these premature colonizers of America will be welcome.—*London Times.*

GEOLOGY AND MINERALOGY.

THE PHENOMENA OF METALLIFEROUS DEPOSITS.

PROF. JOSEPH LE CONTE.

The following is an abstract of a paper read before the American Academy of Sciences at its late meeting in Washington, which in the author's absence was read by Prof. T. Sterry Hunt:

The paper said that the phenomena of metalliferous deposit by solfatusic action at Sulphur Bank and Steamboat Springs have tended strongly to confirm what he had previously believed to be the most probable theory of vein formation, and at the same time time to give it more clearness and definiteness. The structure, the mode of occurrence and the contents of metalliferous veins leave no longer any room for doubt that they have been formed by deposit from solutions. If any doubt had lingered on this subject it was thoroughly dissipated by the phenomena of deposit still in progress at Sulphur Bank and at Steamboat Springs. Among the metallic ores cinnabar has long been considered a possible exception to this mode of deposit. The extreme volatility of this sulphide, the extreme irregularity of its veins, and its frequent occurrence in the vicinity of comparatively recent volcanic action have suggested that it may have been deposited in irregular fissures, cracks, cavities, etc., by condensation of its vapors sublimed by volcanic heat beneath. But the phenomena of Sulphur Bank and Steamboat Springs ought to settle the question forever. Cinnabar as well as other metallic sulphides are now being deposited there, along with silica, from solution. Admitting, then, as established the view that metalliferous veins have been deposited from solutions, the most difficult questions still remain: What are the conditions under which deposit takes place? and what, in addition to simple water, have been the solvents?

In answering the first question it must be remembered that the chemistry of nature is far more subtle and refined that that of the laboratory; that substances which are regarded as practically insoluble in the latter cannot be so regarded in the former. The infinite patience of nature and the infinite slowness of her operations must be taken into account. In the perpetual circulation of subterranean waters infinitesimal deposits, continued and accumulated through almost infinite time, produce large results. Thus mineral veins may be composed of substances of extremest insolubility, and yet be deposited from solutions. In fact, such extreme insolubility, or at least very feeble solubility, would seem to be a condition of mineral vein formation, for otherwise the minerals would be in most cases brought to the surface instead of being deposited below.

Again, it must be borne in mind that solubility, even the feeblest, is notably increased by heat, especially super-heat, and by pressure. The latter is generally regarded only as a necessary condition of super heat and not as itself an active agent. But in fact pressure acts directly as an active agent in increasing the solubility of nearly all substances. Mr. Sorby has not only proven this by actual experiment on a great variety of substances, but has shown that it is a necessary consequence and beautiful illustration of the law of correlation and conservation of natural forces, and that we have in this as in the case of fusibility an example of the equivalency of mechanism and molecular forces. For, as in the matter of fusibility in all cases in which expansion takes place in fusion, pressure by resisting expansion raises the fusing point, while only in those exceptional cases like ice, in which contraction takes place in fusion, pressure by arresting contraction lowers the fusing point. So also in the matter of solubility, in all cases in which contraction takes place in solution, namely, in which the volume of the solution is less than the combined volumes of constituents, pressure by arresting contraction increases solubility, while only in very exceptional cases as, for example, sal ammoniac, in which expansion takes place in solution, pressure by resisting expansion diminishes solubility. These latter cases are so extremely rare that we may assume as a law the increased solvent power of water in proportion to pressure. It is even possible by experiment thus to determine the mechanical equivalent of the chemical force of solution of any given substance; and, in fact, this has been so determined for several substances by Mr. Sorby. There can be no doubt, then, that the solvent power of water may be increased without limit by corresponding increase of heat and pressure. It is quite certain, therefore, that water deep in the interior of the earth, especially in volcanic regions, and therefore under heavy pressure and super-heat, would have its solvent power greatly increased, not only by the super-heat but also by the pressure. It is believed that few substances could resist entirely its solvent power. Such waters, coming up slowly toward the surface through fissures, large and small, would have their solvent power diminished both by cooling and by relief of pressure, and must of necessity deposit in their courses and form mineral viens. But the solvent power of subterraneous waters is still further very greatly increased for most vein matters by the pressure of alkali in the form of alkaline carbonates or alkaline sulphides, or both. This is especially true of the commonest of vein stuffs, viz : quartz and lime carbonate, and the commonest forms of metallic ore, viz.: metallic suphides. The solubility of silica in alkaline carbonated waters is well known, and with excess of carbonic acid in the waters all the earthy and metallic carbonates are also soluble. The solubility of many and probably of all metallic sulphides in alkaline sulphides, especially with excess of hydrogen sulphide under pressure and super-heat, can no longer be doubted; for iron sulphide and mercuric sulphide are now being deposited from such waters, both at Sulphur Bank and at Steamboat Springs.

Mr. Christy and others have proved the solubility of mercuric sulphide under pressure and super-heat by actual experiment; and these are among the most insoluble of metallic sulphides. It is certain, then, that metallic sulphides are soluble to a limited extent in alkaline sulphides, forming doubtless double sulphides. It is certain, also, that the solubility is increased by super-heat and pressure. It is therefore also certain that hot waters containing alkaline carbonates and alkaline sulphides, circulating at great depth and therefore under heavy pressure, would take up silica, earthy and metallic carbonates and metallic sulphides, and that coming up slowly toward the surface they would deposit these substances in their courses, partly by cooling and partly by relief of pressure, and thus form metalliferous veins. Cooling and relief of pressure are the most useful causes of deposit, but not the only ones. Organic matters are of almost universal occurrence in subterranean waters, and their agency in reducing metallic oxides and metallic salts is well known. Organic matter is a universal reducing agent.

The acids of organic decomposition may prove a reducing agent. Such in brief is an outline of a true theory of the genesis of metalliferous viens—a theory apparently confirmed by the study of causes now in operation at Sulphur Bank and Steamboat Springs, and probably many other places in California and Nevada.

COMPARATIVE VALUE OF DIFFERENT COALS.

General M. C. Meigs has lately issued a pamphlet in which he shows the results of experiments made under his direction to determine the caloric value of different varieties of coal. This has in it so much that is valuable that we condense from it what we consider very interesting data. The experiments include thirty-one different kinds of coal. Nearly all the varieties were American, some English and Scotch. These experiments were carried out to determine the relative value of different coals supplied to the United States army for fuel, and the equivalent value of the same coal as compared with cords of oak wood, and have every appearance of having been carefully and faithfully carried out. The measure of value is the quantity of water evaporated from and at 212° F. per pound of coal. The experiments in question were with an improved vertical water-tube boiler designed by General Meigs, and built for this express purpose. The data given below are all from experiments with this boiler. It is only a portion of the whole experiment.

Semi-bituminous coal, Somerset County, Penn., 88.99 per cent of combustible, 9.85 pounds of water; semi-bituminous of another grade, from the same county, 90.92 per cent of combustible, 97.5 pounds of water; Wilkesbarre anthracite from Black Diamond mine, 80.77 per cent of combustible, 9.37 evaporation; Scranton anthracite to D. & H. C. Co., 77.3 per cent combustible, 9.28 pounds water; Lykens Valley anthracite, 93.87 per cent combustible, 9.07 pounds water; Los Cerrillos anthracite, New Mexico, 88.25 per cent combustible, 9.04 pounds water; Scranton anthracite D. L. & W. R. R. Co., 82.85 per cent combustible, 8.87 pounds water; bituminous coal near Pittsburg, 94.04 per cent combustible, 8.78 pounds water; Los Cerrillos, bituminous, New Mexico, 86.74 per cent combustible, 8.60 pounds water; West Virginia splint, 91.9 per cent combustible, 8.34 pounds water; Scotch splint from Glasgow, Scotland, 93.28 per cent combustible, 7.61 pounds water; Davison, West Hartley, 94.01 per cent combustible, 7.6 pounds water; South Wellington, Vancouver's Island, 91.83 per cent combustible, 7.59 pounds water; Cow Pen, West Hartley, England, 93.89 per cent combustible, 7.52 pounds water; Indiana cannel coal, Davis County, Indiana, 75.18 per cent combutible, 7.32 pounds water; Wellington coal, Wellington mine, Vancouver's Island, 90.62 per cent combustible, 6.71 pounds water; bituminous coal Cañon City, Colorado, 90 per cent combustible, 6.45 pounds water; Eastport, Coos Bay, Oregon, 91.16 per cent combustible, 5.24 pounds water; Weber coal, Chalk Creek, Summit County, Utah, 89.98 per cent combustible, 4.73 pounds water; lignite coal, from Dakota, 93,77 per cent combustible, 4.03 pounds water.

In the first specimen of coal, 1521 pounds was equivalent to a cord of oak wood; the last named required 3712 pounds of coal as the equivalent of one cord of oak wood, and the variation was constant; beginning with the first item, at 1521, a continual progression is made, showing that each coal that follows was less and less in value both in evaporative efficiency and in real efficiency as compared with oak wood. There is also another very important point which the users of coal will profit by studying. The percentage of combustible in coal is no index whatever of the evaporative efficiency of the coal in the same boiler. The percentage of combustible has been one of the points about which theoretical engineers have had immense arguments; immense, perhaps, in their prolixity, vague in meaning, entirely indefinite and indeterminate. As an actual fact, which General Meigs has settled most effectually, the semi-bituminous coal proves to be the most valuable, and while the percentage of combustible in the first item is considerably less than that of the last item mentioned, we have an evaporative efficiency of about 225 per cent as compared with the last item, so that if the lignite coal cost $4 a ton, the semi-bituminous coal would be cheaper at $9 a ton for the quantity of water evaporated, which is the true and only actual measure of value in a ton of coal. So far as we know, no individual experiment was ever tried to demonstrate the particular factor, and men buy coal just as they buy nails or sand—so much a load or so much a ton—thinking, perhaps, that bituminous coal at one price is cheaper than anthracite at another, while if the various brands of coal in the market should be carefully and honestly tested, it might be found that certain grades of anthracite coal at $7 a ton were cheaper than another grade of anthracite coal at $5 a ton if anything short of bulk for bulk was to be considered. These experiments are very valuable if steam users will only heed them.—*Cotton, Wool and Iron.*

THE TRINIDAD COAL MINES.

ISAAC T. GOODNOW.

We were now coming east, on a beautiful afternoon, just in the right mood for enjoying the scenery. The railroad very nearly follows the old Santa Fe trail, and also the present well traveled wagon-road over the Raton Mountains, whose fantastic peaks tower right and left to the skies, with openings occasionally to the north that enable us to see, low down in the horizon, the famous Spanish Peaks, one hundred miles away, a wonderful demonstration of the purity of the atmosphere. Just before leaving New Mexico, the train suddenly plunges into a tunnel 2100 feet under the highest crest of the Raton Pass, and on emerging we find ourselves inhaling the pure air and enjoying the bright mellow sunshine of a Colorado day. The highest point of the Raton Pass is 7861 feet, and of the tunnel 7688 feet, a height of 173 feet saved by the tunnel. On leaving this we pass the Devil's Cañon, and in five miles reach the foot of the pass at the little station of Morley; farther on four miles we find Starkville, a sort of suburb to Trinidad, and the site of a remarkable coal mine, stopping an hour and a half to examine it.

The veins of coal are horizontal, and from nine to fourteen feet thick; no finer bituminous coal can be found. This mine has been worked steadily one and a half years, and yields three hundred tons a day, and ninety tons of coke. This is made by heating the coal in ovens to a red heat, and driving off the water and gases. One hundred pounds of coal will make fifty-five pounds of coke, which is nearly pure carbon. Forty-two ovens are in operation here; one hundred and fifty-five men are employed, nine hours constituting a day's work. Laborers outside are paid $2 per day; inside, $3; for mining coal, sixty cents per ton is paid. The laborers are Americans, Swedes, Italians, and Mexicans. We entered the mine on the east side of the mountain by a tunnel six to eight feet wide, and perhaps twelve feet wide, coal above, below, and on both sides, glistening from our little lamps like black diamonds, and generally constituting a self-supporting roof. We penetrated in a straight shute 1400 feet, finding openings to the right and left, with occasional doors to regulate the draft of air which is supplied by fans on the outside driven by steam-power. Turning to the left some fifty feet, we found what appeared to be a small engine with a horizonta cylinder, made so as to drag along the ground, and working a drill horizontally[1] The machine is really operated by compressed air forced into the mine through iron pipes, which are connected with the machine by flexible rubber tubes. This machine is placed at the end of the tunnel and is moved by hand from one side to the other at the bottom, and by its effective action cuts to pieces a thin layer of coal under the great mass at the end of the tunnel; two holes, twelve feet apart, near the top of the mine, are bored and cartridges inserted, and the mass of coal at the end of the passage way is blown off, several tons at a blast; quite an improvement on the old pick. Everything is systematized and moves like clock-work.

Friday, May 18th, 4 o'clock P. M., finds us at Trinidad, the guests of its enterprising and hospitable citizens. With an elegant array of carriages we were met at the depot and driven over the city, and those who wished went to the Engle coal mine, three and a half miles away. At the mouth of the mine, at the west and south, we found a comfortable little mining town of some five hundred inhabitants, representing the usual nationalities. The coal beds, three in number, usually crop out near ravines, are easy of access, and are naturally drained. The beds are horizontal, no shafting or hoisting is necessary, there is no dampness or bad air, as in most mines. These veins are parallel, varying in thickness from six to fourteen feet. The middle one is worked the most; the roof of this is light-colored sandstone, and sufficiently strong to sustain itself, consequently saving all expense in blocking. Never before have I seen such a rare combination of circumstances to produce first-class coal with so little labor, so little inconvenience to health and life to work the same. We notice here the mouths of two other tunnels, one opening into a mountain on the north and the other into a mountain on the east, both the mountains joined together at the base. The north tunnel runs clear through the mountain and also connects with the east tunnel. The magnitude of the work may be realized when it is understood that there are twenty-six miles of underground railway in this mine.

Two hundred and seventy men and boys are here employed, and the amount of coal produced each day is one thousand tons; its cost of production is sixty-two and a half cents per ton; this includes interest on investment, wear and tear of machinery, weighers' and superintendent's salary. Coal sells at the mine at one dollar and a half per ton, leaving eighty seven and a half cents profit. On one thousand tons, the product of this mine per day, yields $875, or $319,375 per year, a very fair profit. Coke sells here at $5 per ton, though formerly brought from Pittsburgh at $25 per ton. To produce coke costs $2 per ton, leaving a profit of $3 per ton; two hundred and fifty ovens will produce three hundred and twelve and a half tons each day, or a net profit of $93,740 per year. After a general survey of the outside, some twenty of us, with the Hon. E. J. Morrill, M. C., than whom a better traveling companion never existed, with lamps in hands, took our seats in some half dozen coal cars, drawn by three fine looking mules. At the crack of the whip, we plunged into the earth, every face glowing with expectation and excitement. The similarity of the Starkville mine renders a description of this unnecessary; they both belong to the same great system of coal measures underlying this portion of the Raton Mountains and comprising an area of one thousand square miles. How far we penetrated I can only guess, probably three-quarters of a mile; here we left the cars, and walking a short distance, found a new machine, operated by the same motive power as the machine described in the Starkville mine; this has been used about two years and is an improvement upon that.

This machine instead of having the drill of the other machine, has an iron roller four feet long and two and one-half inches in diameter, armed with projecting teeth. This, when pressed against the bottom of the coal at the end of the tunnel, by revolving rapidly cuts away the foundation of the great body to the thickness of the rollers two and a half inches, four feet wide and projecting under the coal some five feet; when one breadth is cut, the machine is moved one side to another cutting, till the whole mass of coal at the end of the tunnel, some twenty feet across and five feet in width is undermined. Tho holes two and a half inches in diameter and twelve feet apart near the top of the mine are then bored six feet in depth, and a pound cartridge inserted in each. The joint explosion throws off some twenty tons of coal. Only two of these are used in the mine. The old pick still plays an important part. A shout of "all aboard," and we are speedily in our little cars and Jehu with a flourish of his whip sets our faithful animals upon a jump till we find ourselves again upon the outside of the earth.

THEOLOGY.

PÈRE HYACINTHE AND CATHOLICISM.

E. R. KNOWLES.

Reverend Charles Loyson, well known to us as Père Hyacinthe, was born at Orleans, in France, March 10th, 1827, was ordained a priest of the Catholic Church in 1846, and, after being a professor of theology for six years, became in 1859 a Carmelite monk. He soon became a preacher of note, and his power and influence as a preacher increased till, just previous to the Roman Vatican Council of 1870, he had become "the most famous modern preacher of the world." After the Vatican Council he, like the old Catholics in Germany, refused to receive the decrees of the Vatican Council as dogmas of Catholic faith, and proceeded gradually to reach the theological position which he has since held.

Few Americans, outside of the American Church, understand the theological position of the Gallican Church, which Père Hyacinthe represents. It has been and is, greatly misunderstood, and, because of misunderstanding, as greatly misrepresented. It is my intention here, then, without considering any proofs as to what councils of the Church have, or have not, been Ecumenical, or as to what are, and what are not, the recognized authorities of the Universal Church, and without claiming correctness or incorrectness for the definitions below given on which the nomenclature which I am obliged to use for the sake of clearness is based, to merely state and explain as briefly as possible the theological position of Père Hyacinthe.

He says in one of his published Munich discourses: "Three great principles, or, if you prefer the expression, three great methods, in our time, are disputing among themselves the empire of the soul—Rationalism, Protestantism, Catholicism. Rationalism suppresses Revelation. * * * * * Protestantism maintains Revelation, but mutilates it; and in effect, while extolling the Bible, separates it from the living tradition which is its complement and explanation, and substitutes the individual faith of the Christian for the collective faith of the Church. Catholicism alone abides faithful to the whole revelation, written and spoken—spoken before it was written, and so written, I repeat, that it ever stands in need of being completed and illustrated by speech; only this speech is not that of an individual conscience, of an isolated person, but the universal and constant teaching of the Church—in those masterly words of Vincent of Lerins, 'what has been believed by all, always, everywhere.' *Quod semper, quod ubique, quod ab omnibus.* Doubtless the faith of the intelligent Catholic is profoundly personal, but it has for its basis and its guide the collective faith of the church." In this sense Père Hyacinthe is like all Catholics throughout the world, who do not add Papism or Infallibilism to their Catholicism, neither Protestant nor Romanist, but a Catholic. Essentially the faith of the Gallican Church is the same as that of all Catholics throughout the world who regard as Ecumenical Councils only those which were held in the east during the first eight centuries and before the separation between the eastern and western halves of the church, and who go back for the symbol of their faith to primitive Christianity and confirm their faith by the text of unversality, permanence, and consent, and the decrees of Ecumenical Councils. St. Vincent of Lerins, in the year 434, write his "Commonitory" against heretics, of which a Romanist writer declares that "no controversial book ever expressed so much and such deep sense in so few words." (Gahan's History of the Church, p. 192.) In this book he lays down this fundamental principle, that only such doctrine is truly Catholic as has been believed "in all places, at all times, and by all the faithful." Such is the Catholicism of the Greek, English, and Anglo-American Churches, the old Catholics of Germany, and the Gallican Mission Church, all portions of the Universal Church, in harmony with each other regarding all points of doctrine which they consider as essential, and constituting what may properly be called the constitutional party of the Catholic Church. And while there is no logical standpoint between absolute submission to the decrees of the constituted authorities of the Catholic Church and complete separation from it, it is yet necessary to first be sure what are the lawful authorities of the Church, and whether the Pope is the Catholic head of the Universal Church, or the *Roman* head of the *Roman*-Catholic Church. The Catholic recognizes as Catholic doctrine only such as has been believed by all the faithful, always and everywhere. The *Roman*-Catholic or Papist, holds that the Roman Pontiff is the supreme, infallible, visible head of the whole Christian Church. Because of the prerogative of infallibilty no General Councils of the Church are necessary to ascertain what has been believed in the Church of all lands and ages. "It is enough to interrogate the oracle that speaks at the Vatican."

The position of the German old Catholics, and of Père Hyacinthe is logically unassailable. They apply to their faith the Catholic test of universality, permannence and consent, not recognizing that the Pope of Rome has any right to force upon Catholic Christendom the reception of non-Catholic doctrine, and do not allow that it is possible for them to be cut off from the Catholic Church by any excommunication by the Pope, on the ground that he has no authority to excommunicate them. They say of the Roman Church as did St. Cyprian of the Novatians: "We did not depart from them, but they departed from us;" claiming not that they are the only Catholics, but that such Catholics as I have above mentioned as recognizing as truly Catholic only such doctrine as will stand the test of universality, permanence and consent, are the only Catholics faithful to the methods and traditions of the Church.

Père Hyacinthe's theological position will be better understood in proportion as Catholics insist upon unity only in essentials. The true Catholic spirit sounds forth in those words of his,

"I am not afraid; the truth will conquer!"

ARCHÆOLOGY.

THE GLACIAL PERIOD IN ILLINIOS.

At a recent meeting of the St. Louis Academy of Science, Mr. William McAdams was introduced and invited to exhibit some rare specimens he had excavated in various parts of Illinois. The gentleman, in explaining his specimens, with the view of throwing as much light as possible on the subject, read the following paper:

"The last great convulsion of nature, under the guidance of an all-wise Provdence, ended the geological epoch and finished the earth, leaving it in its present outward form, which is called by geologists the quaternary or drift period. During this period the earth, from some cause not easily explained, became covered toward the poles, with an enormous envelope of ice, which after a time, from causes also obscure, melted and moved toward the equator, eroding away the upheaved prominences and filling up the valleys with clay and other debris that in the end left a great area of the country, especially in the Mississippi valley, with the general level surface upon which the rich soil of this great region reposes.

"The deposits of the drift, as seen in digging wells and making other excavations, as well as in the precipitous exposures made by water-courses, consist usually of a reddish brown clay, underlaid by a bluish plastic clay lying on the surface of the rock, which is usually reached in both Illinois and Missouri at a depth of less than one hundred feet. This depth, however, is sometimes exceeded where the valleys of ancient streams are met with.

"Mingled with these drift-clays are many boulders and masses of rocks of great interest from the fact that they are often of different material from any rocks we have in place in Illinois. It is quite common to find granite, porphyry, greenstone and other primary rocks that have evidently come from the region of Lake Superior. It is not uncommon to find masses of native copper, doubtless from the same northern locality. The present specimens of this copper are from the drift in the neighborhood of Alton and near Grafton. It is quite probable that a period of many years elapsed—ages, in fact—during the subsidence of the drift-glaciers; and although it may not be quite certainly ascertained that man beheld the phenomena of this epoch, it is quite certain that many strange animals braved the rigors of the climate and evidently flourished. Some of these animals were of strange appearance, and where their bones are discovered protruding from the clays, one is astonished at their size. From the clay in the side of a ravine in Calhoun Co., Illinois, we recovered the jaw of an elephant beside which Jumbo would seem small. One of the teeth from this fossil jaw, and which we present for inspection, weighs near eighteen pounds, being much lighter in its fossil state than when in the mouth of the living animal. The teeth of this great glacial elephant are quite different and much larger than those of the mastodon which also existed during the same period. The teeth of this extinct elephant very much resemble the teeth of the elephant of the present day. We have also taken from the drift-clays above Alton the teeth and several bones of a huge carnivorous animal allied to the bison, probably the extinct *Bos latifrons*, the spread of whose horns would make those of a Texas steer seem very small in size.

"It is quite probably that during this period more than one species of horse existed. Bones of extinct horses are quite numerous in the tertiary deposits about the base of the Rocky Mountains.

"In digging a well in Greene Co., Illinois, the workmen found at the bottom of the excavation the teeth of an extinct horse somewhat resembling those of the present day. We also have seen the fossil tooth of a horse from near Alton.

All the remains of the horse we have seen from the 'drift' are of large animals, while the majority of the fossil horses from the 'bad lands' of Dakota are quite small.

"Along the banks of the Mississippi the character of the 'drift' deposits is somewhat changed by a sort of lacustrine marly clay left during the slow subsidence of the waters down the river valley after the ice had melted away. This marly clay deposit which caps the river bluffs is called loess and passes gradually into the drift clays below. It is somewhat remarkable that with the many fluviatile shells and remains of land animals in the loess we also occasionally find the the remains of animals almost wholly marine. From the loess above Alton a few years ago was recovered the skull of a species of walrus with curved tusks down from the upper jaw and much resembling the walrus now inhabiting the Arctic seas. From the clays over the quarries at the mouth of the Illinois River we have taken the remains of a large and undescribed animal that had apparently curved tusks depending from the upper jaw, not unlike the walrus. These tusks were some three feet in length, the smooth surface of the ivory being raised longitudinally in fluted parallel lines, quite unlike the tusk of any known animal. We present portions of these tusks for inspection. Both in the true and modified drift we have seen the remains of rodents, some of them small; but one, an extinct beaver, was of monstrous size. Some of these animals, from the fact that their remains have been found in the mire of swamps, survived the drift period and became extinct in later periods. This is especially true of the mastodon. As little as is known of the animals of this period, still less is known of the vegetation. We also present specimens of wood from the same horizon.

"At one locality on Otter Creek, in Jersey Co., Illinois, the stream cutting through an ancient valley filled with drift-clays, there is exposed beneath the drift-clays a pre-glacial soil near four feet in thickness. In this curious deposit wood and other vegetation are numerous. A tree lies prone in this soil, with parts of the limbs still attached. The trunk of the tree, of which we present a section, with portions of the limbs adhering, is flattened and almost turned to lignite by pressure and lapse of time. But what is still more interesting are the cones or fruit which the tree bore. These cones are about an inch in length and somewhat resemble those of a species of conifer, different, however, from any known species. We place before you other remains of this ancient vegetation."

Judge Holmes in commenting upon the specimens stated that marine deposits had been found in a peculiar stratum which was supposed by geologists to extend as far south as the mouth of the Ohio River and that the tusks referred to in the paper would be a valuable discovery if they proved to be those of a walrus.—*Globe-Democrat.*

TOLTEC ANTIQUITIES.

The Smithsonian Institution has received an invaluable addition to its rare collections. This addition consists of the widely advertised plaster casts of Central America antiquities, contributed to the Institution by Mr. Pierre Lorrillard. These casts include many wonderful monuments of antiquity existing in the ruined cities of Central America, reproducing with absolute fidelity, and in their actual size the extraordinary bas-reliefs and hieroglyphic inscriptions of the ancient temples of Yucatan, Tubasco and other regions in Mexico and Central America. The relics have been fully described in the magazines and daily papers of the country. They arrived in charge of M. Barbier, the agent of M. Desire Charnay, the distinguished French archæologist, who resurrected the antiquities. The collection is packed in eleven boxes, which are now stored in one of the grand halls of the institution. Mr. Barbier unpacked the valuables, and estimates that the placing of them in proper order and position will require two months, There are about one hundred models altogether.

Professor Baird said to a *Republican* reporter that the gift was a most welcome one. M. Charnay had gone out to Central America several years ago under the patronage of M. Pierre Lorillard. Under the laws of the ancient countries explored by him, he was prohibited from bringing any of his discoveries away, being permitted only to casts of them. These casts were first shipped to Paris, where copies were made for the French government, M. Charnay's arrangment with Mr. Lorillard including that privilege. The casts were then shipped to this country. M. Charnay could not come in person to deliver the models, but has sent M. Barbier, a noted artist and modeler of Paris.—*National Republican.*

CLIFF-DWELLERS OF COLORADO AND NEW MEXICO.

FLORA ELLICE STEVENS.

Last winter Colonel James Stephenson, who is well known as an archæologist, made some interesting discoveries in exploring the cliff-dwellings on the southern boundaries of Colorado and New Mexico.

Colonel Stephenson is connected with the Bureau of Ethnology and an enthusiast in pursuit of discoveries. He found in his work several mummies which were wrapped in cloth made of a fabric resembling flax, and in one of the dwellings specimens of the reed entire, from which it is probable that the fabric may be exactly defined.

Colonel Stephenson thinks that the cliff-dwellers were still in existence as late as three centuries ago, much later than archæologists have generally determined; and in defense of this theory cites a Spanish author, who visited this country three hundred years ago, and who describes a people living in this locality, whose cloth and other articles tallies with that found by Colonel Stephenson, which is a very important point indeed.

DENVER, COLO., July 22, 1883.

PHILOSOPHY.

THE NATURE OF THE EXISTENCE OF MATTER.

E. R. KNOWLES.

"We feel but the pulse of that viewless hand
Which ever has been and still shall be,
In the stellar orb and the grain of sand,
Through Nature's endless paternity."

Philosophers are now obliged to refer all the phenomena of the universe to the action of a substance occupying space, which communicates light, heat, electricity, and gravitation from one body to another, and mental emotion and imaginary ideas from one mind to another. This omnipresent medium is called *Etherium*, or *the ether*. Most scientific men are fully convinced of its reality. It is a necessary inference from the following facts:

1. The planets "influence each other," and are all attracted by the Sun.

2. Philosophers agree that the atmosphere does not extend more than two hundred miles from the Earth's surface.

3. Heat, light, electricity, magnetism, and gravitation operate in an exhausted receiver just as well as elsewhere

4. One mind sometimes influences another independently of ordinary sensation or muscular motion, without contact or perceptible connection.

Says Professor Tyndall, "The domain in which this motion of light is carried on lies entirely beyond the reach of our senses. The waves of light require a medium for their formation and propagation, but we cannot see, or feel, or taste, or smell this medium. How, then, has its existence been established? By showing that by the assumption of this wonderful intangible *ether* all the phenomena of optics are accounted for with a fullness and clearness and conclusiveness which leave no desire of the intellect unfulfilled. When the law of gravitation first suggested itself to the mind of Newton, what did he do? He set himself to examine whether it accounted for all the facts. He determined the courses of the planets; he calculated the rapidity of the Moon's fall toward the earth; he considered the precession of the equinoxes, the ebb and flow of the tides, and found all explained by the law of gravitation. He therefore regarded this law as established, and the verdict of science subsequently confirmed his conclusion. On similar, and if possible, on stronger grounds, we found our belief in the existence of the universal ether. It explains facts far more various and complicated than those on which Newton based his law. If a single phenomenon could be pointed out which the ether is proved incompetent to explain, we should have to give it up; but no such phenomenon has ever been pointed out. It is, therefore, at least as certain that space is filled with a medium by means of which suns and stars diffuse their radiant power as that it is traversed by that force which holds, not only our planetary system, but the immeasurable heavens themselves in its grasp." And again, "The ether which conveys the pulses of light and heat not only fills the celestial space, bathing the sides of suns and planets, but it also encircles the atoms of which these suns and planets are composed. It is the motion of these atoms, and not that of any sensible parts of bodies that the ether conveys; it is this motion that constitutes the objective cause of what in our sensations are light and heat." Again he says, "Two atoms of oxygen and one of sulphur constitute the molecule of sulphurous acid. Now it has been recently shown, in a great number of instances, that waves of ether issuing from a strong source, such as the Sun or the electric light, are competent to shake asunder the atoms of gaseous molecules. A chemist would call this 'decomposition' by light, but it behooves us who are examining the power and function of the imagination, to keep before us the physical images which underlie our terms. Therefore, I say, sharply and definitely, that the components of the molecules of sulphurous acid are shaken asunder by the ether waves. * * * * * * * * * Here, then, our ether-waves untie the bond of chemical affinity, and liberate a body—sulphur—which at ordinary temperatures is a solid, and which therefore soon becomes an object of the senses." To other modifications of ethereal action are referable muscular motion, sensation, and all the other phenomena of the material universe.

Says Professor J. Stanley Grimes, "Light cannot penetrate boards and stone walls, but magnetic force can do so; for a magnet affects iron-filings through such obstacles, almost as if there was nothing in the way; and so also does gravitation. It is plain that if we could perceive through the medium of this magnetic force instead of light, we could see through boards and walls as easily as the magnet operates through them; for the magnet operates in the dark just as well as in the light. We must conclude, therefore, from the great number of facts which we have upon this subject, that there is a motion of Etherium, different from light, by means of which the force of gravitation is communicated; and another modification of etherean motion, by means of which magnetism penetrates through opaque bodies. It, therefore, requires no stretch of the imagination to admit a modification of ethereal force which affects the brain and its organs, and produces Consciousness and Clairvoyance in a subject who is, by the process of etherean induction, brought into communication with it. If we analyze a sunbeam, we can demonstrate that besides light and heat it contains another kind or motion of Etherium, different from light and heat, which produces powerful chemical effects and yet we have no senses given to us by which to enable us to perceive by its means, though it may sometimes abnormally induct us and produce clairvoyant perception."

"It seems to me, that there cannot be a doubt in the mind of a philosopher who examines the subject carefully, that there is a peculiar form or modification of ethereal force, which has, with some propriety, been denominated *Animal Magnetism*, and which is concerned in producing all the phenomena of animal life, and all the wonders of Etheropathy and Mesmerism. We seem forced to this conclusion as the only one which will account for facts which we are not able to controvert."

It is well known that orators often exercise a so-called magnetic influence over their hearers. It has been proved that mesmeric susceptibility is owing neither to the imagination, nor the credulity, nor the nervousness of the subject, and that when a subject is in a state of etheropathic sympathy, produced by induction, ideas can be communicated from the mind of the operator to that of the subject, and the subject made to act by the mere silent will of the operator, without any indication being given to the subject by the word, look, or act of any one as what the operator has in mind[1]. These last mentioned facts have led some scientific men to suppose this ether to be homogeneous with, or at least intimately connected with, that immaterial, simple substance, the soul.

The idea that the will of man can direct ethereal action in such a way as to produce etheropathy, or mesmerism, is perfectly consistent with the nature of the will. In the case of the electric eel, we have an instance of the will directing electricity in such a way as to paralyze the limbs of animals at a great distance, and even to produce death.

If, then, the electric eel can habitually and instinctively direct by its will *one* modification of ethereal action, it is reasonable to suppose that the will of man can direct *another.*

In view of the facts herein already adduced, the only way whereby to account for certain incontrovertible facts is to refer matter, as well as light, electricity, etc., to the immaterial substance called the ether. All the difficulties with which philosophers now meet in explaining various phenomena by the action of the ether, arise from their not explaining the very existence of matter by ethereal action.

"That which truly is, or essence," is the proper meaning of substance. *Substance* is "the ultimate point in analyzing the complex idea of any object. *Accident* denotes all those ideals which the analysis excludes as not belonging to the mere being or nature of the object."

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1 "If we proceed still farther, we gradually, in many subjects, acquire a power of moving their organs by merely willing, and without expressing our will by any sign; but, in these cases though neither assertion nor sign is necessary to influence the subject, yet an assertion, if made, is wonderfully potent."—(Grimes' Etherology, etc., p. 149.) "Let us now consider, that when a subject is perfectly inducted, the mere silently expressed *will* of the operator can influence him, and cause him to move or feel in any desired way. No assertion in this case is necessary—no sound—no sign—no external muscular motion. There is nothing but the operation of the silent but potent will.—(Ibid., p. 147.)

The substance of all matter is the ether, this "creating and informing spirit, which is with us and not of us." The accidents of any object are its peculiar modifications of ethereal action.

The ether acts in space, directed and compelled in its action by the Divine Will. There are:

1. Simple modifications of ethereal action.
2. Combinations of such modifications.

The accidents of objects are constantly sustained by the Divine Will in accordance with fixed and permanent laws. This theory explains the phenomena of matter by the action of the ether; but it teaches neither that the ultimate reason of all movement is a force primitively communicated at creation, a force which is everywhere present in all bodies, but differently limited; nor that any such force is inherent in the ether; nor yet that force is transmitted through the ether. I hold that the Divine Will constantly sustains by sympathetic induction all the modifications of ethereal action which constitute matter.

At any point in space the ether is constantly governed by the Divine Will in such a way that an object there situated, has a real existence *there*, whether any one is there to perceive it or not, its real existence being a combination of certain modifications of ethereal action; and the same object is presented to every spirit who happens to come or be brought into communication with that point in space, this presentation being governed by fixed laws, and any one who has already perceived a particular object knows that upon going again to the place where it is, the same object will be perceived by him, *i. e.*, the same combination of modification of ethereal action will be communicated to his soul by means of this same ether as a medium and by certain other modifications, and combinations of modifications, of ethereal action.

Our perception, therefore, of real ideas or material objects is the result of the action of the Divine Will on our minds, and the Eternal Spirit constantly sustains and presents these real ideas for the contemplation of created spirits, but they exist out of the minds which perceive them.

This theory does not merge the creature in the Creator; and does not make God the agent or power in everything that is done, and thereby lead us to the same point with Hume, viz.: that the mind is but a mere series of impressions, and that we can have no knowledge of it.

THE SCIENTIFIC STUDY OF HUMAN NATURE IN SCHOOLS.

C. A. SHAW.

I once, in conversation with a superintendent of schools, suggested that a text-book of human nature be introduced. He wearily replied that the list of studies was now so great that mastery of any one was impossible, and that to introduce a few more would make the varnish of public instruction so thin that it would not bear the least scratch of practical experience. "Superficial information is the bane of this country," said he.

The answer to his complaint did not immediately occur to me, or rather, I did not at once group all my arguments against his assertion in a sufficiently connected manner to think it wise to take up his valuable time by presenting them at that moment. Since then I have considered the subject and venture to present my views as follows:

There is, I think, a wide difference between knowing of things and knowing the things themselves; also, of knowing about things and about the uses of things, —that is people. It seems to me a superficial knowledge of a good many things is not such a bad education; for example, when a lad from the country first comes to the city he is hopelessly confused; he loses his way; he is ignorant of prices; of articles he requires; of the means of obtaining them, and of the proper place for seeking instruction. His ignorance is not that of capacity but of locality. He is not like a man to whom music is a sealed art, having neither taste nor instruction, neither is he like a man skilled in one profession who, late in life, is forced to attempt another for which he has neither aptitude nor training, for in these instances nothing derogatory to the person is implied. But we all ridicule the simple-minded who cannot readily group and use for their benefit the thousand appliances of civilized life with which we are surrounded. It denotes, we think, a want of that adaptiveness which in practical life is the most valuable attribute for success. A student, by diligent application, may become a profound Grecian, but in how few instances will his thoroughness avail against the annoying intricacies which the adaptive man so readily escapes.

I do not wish to imply that this superficial knowledge of common forms is a matter of very great importance, but it is certainly worth considering as an element of a man's life.

It frequently happens that to know men is better than to know things. It would not answer if nobody was to be learned, or wise, or thorough. But it is one of the peculiarities of the human brain that one boy will learn easily one thing and not another, and that culture consists in training those faculties which the youth is naturally disinclined to use. The study of human nature would be quite unnecessary if all in the school intended to become commercial travellers. They learn the lesson soon enough. They are obliged to do so and if by commerce with the world of tradesmen that congregate at hotels they learn too thoroughly an objectionable side of human nature, yet to them it is possibly only the extreme of adaptiveness which we lament the lack of in a student who, perhaps, has a profound knowledge of ferns and does not know one man from another.

It may be asked what text-books could be advantageously employed? Well, they would have to be written, that is certain. I do not incline to the phrenological chart. It too frequently happens that a man inherits the external presence of a progenitor without his ability. He is walking about and masquerading in another man's dress. I do not say but that a practiced scientific phrenologist could readily detect the imposture. They pretend to do things much more surprising. But the art I would first inculcate upon youthful minds would be easy matters of every-day application. I think briefly something like this might be shown.

First: that youth is self-confident (for a very good reason, since without confidence little will be attempted,) but that in itself this does not imply special capacity.

Second: that success breeds confidence, for what a man has done once he believes he can do again.

Third: that a certain discipline of the physical, mental, and spiritual faculties breeds a calm confidence that is eminently fitted to ensure success.

For this discipline of the nerves I think music and playing upon some musical instrument, billiards, firing a pistol or rifle, riding or travelling greatly assists the body in attaining and retaining, and a student of any sedentary occupation should seek such contrasting influence. I do not advise military drill, for I do not like the sort of men that usually seem to be the result of military education, but that may be a personal prejudice or the result of special training in a narrow field. A martinet is only more objectionable in a military role as he is hedged about by greater power of authority. Thoughtful educators have advocated military tactics as very valuable.

The result of failures might be shown to be not always discouraging. A man must learn to do his best work in the field best adapted to his powers. It is no hardship for a young man to fail as a lawyer if thereby he is induced to give his time and talents to a pursuit for which he is better adapted. Failure should be shown to rest upon character and not upon circumstance.

The cause of failure, however, such as resulting from lack of nerve, either from physical disability, ill health, old age, etc., should be made evident, and also that sucess in one line naturally debars a man from success in another. Even the great Goethe was once heard to lament that "he lacked the cheek of the bagman of his day." But not every one aspires to the complete many-sidedness which was Goethe's affliction. Too frequently the novelist points out that the wise minister, or student, or teacher, is little better than an idiot "because he is not up" in all the little ways of the great world. But this is a mistake. A man after his first youth can afford to dress according to comfort more than to fashion and if, when a boy, he has looked at the world from the practical side and found nothing very alluring therein, if in middle life he finds it full as pleasant to be "off the stage," as on, he is thereby not to be classed as a "fossil" and a "country guy." There is a wide difference between "having known and out-grown" and "never having known." The latter always rests upon a weakening desire to experience it. It is this state of mind which sends so many good men staggering when by chance they get a little unwonted liberty late in life, and which ruins so many young men too tightly kept in restraint when boys. There is not much in civilized life that is tempting to the experienced, but who can convince the inexperienced of this?

I know that the student of the humanities makes nearly the same plea that I have made and against the sciences. But I would retain the scientific basis of study even in this new walk. For the scientific way, at least by its classified regimen, shows its narrowness upon its face. These being known can be corrected.

A SCIENTIFIC INVESTIGATION OF SPIRITUALISM.

Some time since Mr. Henry M. Seibert endowed the chair of moral and intellectual philosophy in the University of Pennsylvania, with a request or provision that the trustees should appoint a commission from the faculty to investigate what is known as spiritualism. The trustees have, within a short time past, acted upon the bequest and made the appointments. The commission consists of Dr. William Pepper as chairman, who is the provost of the university, a gentleman of acknowledged scientific attainments. The other members are Prof. George A. Koenig, Ph. D., assistant professor of chemistry, and a graduate of Heidelberg; the Rev. Robert E. Thompson, A. M., professor of social sciences; Joseph Leidy, M. D. LL.D., professor of anatomy, and the Rev. George W. Fullerton, instructor. The commission will be divided into branches, and members assigned to them in accordance with their experiences and qualifications. Dr. Pepper will have charge of the medical and physiological phases of the subject; Professors Leidy and Koenig, the physical aspects; Rev. Dr. Fullerton and Rev. Dr. Thompson, the intellectual and metaphysical phenomena. Mr. Seibert was a firm believer in spiritualism, yet it is understood that all of the members of the commission are non-believers. Few people, unless they have given attention to the matter, have any correct idea of the number of persons who have embraced this belief. The spiritualists claim a million of believers in the United States, and as many more in Europe. It is well to have an investigation by scientific men. It can do no harm, and may do a great deal of good.

THE TENDENCY OF SCIENTIFIC INQUIRY.

At the Annual Meeting of the Victoria Philosophical Institute, held at London, England, in the last week in June, the Honorary Secretary, Captain F. Petrie, F. R. S. L., read the yearly report, by which it appeared that the Institute—founded to investigate all questions of Philosophy and Science, and more especially any alleged to militate against the truth of Revelation—had now risen to 1,020 members, of whom about one-third were foreign, colonial, and American, and new applications to join were constantly coming in. An increasing number of leading men of science had joined its ranks, and men of science, whether in its ranks or not, co-operated in its work. During the session a careful analysis had been undertaken by Professor Stokes, F. R. S., Sir J. R. Bennett, Vice-

President R. S., Professor Beale, F. R. S., and others, of the various theories of Evolution, and it was reported that, as yet, no scientific evidence had been met with giving countenance to the theory that man had been evolved from a lower order in animals; and Professor Virchow had declared that there was a complete absence of any fossil type of a lower stage in the development of man; and that any positive advance in the province of prehistoric anthropology has actually removed us further from proofs of such connection, namely—with the rest of the animal kingdom. In this, Professor Barrande, the great palæontologist, had concurred, declaring that in none of his investigations had he found any one fossil species develop into another. In fact, it would seem that no scientific man had yet discovered a link between man and the ape, between fish and frog, or between the vertebrate and the invertebrate animals; further, there was no evidence of any one species, fossil or other, losing its peculiar characteristics to acquire new ones belonging to other species; for instance, however similar the dog to the wolf, there was no connecting link, and among extinct species the same was the case; there was no gradual passage from one to another. Moreover, the first animals that existed on the earth were by no means to be considered as inferior or degraded. Among other investigations, one into the truth of the argument from Design in Nature had been carried on, and had hitherto tended to fully confirm that doctrine. The question of the Assyrian inscriptions and the recent Babylonian researches had been under the leadership of Mr. Hormuzd Rassam, who, on his arrival from Nineveh, had given a full report of the extent of his new excavations, which were of the highest interest. His discovery of Sepharvaim, one of the first cities mentioned in Holy Writ, was most important. Professor Delitsch and others aided in the consideration of the discoveries and the inscriptions found. Two meetings had been held to consider the questions raised in Herbert Spencer's Philosophy, and Lord O'Neill and others had shown, by a careful analysis of his arguments, that a greater attention to accuracy in statement would have kept Mr. Spencer from arriving at those hasty conclusions which had made his philosophy remarkable. It was announced that the results of explorations now being carried on in Egypt would be laid before the Institute early in the winter. The discoveries were very important, especially that of the site of Succoth, which, like the results of the survey of Palestine, was confirmatory of the Sacred Record. The quarterly journal, which had been published for sixteen years, was now issued free to all Members and Associates, whether at home or abroad.

We are glad see the evidences of prosperity which are presented by the American *Naturalist.* The first half of the seventeenth volume contains over seven hundred pages, more that in some of the whole volumes of previous years. Illustrations are not used so freely as in the past.

ENGINEERING.

OF FRESHETS AND OVERFLOWS.

REV. ALBERT E. WELLS.

We Americans are an inventive people and stand ready to grapple with any problem that comes in the way of our developing the vast country that is our inheritance. Permit then, in view of the annual devastation wrought by water, a suggestion in regard to the proper method and place of meeting and guiding the waterfall or catch of the Mississippi basin. Is there not bad contrivance, to say the least of it, in trying to handle its enormous bulk along the lines of river border in Louisiana? If I wished to direct the water falling upon the roof of a barn I would catch it as near the roof as possible, and not wait to have it mingled with the rain falling on all the farm. The proper place, therefore, to deal with the overflows that do so much damage from Omaha, St. Paul, and Pittsburg to New Orleans, is on the upper watersheds. A tub that will not hold water is a failure for a tub. Competent engineering could, I believe, make every town in this vast area hold water at least long enough to deliver it in proper shape to the watercourses that lie next below. And every town would be the better for doing so.

Consider for a moment the present system of natural open drains. They waste land, by the space they occupy, and by washing of their banks. If we start at the head of the draw, and follow down, we shall meet, first, the break in the sod or soil where the force of the water begins to cut. Second, a deepening ravine or gully where, the top soil being cut through, we find the clay washing out. Third, the rock formation is reached, and by the time we are three miles down the stream we have a cross section of some forty-five square feet and waste ground each side of it, sixty feet wide on an average.

Most of the time the bed of this watercourse is dry. After an ordinary shower it is bank-full, after a heavy rain it overflows its banks, and its turbid waters tear away its banks like flumes, and below there is for the larger stream a choked-up channel that puts it in a rage, and the washing out is on a larger scale until the river is reached where we have our yearly unmanageable torrent. And nine-mile creek has a bed large enough for a navigable river in which one is not likely three weeks after a heavy rain to find running water enough for his horse to drink, and drift beyond its banks sufficient to indicate the awful power of its flood. An examination of its bed shows piles of loose stone, sand-banks and mud-banks, stranded drifts of logs, trees, stumps, and straw, and corn-stalks. A calculation of the amount of water that has probably passed through the channel will serve to excite our wonder. Say the basin drained is a township of thirty-six sections. A three-inch rainfall has flooded the basin, and nothing of it now is seen save the wrecks it has made. A navigable river discharging 90,000 cubic feet an hour, should have at least a year's time to disgorge it, 80,301,860 cubic feet of water have rushed through that bed in ten or twelve days. The problem of handling this bulk is worthy of our greatest engineering talent. And the place for the most useful handling, and as well as the most successful, is the place where it falls.

1st. Fifty acres of water surface to every township is none too much and is less than is now wasted. The avoiding of open drains and of washing are items of considerable importance to farmers. The delivery of clean water to the larger rivers is one of considerable importance to river men, and the interests of navigation. A constant flow in all streams whose minimum and maximum are known is greatly desired by railroads that have to provide bridges, and culverts, to roadmasters who have to construct bridges and approaches to them for these streams. If the basin of any of the minor rivers in north Missouri were so dealt with that every township could deliver in catch-ponds its rainfall so that land should be ready for the plow ten or twelve hours sooner than at present, and not deliver to the streams in bulk this vast amount of water, it would be a gainer.

For instance, Grand River drains about 1,000 townships. It should be a navigable river, its bed is large enough from the mouth to the north line of the State. Its watershed provides water enough if the flow were regulated to afford a good pathway for steamboats of 100 tons displacement. If the entire basin were, under skillful engineering, drained and reservoirs so placed that every township should hold its catch at least sixty days before parting with the last of it, and then deliver no drift, it would add greatly to the safety, the utility and the beauty of that stream, and would save us the bar at its mouth in all probability. If all the streams in the vast basin under consideration were thus dealt with a great deal better success would attend our attempts to improve the navigation and protect the levees of the lower river. Now all this region is inhabited by intelligent and thrifty people, and the organization that has the most to do with it is the town meeting or the county board, the units of our commonwealth. Of course the engineering problem would be different in every locality, but not insuperable in any. For the data are given so nearly that the exact character of the work can be determined, when place and area are known. The fall for the year here averages forty-two inches, on the upper Mississippi it is forty, what it will be for any area is readily determined. We cannot ride ten miles from this city without crossing some one of these beds of streams that are miserable gullies and washes. And in this land at least, "The Brook" of Tennyson is unknown. The beautiful streams of the lake country of Wisconsin are not found here. May they not be made? Filling a narrow gorge or cañon with a seething mass of water, mud and drift does not add to the useful drainage of a country, while the filling of a lake, or pond, or tarn with pure water and guiding its surplus away through dewy meadows or shady forest, a living stream, to join some other living stream and "so go on to join the brimming river" might add beauty to utility.

I love the water. Its beauty in the landscape. Its comfort in the land. The purposes of thrift that it serves. I cannot forget the enjoyment they give, in the land they make beautiful, those lakes of Wisconsin. Though they may not be reproduced here, yet our supply of water enables us to do a far better part by our land than we are doing now. I hope our civil engineers will take up the subject.

MEXICAN RAILWAYS.

There were 2,379½ miles of completed railways up to the end of April in Mexico. A few of the shorter ones are now worked by horse-power. The completed and partially completed roads are the Tiascala road, 2½ miles; the Orizaba-Ingenio, 3 miles; the Nuetla-Tiasciaco, 4 miles; the San Adres, 7 miles; the Tialmanalco, 9 miles; Pueblo and Matamoras Izucar, 19 miles; San Martin, 23 miles; Tehuacan-Esperanza, 31 miles; Tehauntepec, 31 miles; Sinaloa and Durango, 36 miles; Vera Cruz-Medellin, 39 miles; Hidalgo, 56 miles; Pueblo San Marcos, 57 miles; Yucatan, 68 miles; Mexico-Tialpulalpam, 75 miles; Sonora, from Guaymas to Nogales, 234 miles; Inter-Oceanic, Mexico to Curantla and branches, 183 miles; Mexican National, Mexico to Acambaro, 178 miles; from Laredo Southward, 208 miles; branches, 87 miles; Mexican Central, Mexico to Lagos, 311 miles; Paso del Norte to Chihuahua, 302 miles; Tampico to San Louis Potosi, 62½ miles; Mexican, Vera Cruz to Mexico, 264 miles, and Pueblo and Jalapa, 89½ miles. Of these the Mexican National, the Inter-Oceanic, the Hidalgo, and the Yucatan lines are narrow gauge, the other lines are standard gauge.

CHEMISTRY AND PHYSICS.

ANCIENT AND MODERN GLASS OF MURANO.

JAMES JACKSON JARVES.

Of all the peoples which have made glass a special industry, the Venetians, for artistic variety and quality, are the most renowned. The Egyptians, Phœnicians, Greeks, and Romans in certain kinds are unrivalled, especially in moulded, cut, mosaic, and cameo-glass, of which last the Portland and Neapolitan vases are unsurpassable specimens. With the Byzantines the art survived, but in a degenerate form, as with classical painting and sculpture. Nevertheless, there is little doubt that it was more or less extensively practised at Constantinople and in Italy during the Dark Ages, although so little information and so few specimens of these times have reached us. In the form of mosaic it must have been extensively cultivated, at least from the fourth and fifth to the ninth and tenth centuries. We may be tolerably certain that the beginnings of the Venetian art came from Oriental and Byzantine sources. But there are no records relating to its glass previous to the twelfth century. In 1268 we have notices of scent bottles and table ware, and in 1275 the exportation of the materials used in the manufacture was prohibited. So rapidly did it grow into commercial importance that the State intervened to protect and encourage it in every possible way, and to make it a national monopoly. In this it succeeded so far that the fine manufactures of Venice controlled the markets of the known world for centuries; and although more or less successful attempts were made in other countries to become independent of her, none ever succeeded in equaling the variety, beauty, and refinement of the best Venetian work. The republic wisely ennobled the art, and in 1376 decreed that the descendants of glass-blowers who intermarried into the noble families should be considered as patricians. Particular civil privileges were conferred on the guild. It was not amenable to the inferior courts, but was under the special jurisdiction of the celebrated Council of Ten.

Although Venice itself gives its name to the glass as early as 1291, the works in general were removed by statute order from that city, and established in the neighboring island of Murano, a mile to the northeast, where there were already in existence manufactories, but on a smaller scale. This was to guard against the risk of fires in the thickly populated city, and for sanitary reasons. Henceforth Murano became the chief locality of this industry, which finally took such proportions that the street along the chief canal, more than a mile long, became mainly devoted to it. Coccio Sabellico, in his account of Venice, written about 1495, thus alludes to Murano:

"There is a street which might, from the magnificence and size of its edifices to those who beheld it from afar, appear a city; it extends a mile in length, and is illustrious on account of its glass-houses. A famous invention first proved that glass might feign the whiteness of crystal, and as the wits of men are active and not slothful in adding something to inventions, they soon began to turn the material into various colors and numberless forms. Hence came cups, beakers, tankards, caldrons, ewers, candlesticks, animals of every sort, horns, necklaces; hence all things that can delight mankind; hence whatever can attract the eyes of mortals; and, what we could hardly dare to hope for, there is no kind of precious stone which cannot be imitated by the industry of the glass-workers. Consider to whom it did occur to include in a little ball all the sorts of flowers which clothe the meadows in spring.[1] Nor has the invention been confined to one house or family; the street glows for the most part with furnaces of this kind."

This is a graphic description of the condition of the industry at Murano in latter part of the fifteenth centry, when it was bordering on its most artistic and flourishing period, in which it was a virtual monopoly of the Republic. Murano

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Referring to one kind of *Millefiori*—thousand flowers—glass, made from *canne*, or rods of many colors.

so eclipsed all other Italian cities that none other ever acquired any reputation for glass. There were sufficient reasons for this success. Its secret processes were jealously guarded, and the skill of the workmen in various departments kept, as it were, in certain families, and transmitted from generation to generation.

Among the most distinguished were the Berovieri, the Miotti, Briati, and Ballerini, some of whose descendants are still engaged in the same occupation in the new establishments of Salviati and the Venezia Murano companies, reproducing and even rivalling the artistic dexterity of their ancestors. Their chief aim was to make *artistic* glass exclusively for beauty; and, secondly, to ornament and shape even the articles of common use so that they should, as Sabellico happily expresses it, "attract the eyes of mortals" and "delight mankind." This vital æsthetic principle of work was the real secret of the fame and success of Venetian glass, as of its painting. In making beauty, not utility, its governing rule, it demonstrated by its commercial success and enrichment of the State that the higher the aim of industrial art, the surer the road to fortune, as well as mental delight. It "paid" Venice amazingly well to give beauty its rightful place in manufactures, and be satisfied with nothing short of its fullest development. Besides seeking the best materials, and aiming at strength, delicacy, and lightness, which were promoted by not using lead, as is the general modern practice in glass, each manufactory so well kept its secrets that we now know very little of their modes of manufacture. The State lent its aid also in a series of Draconian enactments, which, if they did not wholly preclude competition in other places, mainly prevented it. Workmen who took their craft to foreign countries and refused to return were condemned to death, and secret emissaries were sent to execute the sentence. In 1549 it was enacted that workmen caught leaving the country should be fined and sent to the galleys, and that no foreigners be employed in the glass houses. If it were a cherished and lucrative business at home, under the eyes of the "Ten," it was equally made a most dangerous calling to be exercised by any Venetian abroad.

As early as 1500, there were twenty-four glass-houses at work at Murano, each having more or less its specialty The furnaces in general were small. During the period of its greatest prosperity—the fifteenth, sixteenth, and seventeenth centuries—Murano counted thirty thousand inhabitants—now reduced to about five thousand. Each owner of a factory was obliged to contribute annually a certain sum to a common fund for the succor of the unfortunate of their own class—poor and infirm artisans, or those out of employment, and for the maintenance of the schools of inventive design. No apprentice could be admitted as a master-workman before passing a strict examination in his art, and proving his skill in the manufacture of certain objects. The candidate was elected into the body of masters by their secret ballots. Each factory was subject to inspection night or day by certain officers, whose duty it was to see that the work was regular according to the statutes, to note the quantity and quality of the objects, and that no glass in fragments, or cullet, be exported. Proprietors, and master-workmen of ten years' experience, if they honorably failed, and had no other means of subsistence, were entitled to pensions of seventy ducats annually. When there were more master-workmen than could be profitably employed, it was forbidden to increase their number from the apprentices untill there was a real call for new hands. Whoever became a member of the guild was obliged to take an oath of fidelity. No one who had not a regular discharge from his employer could be received into the service of another, and every proprietor was obliged to seal his cases with his own trade-mark. It was forbidden to employ strangers under any pretence. If there were not enough of the Muranese at times for labor, or to exercise the art, Venetians only might have the privilege, but they must be duly qualified. No employer could hire a master-workman who was in debt to another of the guild. Such were some of the regulations to keep the art in a high state of efficiency, and which for more than five centuries gave it an incontestable superiority in its special aim over all other establishments in Europe. In fine, Murano became as artistically famous for its glass as Urbino, Pesaro, Gubbio, or Chaffagiolo at the same time for their majolica, but with far greater commercial development.

Mr. Franks, somewhat incompletely but conveniently, so far as he goes, classifies the decorative glass as follows, in six divisions:

First. The transparent and colorless glass, or of single colors, commonly black, purple, blue, ruby, green, opalescent, amber, etc. Sometimes there are two colors in the body of the same vessel—one inside and the other on the outside. Frequently in the handles and external ornamentation a variety of colors twisted in light fantastic forms of extreme delicacy, or laid on in threads, is used, especially in drinking-vessels.

Second. The heavier Gothic or classical forms, originating in the fifteenth century, before the fashion changed to the extremely light and capricious shapes of the sixteenth, were profusely gilt and enamelled. As these processes required considerable strength of material, they were confined to the heavier objects, in the form of bowls, cups, tumblers, salt-cellars, nuptial and other gift goblets. The decorations consisted chiefly of pictorial scenes, such as processions, portraits, coats of arms, inscriptions, allegories, scroll and lace work, and various intricate designs: sometimes merely flowers, garlands, or flower-like ornamentation in gold, diversified with many dots in lines representing pearls and precious stones, or scale decorations. In later times, cups and dishes, instead of the more expensive and difficult enamelling, were painted on their under surfaces in oil-colors. As this form of glass requires not only great skill in its material preparation, but but equal artistic talent, and is liable to many accidents in the furnace, it was always expensive and not common. Good specimens of the ancient are very rare, and the finest valued at thousands of dollars each, especially those done by Berovier, of whose work the nuptial cup at the Correr Museum at Venice is a noteworthy example, of about A. D. 1450.

Third. In the sixteenth century, glass with a rough surface, as if frosted or frozen, called *crackled*, first came in vogue; also the kind incrusted with fragments of glass of different colors, giving great brilliancy of effect to the roughened surfaces.

Fourth. The kind now common, but expensive, known as aventurine glass, was first made in the seventeenth century. But before this the fashion of imitating stones had begun, as also the opaque, variegated, marbled glass, commonly known as *schmelz*. The old specimens of jasper, lapis lazuli, tortoise-shell, agate, onyx, chalcedony, and mixed colors, chiefly in shape of essence and tear bottles, vases, jars, jugs, urns, etc., are extremely well done, colors intense and harmonious; but the modern are fast rivalling them, although, as we shall see, as yet not equal to Miotti's brilliant chalcedony, with its transmitted ruby light inside, or the earlier, softer, and more diversified aventurine. The modern is of a uniform, tiresome, mechanical, even sparkle, with no relief of tint and shade.

Fifth. In the fifteenth century, or perhaps earlier, began the attempts to revive the varieties of the old Roman and Etruscan mosaic glass, or that known as the *millefiori*, or thousand flowers, which is made by the combinations of *canne*, or rods, in fusion and union of colors in divers patterns. The old Venetians were successful, but not the extent of quite equalling the taste and beauty displayed by the Romans in this line of art.

Sixth. The Venetians, however, surpassed the ancients in lace or reticulated and filigree glass—*vetro di trina*, *reticelle*, *filigrana*, and the milk-white (*latticinio*) varieties, in the manipulation of which they acquired great skill.

These divisions by no means include every species of work done by the old Venetians in this material. As early as the fifteenth century we have specimens of elaborate architectural compositions, like temples or tabernacles, and of cabinets, coffers, altars, crucifixes, and other objects of the most diversified, quaint, ornate, and complicated character, constructed of glass. Not only these, but statuettes and groups of figures in enamelled glass, beautifully modelled, were fashioned; mirrors, frames, lamps, candelabra, beads and chandeliers of costly elegance and variety of ornamentation also were largely produced, not to mention the grotesque and picturesque shapes given to articles of common use. In the seventeenth century, engraving with the diamond point began to be practised, generally in delicate lace pattern. The famous Giuseppe Briati in the next century successfully imitated the German and Bohemian cut and engraved glass to a certain extent, and was renowned for his glass-framed mirrors and chandeliers, ornamented in intaglio, and with foliage, fruits, and flowers. He revived also the best forms of the sixteenth century, especially the filigree and lace glass, with equal lightness and brilliancy, while his glass was of superior purity and clearness. His works were so much admired as to be put on a par at entertainments with the gold and silver plate. He died in 1772. With him passed away the best period of glass-making. Subsequently its forms became heavy and rococo. The fall of the Republic gave the death-blow to the industry, which virtually became a lost art until 1838, when Signori Bupolin, Bigaglia, Tosi, Radis, and others sought to re-establish it, with, however, but indifferent success.

It was not until 1864 that any serious attempt with sufficient capital was made to revive the artistic manufacture of glass at Murano on its ancient scale. Assisted by several English gentlemen, Dr. Salviati formed his first company for this purpose, which, after becoming successfully established, divided into two—that which now goes by his name, and the Venezia-Murano Company, under the auspices of Sir Henry Layard and Sir William Drake, Signor Castellani being the able director.

These companies had in reality to begin anew, and feel their way backward to the old artistic forms and skill. The first effort was toward a revival of the ancient feeling for graceful, elegant, and varied form, without which the superior technical processes and chemistry of the nineteenth century would have been unavailing. Both companies have made extraordinary progress, as the exposition at Milan of 1881 of Italian industrial art clearly showed. Each has succeeded in its blown glass, in imitation of or in direct copying the best examples of the exquisite forms of the sixteenth century, in infusing it with the essential life or soul without which all art is dumb, and which speaks so eloquently in the ancient glass. With a substance that time acts on so slowly in the best examples, it is not easy to discriminate between the originals and copies. In general, however, the modern workman has yet something to learn in lightness and evenness and solidity of touch, in graceful tournure, and in those almost intangible qualities in art which come from long experience and enthusiastic passion. He has not yet wholly emancipated himself from the *rôle* of mere copyist. But the old genius of the Italian race for artistic invention begins to manifest itself. New forms and designs are rapidly coming into existence, rivaling in dexterity and beauty the old. I speak only of the real artistic objects made with a view of displaying the utmost skill of their best artists.

The beautiful covered chalice of the Salviati Company done by Leopoldo Bearzotti, as a specimen of exquisite enamelling and original design, is a masterpiece. His copies of the Correr nuptial cup, and the famous Byzantine tazza in the treasury of San Marco, and other old pieces, leave something to desire in the completeness of their technical execution after the antique manner. It is said that eighty thousand francs has been offered for the little San Marco tazza. In the Venezia-Murano exhibition there is to be seen a copy, of the exact size of the original, done by Edwin Benvizzi for Sir William Drake, and mounted in the same manner, which cost four thousand francs, so like it that apart it is not easily to be taken as a copy. But the chief specialty of the Venezia-Murano Company is their successful reproductions of the famous antique murrhine glass, mentioned by Pliny, in imitation of fluor-spars, gems, and precious stones of transparent colors, in the form of cut and polished cups, bowls, and dishes. The old Venetians, so far as we know, did not attempt to do this on any large scale. They are costly to execute, the great bowl at the exposition being priced at five thousand francs. It is twelve and a half inches in diameter, of one piece of interblended amber and turquoise colors, and is the largest ever made. There were only two made. The uncut one I secured, and it is in the New York museum. The artist who made it says it is even richer in color than the one shown at Milan.

Smaller pieces are of corresponding beauty and value, and serve to show to what perfection modern science and skill have developed this very ancient branch of glass-making. The recent imitations by the same company, and by Salviati's, of Phœnician tear and toilet bottles so closely resemble the antique ones that antiquarians may well be in despair to distinguish the new from the old, especially if the corrosions, fractures, and little marks of age have also been attempted. I showed Mr. Alexander Nesbitt a beautiful bowl of delicate blue tint, with small heads or faces interspersed in the material, recently made by the Venezia-Murano Company, so precisely like the antique Roman that, after a careful examination, he said, if a fragment of it had been brought to him in Rome, he would have sworn it was ancient glass. We may now fairly consider that the lost art of both old Rome and old Venice has been reconquered by modern enterprise, for the subtle differences that still exist in certain technical points and invention, appreciable now only on closest study, may soon entirely disappear, and Venice once more supply the marts of the world with the finest artistic glass in old and new shapes. Among her work there are now to be seen excellent reproductions of the Christian glass of the fourth and fifth centuries, found in tombs and the catacombs. These consist of dishes, cups, and goblets, with designs in gold-leaf, chiefly heads of saints, emblems, and Bible stories, imbedded in the glass itself, or placed in form of medallions between two layers of different colors, which are fused together in the furnace into one compact mass.—*Italian Rambles.*

WHO DISCOVERED THE ELECTRIC TRANSMISSION OF SPEECH?

A book of absorbing public interest is announced shortly to appear in England and this country—a history of the telephone of Johann Phillipp Reis, with a biographical sketch of its inventor, by Professor Sylvanus P. Thompson.

The telephone outranks all previous discoveries in its direct enlargement of human power. The telescope and microscope are its nearest compeers. The telegraph, beside it, is a clumsy mechanism. The telephone, which makes a whispering-gallery of the round earth, may well exert an influence on civilization, comparable with that of the railroad and steamship. Already the business centers expand, and the values of city lands change, under the magic of an invention which places every man at every other man's ear. But this promise or prophecy of the telephone is not all that affects the interest of the American people. There is a menace in connection with its present history which justly awakens public concern. Rapacious hands have clutched the throat of the telephone, to extort oppressive tribute for every word which it utters.

Professor Thompson's book, which treats exhaustively the early history of the telephone, is therefore not only of scientific but of social interest and importance. It establishes beyond honest doubt or question, by historical evidence, by the reproduction of original documents and illustrations, and by the public records of scientific bodies, that Philip Reis discovered *the electric transmission of* *speech* in 1860–61; that he elaborately described and exhibited his telephone in 1861; that he invented transmitting and receiving instruments, which not only talked then and talk now, but which include the essential principles of the transmitters and receivers now in use; and that he manufactured, placed on the market, and sold his instruments in 1863, for the purpose of illustrating the electric transmission of speech and song. That an invention so important, made in the heart of Germany, should not have been instantly perfected and utilized would surprise us in this country, if history did not abundantly teach that inventions, complete in themselves, often lie sterile until the favorable season and soil are found for their commercial adoption and development.

Professor Thompson, without the least imputation of plagiarism, shows, in parallel columns, the identity of expression between Reis and Bell, in their statement of the essential principles of the telephone. The impression of the identity of Reis's and Bell's discovery grows, page by page, during the perusal of this book.

The conclusion reached by Professor Thompson, from the survey of the whole field—a conclusion which seems to be fully borne out by the facts adduced—is the following: "There is not, in the telephone exchanges of England to day, any single telephone to be found in which the fundamental principles of Reis's telephone are not the essential and indispensable features."

This conclusion makes the speaking telephone, in its elementary form, free to the whole world. It opens wide the door for the future development of the telephone; and it should assure to all those who, by their genius and industry, in our day and generation, have improved or may improve the telephone, an ample pecuniary reward. The recompense due to the family of Philipp Reis should take the form hereafter, not of a tax, but a free gift from the world's gratitude.

This book comes, then, as a charter of freedom of speech in a larger sphere than ever before known.

In the light of historic facts which this book establishes, the decision of the courts of the United States that Professor Bell is the discoverer of a new and useful art (the electric transmission of speech), to which he has exclusive title, must be reversed as speedily as possible, that our courts may retain the respect of the people of the United States.—*Dr. W. F. Channing, in Popular Science Monthly for August.*

A fine meteor, apparently about six inches in diameter, was observed at this city on the evening of the 23d of July in the southeastern sky. It fell almost vertically.

ASTRONOMY.

SUN AND PLANETS FOR AUGUST, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's apparent annual motion around the Earth brings him on August 1st to Right Ascension 8h. 46m., and on the 31st 10h. 38m. His north declination on the 1st is 18° 00′; on the 31st 8° 36′; the change being nearly two hours of R. A., 9° 24′ of Declination. Solar spots have been quite numerous during July; and bid fair to make a fine show in August. During the first week in July a group of two or three large spots was very plainly visible to the naked eye—protected by a shade-glass. It attracted much attention, and was seen by many persons.

The constellation of Scorpio is still conspicuous in the southern sky, bearing westward as the month advances. Its principal star, the bright red Antares, souths on August 1st, at 7:35 P. M., and about four minutes earlier each succeeding day through the month. Alpha Lyræ, the bright star near zenith, crosses the meridian at 9:46 on the 1st, and the usual four minutes earlier on following days. Mercury is evening star this month; and about the 24th it is in near company with Uranus. Moving eastward Mercury becomes barely visible to the naked eye by the last of the month, a little south of west. Venus, Mars, Jupiter, Saturn, and Neptune, are all morning stars. The moon will pass among them the last week in August, making scenery of much interest to those who are fond of observing the heavens in the early mornings of summer. Soon after 5 A. M. of the 24th, she passes over Neptune, which would have been an interesting occultation had it occured two hours earlier. The next day soon after noon she passes Saturn, and a little before noon of the 27th, near Mars, visits Jupiter on the 28th about midnight, and Venus near the last hour of the month—being then near the Sun, or New Moon, which occurs seven hours afterward.

Saturn is near the bright star Aldebaran in the Hyades group, Taurus. In the morning of the 13th, the planet will be 3° 40′ north of the star. Mars moves rapidly eastward, and is below Saturn an hour or so; being the only bright star in the neighborhood it will be easy to recognize. During the first week in August Jupiter may be seen low in the NE., or rather E. NE. near the boundary of Gemini and Cancer; in the early morning. It will rise higher every day—being near two hours high at morning dawn the last of the month. His four moons can then be seen with a spy-glass one and one-half inches aperture.

THE SOLAR ECLIPSE OF MAY 6TH, 1883.

We cull the following items from the reports of Professors Holden, Hastings, and others, regarding the journey to Caroline Island and the phenomena of the eclipse as observed by them on May 6th. Professor Holden's report is made to Professor C. A. Young, Chairman of the Eclipse Committee of the National Academy of Sciences, and contains some details concerning the voyage and the stay of the observers on the island which, while out of the usual run of official reports, will be none the less interesting to the readers of the REVIEW. Prof. E. S. Holden belongs to the U. S. Naval Observatory, but is temporarily in charge of the Washburn Observatory, at Madison, Wisconsin, and was the principal officer of the American Expedition:

Journey from New York to Colon (1,989 miles), from Colon to Callao (1,722 miles), and from Callao to Caroline Island (4,324 miles). The six members of the American party sailed from New York March 1, 1883, on a Pacific mail steamship Acapulco (Capt. W. Shackford), and arrived at Colon March 11, after touching at Castle Island, March 7, to send off a mail. At Colon the expedition was joined by the English photographic party. As the steamer on the west coast of South America did not leave until the evening of March 12, the American party remained in Colon till the morning of that day, and went thence to Panama.

Every day during May a rehearsal for the eclipse observations was gone through with, and two days before May 6 everything was in complete readiness. On the morning of May 6 there were three showers and several persistent banks of clouds. The sky was clear at first contact (about 10h. 3m. local m. t.), cloudy at intervals till near totality, clear during totality, except slight haze during the first minute of totality, cloudy a few minutes after third contact, and finally clear at fourth contact. The observations of the various parties may be considered to have been successful. But the success was owing to the apparent accident of the dissipation of a local cloud. I am more than ever convinced that my conclusion to go to Flint Island, had I found the French party occupying Caroline Island, was a sound one.

On the twenty-third day out from Callao, we sighted one of the islands of the Marquesas group, and at 8 A. M., of April 20, Caroline Island was seen as a low green streak on the horizon. We had come 4,324 miles in twenty-nine days, mostly under sail (an average of 149 miles per day) without seeing a single sail or any land, except Magdelena Island, of the Marquesas, which we had gone out of our course to sight. I cannot refrain from quoting here Darwin's entry in his "Journal of a voyage in the Beagle," under date of December 19, 1835: "We now consider that we have nearly crossed the Pacific. It is necessary to sail over this great ocean to comprehend its immensity. Moving quickly onward for weeks together we meet with nothing but the same blue, profoundly deep ocean. Even within the archipelagoes the islands are mere specks, and far distant one from the other. Accustomed to look at maps drawn on a small scale, where dots, shading, and names are crowded together, we do not rightly judge how infinitely small the proportion of dry land is to the water of this vast expanse."

It must be remembered that we knew absolutely nothing of Caroline Island, except that it had been inhabited in 1874 by at least one white man and some thirty natives. The boat landing was known to be somewhere on the south-western side, and an "entrance to the lagoon" was spoken of on the eastern side. The Hartford approached the island from this side, and from end to end there was nothing to be seen but a line of heavy breakers, then a strip of white beach, and above this a growth of trees, the highest of which were cocoa palms. Finally in among these was seen the gable roof of a European house, but no inhabitants. Coasting round the island, everywhere surrounded by high surf, the Hartford came opposite the place where the boat-landing was reported, and the whaleboat was lowered, and Lieut. Qualtrough sent in her to land, if possible. It seems all very simple now, after Caroline Island, its reefs, its lagoon, and its landing are as familiar to us as the beaches of New England; but at the time it was all quite strange and new. The advent of a man and dog on the reef was an event. It seemed to settle one thing at least, and that was that we should find some assistance in landing. But the native disappeared and Lieut. Qualtrough was left to find his own way among the breakers, which he did in a capital manner. The ocean reef forms a solid wall all round the island, except at one narrow and crooked entrance, just wide enough for a boat and oars, and through this entrance each boat must come, or be broken into bits against the steep face of the coral wall. The whaleboat returned shortly with the news that there were four native men, one woman and two children on the island, that two frame houses were standing, and that we could land at once.

At high water this ocean reef was covered to a depth of about thirty inches, and at low water to about ten inches. The boxes were then lifted from the boat and transported by carrying parties to the high-water mark, a distance of 1,400 feet. This transport had to be made over the ragged surface of the ocean reef and through water of a depth varying from one to three feet, as I have said. From high water-mark, other carrying parties transported the boxes along the beach of the lagoon and across the island to the site of our observatories (some 1,300 feet further) which had been selected by Dr. Hastings and myself. On board the Hartford I had prepared a plan of the proposed camp; the position of each observatory was fixed on the ground by a stake, and to this stake all the boxes of each instrument were brought. In this way all proceeded in an orderly manner. By the evening of the twenty-first all the boxes and baggage of the expedition were landed, as well as bricks, cement, lumber, etc., for the observatories.

The entire party slept on shore also; and I shall never forget the quiet rest of that cool night after the intensely hot day of active work. Our hammocks were swung on the wide veranda of one of the houses, close to the beach of the mirror-like lagoon. The wind was cool and fresh as it blew through a break between two of the islands and directly from the open sea, the monotonnus roar of whose surf was incessantly heard. The nearly full moon was overheard and the long fronds of the cocoa palms made grotesque shadows on the level ground. Occasionally there would be heard the shrill cry of some sea-bird flying over, and other than this and the roar of the breakers, there was nothing to disturb the quiet and rest which came as a fitting conclusion to our restless month at sea.

During the 22d or April the Hartford remained by the island, and a force of carpenters and bricklayers proceeded rapidly with the construction of our observatories. By night-time the observatories belonging to myself, Dr. Hastings, and Mr. Preston were up, and piers of brick or wood completed. The brick piers of the English party were well under way, and were completed on the 23d by Mr. Wood, who thus added a new profession to his former acquirements.

The Hartford sailed at 6 P. M. of the 22d for Tahiti, and some of us went to the ocean reef to see her off. Besides her lights we saw those of L'Eclaireur, the man-of-war which was bringing the French eclipse expedition. Early on the morning of the 23d I met the maitre d'equipage of the L'Eclaireur on the reef and gave him such information as to the landing, etc., as I was sure would be of use. Shortly after this the French party came on shore for the day, and the morning was spent in aiding them to select a site for their observations, etc. This party consisted of M. Jansen, director of the Observatory of Astronomical Physics of Meudon; M. Trouvelot, assistant at the Meudon Observatory; M. Pasteur, photographer of the Meudon Observatory. These gentlemen were accompanied by M. Tachini, director of the Observatory of the Roman College; M. Palisa, astronomer of the Imperial Observatory of Vienna. Besides these astronomers there were seventeen of the crew of L'Eclaireur left on shore, making the French party twenty-two in number. Thus the total population of the island was fifty-one in all, including natives. Our relations with the gentlemen of the French expedition were throughout of the most cordial character. So far as our researches lay in the same direction, we worked together to a common end. It was a pleasure to us to be able to extend to them what aid was possible, and to receive the same in return.

During the remaining days of April everything was making progress toward complete readiness for observations of the eclipse. The observatory of Dr. Hastings and my own were completed by April 27, and each of us used a six-inch equatorial for some hours each night in an examination of the southern sky. During the course of this we detected some new doubles and red stars, a list of which is given later.

The vision was not especially good, and comparatively few hours were given to telescopic work, owing to the impossibility of obtaining a quiet sleep during the day. Still new double stars were found. This shows that if a suitable telescope were to be used in a favorable place in the southern hemisphere, at Quito or Santiago for example, a great number of new objects could be catalogued in a comparatively short time. It appears to me that this expedition is worth making. Immediately after the eclipse we commenced preparations for departure. These occupied May 7 and 8, and at 5 P. M. of May 9, the Hartford, with the expedition on board, took her departure for the Sandwich Islands. We left Caroline Island with mingled feelings of pleasure and regret. Each one of us had at least some one thing left to do or to see, and yet it was a pleasure to leave the place where our mission had been accomplished, and to meet our friends in the ship, who were endeared to us by that intimacy which sea life induces.

It may be added, as Professor Holden's modesty excluded it from his report, that there was a spirited race between the French and American expeditions, of four thousand miles from the coast of South America. Each desired to reach Caroline Island ahead of the other in order to secure first choice of locations.

Professor C. S. Hastings, of the Johns Hopkin's University, also includes many interesting details in his account of the trip:

The voyage from New York to Panama was pleasant with the exception of a few hot days near Aspinwall. Somewhat further south the wind changed, obliging them to call their overcoats from the bottom of their trunks to keep out the cold when crossing the Equator. During a short stop in Lima the party had an opportunity of studying South American life. The products of this country are fruits and photographs of the young women. The party enjoyed both eating the former and bringing the latter home for the admiration of their friends. The expedition really began at Callao, where the party embarked on the United States man-of-war, Hartford. Few circumstances contributed more to the enjoyment of the trip than the luckychance which threw this vessel in their way. The Hartford was fitted out last August as flag-ship of the South Pacific squadron. The admiral had not yet removed his flag to the vessel, but the extra accommodations provided for him and his train condoned the dignity lost by his absence. On March 22 they weighed anchor for a sail of more than four thousand miles over the blue ocean which stretches between Callao and their destination, Caroline Island. The southeast trade winds favored them, and from the first day there was actually no necessity for altering the position of a sail.

* * * * * * *

The inhabitants—five men, one woman and two children, according to to the eclipse census—are natives of Tahiti. The houses are one-story structures with clapboard sides, probably cut out in California and brought out in ships, to be erected on this island. The island on which they are built is about three-fourths of a mile in diameter and nearly circular in outline. The edge, which rises from five to twenty inches from the water, according to the tide's phase, goes down under the water to an even table of coral running out many feet into the sea; and is impossible to step on it with bare feet. At the end of this table the reef goes down perpendicularly, a sheer precipice, into the unfathomable sea. No vessel can anchor here, and to make a landing was an exciting matter. The island was approached in small boats on the side sheltered from the wind, and here, with the luck which characterized the trip, was found the only opening in this barrier of coral. A long cleft, perhaps eight feet wide, at the outer edge of the reef, ran in narrowing to a mere crack near the shore. Watching a favorable chance, the boats were guided through the surf into a cleft as far as shoal-water, when the men jumped on to the reef and carried baggage and instruments ashore as quickly as possible. The boats, which were new when they entered the surf, came out much the worse for wear, and the boat in which Dr. Hastings landed was stove in. Once on shore, life became a succession of wonders, rivaling the tales of Gulliver, and needing the conscientious descriptions of exact scientists to make them credible.

The members of the observing party took up their abode in the larger of the three houses, sleeping in swinging cots slung from the verandas, which afforded shade on three sides of the building. The second house was occupied by the sailors, while the third was left to the natives. These latter were sufficiently conversant with English to serve as excellent guides. Each day the party bathed in a lagoon in the centre of the island. This lagoon was bordered by a beach of dazzling white coral sand, and all through its water extended reefs of living coral of the more delicate and elaborate kinds. These corals gave the lake a wonderful variety of colors, forming a picture impossible to paint or describe, and with the least ripple from a passing breeze the whole scene changed to new groups of color. The water was very clear, and in some places deep; in others so filled with coral that a boat could barely skim over the surface without scraping the keel. After crossing a long reef, one day, they entered on a sheet of water so deep that their longest line would not reach the bottom, plainly visible beneath. Fish swarmed here, and it was characteristic of them that every species, if not brilliantly colored, was marked in the most peculiar manner. One variety which frequented the shallow water, where it was heated to the degree uncomfortable to the touch, was a pure milky white, with black eyes, fins and tail.

The French party arrived two days after the Americans. They had steamed directly from Panama with the hope of anticipating the Americans.

It rained on the morning of the eclipse, but cleared off in good time and the definition was particularly good. Photographs occupied the time of the English and French observers. Professor Holden and Dr. Dickson searched for intermercurial planets; Mr. Preston took the times of contact; Dr. Hastings and Mr. Rockwell devoted their attention to spectroscopic observations of the corona. Dr. Hastings' observations have led to the production of a new theory of the corona. Briefly stated, the theory is that the light seen around the Sun during a total eclipse is not due to a material substance enveloping the Sun, but is a phenomenon of diffraction.

From his observations during the eclipse of 1878, made at Central City, Dr. Hastings conceived the first idea of this explanation of the solar corona. Further study served to convince him of the truth of this theory, but he had no means of proving it. Before the present eclipse, however, he devised a crucial test of his theory. This test is based on the following already known phenomena. When the moon covers the face of the Sun an envelope of light is seen all round it, the envelope is not visible when the Sun is shining on account of the Sun's greater brightness; this light is called the corona; it is extremely irregular in outline. According to the drawing of Mr. J. E. Keeler at the eclipse of 1878, it enveloped the Sun as a hazy glow extending for a distance of several minutes of arc from the Sun's limb, and at two nearly opposite points is extended out in two long streamers feathering off into space. The opinion has been that this light was due to an atmosphere extending for millions of miles from the Sun. According to Dr. Hasting's view it must be light from the Sun which has undergone refraction: *i. e.*, has been bent from its regular course by the interposition of an opaque body like the Moon.

In order to make this perfectly plain, suppose the front of a surface of waves of any sort to be striking an object which resists them. If an organ of sense is placed in the resisting object, it will judge the direction of the waves or the direction of the object producing them by a line at right angles to the wave front. Now suppose a body is placed between the object producing the waves and the sensitive organ. The waves must go around this body and will produce an eddy behind it, so that the wave front will have a different direction, and the organ of sense will conceive the origin of the waves to lie in a direction different from that before the body was interposed. Now consider the waves to be waves of light, and their origin the Sun. The organ of sense is the retina of the eye. The Moon is the opaque body interposed in the course of the waves, and they, being bent, make the impression on the eye that the light comes from beyond the edge of the Sun. The Moon covers the Sun during the eclipse and a little more, so that it can move for about five minutes and still cover the Sun entirely. This movement is very slight, and if the corona consists of light from a solar atmosphere, it should not change at all during this movement of the Moon. But if diffraction is the cause of the light, then the slightest change in the relative positions of the Sun and the Moon should change the configuration of the corona; *i. e.*, the corona should not remain exactly the same during a total eclipse. The character of the light as shown by a spectrum analysis should change.

To determine this point Dr. Hasting's invented the following instrument: Two lozenge-shaped prisms of glass were fastened in the form of a letter "V" and so arranged that all the light falling within the aperture of the "V" was lost, and that falling on the ends of the glass prisms was transmitted by a series of reflections to the apex of the "V," where the prisms touched; here was placed a refracting prism, so that the light could be analyzed. This instrument was attached to the eye-piece of the telescope and the image of the eclipse reduced to such a size that the Moon just fitted into the aperture of the "V," while opposite sides of the corona were reflected through the prisms to the place where they came together. In this way both sides of the corona were seen through the eyepiece at the same time. On looking at the eclipse this is what Dr. Hastings saw: The light of the corona was divided into its constituents. Prominent among them was a bright green line, which is designated by the number 1,474; to this line attention was directed. Its presence in the spectrum has been an argument in favor of the view that the corona is a solar atmosphere. If this is the case, the line should remain fixed during the eclipse; but if the corona is due to diffraction this line should change; it should grow shorter in the light from one side of the corona, and longer on the other. The observation was now reduced to watching for a change in the relative length of two green lines.

At the beginning of totality the line from the west side was much the longer, but as the eclipse progressed it shortened notably, while the line from the east side, shorter by about one-third at the beginning of the eclipse, grew longer. When the eclipse ended the proportions of the lines were exactly reversed. There had been a change equal to two-thirds the length of the lines, while the Sun and Moon had only changed their relative positions by an extremely small amount. The only way in which this phenomenon can be accounted for is on the defraction theory. The material view of the corona will not answer for it. But there are other discrepancies in the older view which have been known for some time. The principle ones are: 1. It is known from study of the Sun that the gaseous pressure at the surface must be less than an inch of mercury, and is probably less than one-tenth of an inch, but an atmosphere extending to the supposed limits would cause an enormous pressure at the Sun's surface, especially since the force of gravity on the Sun is very much greater than on the earth. 2. The laws of gravitation would require a solar atmosphere to be distributed symmetrically around the Sun, while the corona is enormously irregular in form. The Sun is irregular in outline, which would make its diffracted phenomena show the observed irregularity, but it is symmetrical as regards density. 3. The most interesting discrepancy of the theory of the solar atmosphere is the fact that while it is supposed to extend for millions of miles from the Sun, the recent comet passed within two hundred thousand miles of the Sun, and yet its orbit was not affected in the least—as it would have been if it had ploughed its way through a material substance. In taking photographs of the corona it is seen to be larger as the time of exposure is longer. This shows that the corona extends indefinitely, and it decreases in brilliancy in exact accordance with the mathematical laws of diffraction. These laws involve very complicated mathematics, but by them alone Dr. Hastings has proved that there must be diffraction where the corona is, and that it must follow the same laws as those observed. There is a small envelope around the Sun, but in the opinion of Dr. Hastings it does not extend beyond what is known as the chromosphere.

The question seems to be settled, with considerable certainty, that nothing exists inside of Mercury large enough to be dignified by the name of planet. There may be, and there probably are, for the perturbations of Mercury indicate it, multitudes of small masses circulating around the Sun like the planets, being fragments of comets or condensations of primitive matter, whose combined lustre is seen in the Zodiacal Light.

The other results of the work of the Commission, so far as now known, are connected with the structure of the corona, the solar appendage, which extends out for millions of miles from the Sun's disk. In the photographs of the Egyptian eclipse of last summer these streamers can be traced back of each other where they cross; no better proof of their extreme tenuity could be given.

The duration of an eclipse of the Sun depends on three things, the distance of the Sun from the earth, the distance of the Moon from the earth, and the distance of the station from the equator. All or these were favorable to a long eclipse in the case of the recent one, and the six minutes of totality gave opportunities for deliberate work not often enjoyed. For the complete result we must await the official report.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	June 20th to 30th.	July 1st to 10th.	July 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	. .	. .	. .	. .
Max	. .	. .	. .	. .
Min. and Max	. .	. .	. .	. .
Range	. .	. .	. .	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	67.6	73.8	74.2	71.9
2 p. m.	85.9	72.4	88.4	83.9
9 p. m.	73.0	72.4	73.4	72.9
Mean	75.5	74.3	77.3	76.2
RELATIVE HUMIDITY.				
7 a. m.	.92	.91	.90	.91
2 p. m.	.76	.77	.72	.75
9 p. m.	.90	.90	.87	.89
Mean	.83	.86	.83	.85
PRESSURE AS OBSERVED.				
7 a. m.	29.15	29.47	28.96	29.19
2 p. m.	29.02	29.06	28.92	29.00
9 p. m.	29.06	29.06	28.91	29.01
Mean	29.07	29.19	28.93	29.03
MILES PER HOUR OF WIND.				
7 a. m.	8.6	11.5	6.5	8.9
2 p. m.	12.1	17.1	4.1	11.1
9 p. m.	7.	10.7	3.8	7.2
Total miles	2103	2829	2863	7795
CLOUDING BY TENTHS.				
7 a. m.	2.8	3.0	6.5	3.8
2 p. m.	5.2	5.1	4.1	4.8
9 p. m.	1.8	3.0	3.8	2.8
RAIN.				
Inches	2.15	3.07	.58	5.80

The period embraced in this report has been rather above average temperature for this season and we can again record quite a heavy rainfall.

On fifteen days the temperature has reached 90° and upward, the highest being 98° on June 30th. The lowest temperature was 62° on June 23d. Highest barometer, July 18th, 29.300, reduced to sea-level and zero, 30.235. Lowest barometer, July 12th, 28.780, reduced 29.708.

On June 23d, just after a heavy rain-storm, the air having had a temperature of 65° to 70° all the forenoon, the temperature suddenly rose more than 20° in consequence of a hot current of air from the south. This lasted but half an hour when the temperature fell as suddenly as it had risen.

On the evenings of the 7th and 8th of July auroras were visible at this station about 9 o'clock in the evening. The wind travel has been less than any previous month this year, and no very high gales have occurred here. The prevailing wind has been from the south as usual at this season.

BOOK NOTICES.

FROM THE PYRENEES TO THE PILLARS OF HERCULES: By Henry Day; 12mo., pp. 249. G. P. Putnams' Sons, 1883. For sale by M. H. Dickinson.

As is justly remarked by the author of this work, Spain lies out of the ordinary route of travel and less is known of it than of any European State. It has a wonderful history which has never been well written by English authors, though the most valuable illustrations of it have been produced by such American writers as Prescott, Irving, and Ticknor, within the last half century. The mixture of Roman, Moorish, and Teutonic blood in the veins of its people gives them a peculiar character, accounting, perhaps, for their romantic and passionate temperaments, their daring and domineering dispositions, but not for their lack of that pertinacity and steadfastness of purpose which insures success. With greater opportunities than almost any other people, none has made a more disastrous failure as a great factor in the world's history. Although in the sixteenth century it was one of the most wealthy and powerful of the nations of the earth, and its literature, art, and fashions held sway in all the courts of Europe, its want of national coherence was such that it never crystallized into a first-class power, but gradually declined, until now it is principally engaged in internecine wars and occupies one of the lowest positions among European nations. The climate is admirable and the valleys lovely, and as our writer observes "it is no wonder that the Moors from the hot deserts of Africa and the level, sterile wastes of Arabia, glowed with delight as their eyes rested on these charming valleys. No wonder they fought to obtain them and periled their all to keep them. Here they found the orange, the fig, the aloe, the pomegranate, the grape, and the palm, the almond and the sugar-cane, the mulberry and the cotton-tree, the citron and the olive, all growing side by side. Here was perpetual spring."

Recently tourists are turning their attention in this direction more than formerly, several citizens of this region, even, having visited its classic shores and medieval cities within the past few years.

The author of this work writes very pleasantly and instructively of Barcelona, which is so old that the local historians claim that Hercules founded it 400 years before Romulus was born; of Montserrat, one of the many and perhaps the most celebrated of the sacred shrines of Spain; of Saragossa, the capital of Arragon, named after Cæsar Augustus; of Madrid, with its treacherous climate, its attractive armory, museum and picture galleries, of the Escorial, a sublime and costly monument of folly erected to the memory of Charles V; of Toledo, once the capital of the Goths, then of the Moors and finally of the Christians, each of whom in turn devoted it to the priests and kings; of La Mancha, better known as the "stamping-ground" of Don Quixote and his doughty squire, Sancho Panza, than for anything else. Cadiz, Gibraltar, Tangier, Morocco, Malaga, and Burgos, each receive a description, and the book closes with the Pyrenees, with their lofty snow covered peaks, remaining both as to cultivation and the habits and customs of the people, in the same primitive state as centuries ago.

The reader will be well repaid for the time consumed in reading this book.

MANUAL OF ASSAYING GOLD, SILVER, COPPER, AND LEAD ORES: By Walter Lee Brown, B. Sc., with illustrations; 12mo., pp. 318. Jansen, McClurg & Co., Chicago, 1883. $1.75.

This work, though prepared especially as a guide to students and persons having no previous technical knowledge of assaying, will be found very useful to all who have occasion to refer to a thoroughly practical hand-book. It is clearly and plainly written, with all necessary details, descriptions of apparatus, reagents and processes for the unpracticed operator, while the appendix contains instructions for special methods, lists of gold, silver, copper, and lead-bearing minerals, lists of books applicable to the subject, etc.

As an evidence of the practical method and form of its arrangement we select from the table of contents a few titles of chapters and sections, premising that there are sixty-nine illustrations of the various implements and tools used in assaying. Eighty-one pages are devoted to describing apparatus, such as scales and balances, furnaces and furnace tools, glass and porcelain implements, and miscellaneous apparatus; twenty-seven pages to reagents, such as wet and dry reagents for assaying and reagents for analysis: eight pages to preliminary work, testing reagents, etc.: forty-two pages to the assaying of gold and silver ores, with their occurrence, preparation of the sample, assay by the scorification process and by the crucible process: four pages to the assay of copper ores by the method for native copper, the method for oxides and carbonates of copper free from sulphur, and the method for the sulphides of copper with antimony, arsenic, etc., and ten pages to the assays of lead ores by the methods for galena and by the methods for oxides and carbonates.

All of this is most carefully worked out and thoroughly detailed, so that apparently an ordinary assay may be made by an inexperienced hand after a very brief practice.

The appendix contains explanations of and directions for assaying of the various minerals contained in an ore; of ores containing free gold or free silver; analysis of copper ores, amalgamation assay or laboratory mill-run; pan-test for gold "panning"; chlorination assay for gold ores; chlorination test for silver; assay of gold bullion and base bullion; color tests, scorification, scorifier, cupel; qualitative tests, carbonates, chlorides, sulphates, sulphides, tellurides, copper, iron, lead, silver; a brief scheme for silica, iron and manganese, and determination of moisture in an ore.

To this is added a chapter giving lists of the principal gold minerals in the United States, and minerals likely to carry gold; list of the principal silver minerals found in the United States, and minerals likely to carry silver; list of principal copper and lead-bearing minerals of the United States; list of useful books upon assaying, chemical technology, laboratory manipulation, mining law, etc.

Section third comprises tables of values of gold and silver, tables of weights; equivalents of some English and French weights; assay ton equivalents in grammes, Troy grains and Troy ounces. The work closes with a copious and well arranged index.

We have been more particular than usual to give in detail the contents of this manual because we have been asked several times by friends and acquaintances engaged in prospecting and mining to recommend a simple and practical work suited to the circumstances and surroundings of such persons. This we can candidly do in regard to this book and at the same time assure them of a neat, tasteful, well printed volume at a low price.

Italian Rambles: By James Jackson Jarves; 16mo., pp. 446. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; $1.25.

In this study of the life and manners in the new and old Italy, the reader perceives the difference between the work of the hasty tourist who rushes across the country by rail and writes his observations from the guide-book, and that of the experienced traveler who has given months and perhaps years to a district, until he knows its byways as intimately as its highways.

Mr. Jarves has spent many years in Italy, and these "Rambles" are the resultant. No one can read them without observing an unaccustomed tone of familiarity with the various topics treated, frequently wanting in the sketches of better known writers and travellers. Besides this, the style of the author is familiar, breezy and artistic, showing the scholar and the man of taste. The topics are mostly outside of the range of the ordinary observer, which renders them still more attractive. Pescaglia, Serra in the Appenines, In Porsenna's

Country, Ancient days in Venice, Ancient and Modern Glass of Murano (part of which we copy in this number of the REVIEW), The Gates of Paradise, Klagenfurth, A Lesson for Merchant Princes, and New and Old World Manners, are fair samples of the titles of the articles presented.

The work is handsomely gotten up by the publishers, as usual, and will have a large sale if it meets its deserts.

STUDIES IN BIOGRAPHY: Edited by Titus Munson Coan. 16mo., pp. 246. G. P. Putnams' Sons, N. Y., 1883. For sale by M. H. Dickinson. Cloth, 60c; Paper, 25c.

This is the second volume of the "Topics of the Time" series, to which we called attention last month, and comprises sketches of the lives of Leon Gambetta, Jonathan Swift, Miss Burney, and Samuel Wilberforce; also a Lucianic dialogue between Lord Westbury and Bishop Wilberforce; an account of the life and work of George Sand (Madam Dudevant), and a final chapter upon Literary Bohemians, in which the Bohemian instincts and practices of Dumas, Victor Hugo and other well known writers are depicted and discussed.

This series is skillfully presented by the editor and cannot fail of being popular. The next number is entitled "Studies and Literature" and comprises American literature in England; Hamlet, a New Reading; The Humorous in Literature; The Bolandists; The Unknown Public, and The Isaiah of Jerusalem.

MAN BEFORE METALS: By N. Joly. 12mo., pp. 365; Illustrated. D. Appleton & Co., New York, 1883. For sale by M. H. Dickinson. $1.75.

This is number XLV of the International Scientific Series and corresponds very well in character with the other volumes of that valuable series. It is divided into two parts, the first of which is devoted to The Antiquity of the Human Race, and the second to Primitive Civilization. In both of these the general facts of archæology are presented about as they are by Lyell, Quatrefages, Tylor, Figuier, and others, and the conclusions drawn do not differ materially from those of other French writers upon the subject. The general course of M. Joly's discussion is The Prehistoric Ages; The Work of Boucher de Perthes; The Bone Caves; The Peat Mosses and Kitchen Middens; The Lake Dwellings and the Meraghi; Burial Places; Prehistoric Man in America; Man of the Tertiary Epoch; The Great Antiquity of Man. In part II he takes up Domestic Life, Industry, Agriculture, Navigation and Commerce, The Fine Arts, Language and Writing, Religion, The Portrait of the Quaternary Man.

The chapter upon Language and Writing, including the Origin of Speech, is one of the most original and interesting of the whole, while that upon Religion is a learned compilation of authorities such as can be scarcely be found in any other work, which will be appreciated by all students, and from which all readers will not necessarily reach the same conclusions as the author.

SCIENTIFIC MISCELLANY.

SOME FACTS ABOUT CHOLERA.

Medical men are not very well agreed about the origin of cholera epidemics, and are still less in harmony in their application of remedies. But by common consent few diseases are more severe, or more quickly and surely fatal, than cholera. Efforts have been made to establish a connection between its appearance and the recurrence every twelve years of great Hindoo pilgrimages and festivals, and the writer of a learned article in a popular cyclopedia, published some years ago, went so far as to predict visits from this plague in 1877 and 1879. These prophecies were not fulfilled. The truth of the matter seems to be that the exciting causes of cholera are always active in some parts of India, in the Philippine Islands, and in other far eastern countries, and that the methods of commerce prevailing nowadays are most favorable for disseminating the pestilence throughout the world. Its ravages have been extensive and almost constant for at least two years in the regions of its origin, and it has now broken out in Egypt, and possibly also at Gibraltar and London. There is much reason to believe that it will appear before many months in every country of Europe, and in this country also.

It is now generally held that cholera is not, strictly speaking, "contagious." that is to say, it is not spread by touch, pure and simple. Its seeds, in order to do their work, must be introduced into the system through the lungs or the the stomach. The most frequent means of their spread is the use of contaminated water. Some authorities, indeed, go so far as to say that all the most virulent epidemics have been connected with the pollution of drinking water by choleraic evacuations, and that there is but little danger of a very extensive outbreak of the disease in any city where the drinking water is originally pure, and is conveyed in close and clean pipes. It seems, however, that the infecting matter in the discharges from the bowels of those who have the disease is apt to be diffused through the air or become attached to clothing, and thus to find entrance into the lungs of healthy persons.

It is still undetermined whether the morbid material that constitutes the cholera poison is a parasitic germ or a miasm. And no one professes to know how the poison is generated, or why it tends to spread more widely at some times than at others, or how the presence of decomposing matter and certain conditions of climate and soil, and certain physical characteristics of individuals, favor its distribution. The disease, in short, is known only in its effects.

The thing to be done, therefore, is to take heed to the conditions under which fatal effects are most likely to be produced, and to see to it that the poisonous matter does not find lodgment in the system. The best authorities say that the prime factor in the spread of the disease is the transmission from one locality to another of the specific infecting matter. This is brought about, so far as it is positively known, only by the migration of infected persons. Cholera moves along great lines of travel. Hence its sudden leap from Cairo to London. No matter how violently cholera may rage, he who drinks no water, eats no food and breathes no air polluted by cholera patients is reasonably certain of escape. Every precaution of course ought to be taken against the disarrangement of any function of the body by eating unripe or decayed fruit, breathing sewer-gas, or neglecting obvious sanitary requirements. But in the case of healthy and prudent persons the chief danger lies in the use of impure water.

Inasmuch as the plague is known to be approaching the United States every family and every community obviously ought to prepare itself to meet it. It is of the utmost importance to cleanse outhouses and back yards, to dispose of every scrap of decaying vegetable and animal matter, to pour sunlight and air into damp, dark cellars, and above all, to see to it that there is absolutely no drainage from cesspools into cisterns and wells. Every householder must look out for these things for himself, bearing in mind that in making ready to ward off cholera he is also averting diphtheria, scarlet fever and other scourges. Towns and cities, moreover, have warning of the impending pestilence in time to improve their sewerage and water connections where they are defective, and to put their streets into proper shape. And, finally, preparations should be made at once by the proper authorities to enforce the most rigid inspection of vessels coming from parts where cholera exists, together with a perfect quarantine when the disease appears.—*Globe-Democrat.*

THE STUDY OF GREEK.

Inasmuch as the number of people who know Greek is very small, while the number of those who are ignorant of it is very great, it is not to be wondered at that the recent counterblast of the Adams family against the study of the Greek language has been widely approved. But it will hardly do to consider ignorance of any subject as a qualification for sound criticism on that subject, and the grand and wondrous tongue which for more than two thousand years has stood forth as the perfection of intellectual achievement, will probably survive the new objection to it that none of the Adams family had been able to master it. If the world is put to it and is compelled to choose between the wisdom of the Greeks and the wisdom of the Adamses, we are very certain that the Greek language and Greek literature will still be a living influence in ages when the Adamses will be forgotten.

Merely as an intellectual exercise the study of Greek stands highest and chiefest in the scheme of mental training. The range of mathematical training is limited and its influence is limiting; the study of the natural sciences widens and strengthens the mind, but it leaves out culture. Metaphysics and logic and all philosophy of the mind or of the morals cannot be mastered by one who is ignorant of Greek. It is the key to poetry and to art, which are rightly understood only by those who rightly understand the Greek spirit and temper, and in the intellectual life there is no achievement and no perfection which is not so interwoven with Greek influences and teaching as to vindicate for the language of Greece a higher place than has ever been claimed for it in the customary schemes of classical study.

Let us not be misunderstood as undervaluing the practical demands of the age, with which Greek has little or nothing to do. We recognize that the primal duty of every citizen is to provide for the material wants of his nature. But if success in life means mere material success—dollars and cents—then, if experience goes for anything, the best education is no education at all. Not only is the study of Greek a loss of time, but all study is loss and waste. Our colleges are luxuries and our sons are wronged when we do not put them on their own resources at ten years of age to work their way to a fortune first and to education afterward.

But if education has any meaning and any value, if the systematic training of the mind is worth considering, if it is worth more in itself and in its consequences than the random picking up of information here and there as we go on, then the study of Greek is so far removed above the reach of disparagement that it needs no apologist. Its structure is the most perfect, its capacity the greatest, its resources the most ample, its beauty the most admirable of all languages, and as the human race in all its history has never produced another so perfect language there is no reason to expect that it will ever do it in the future.

Even in our daily lives the best and highest influences still come from the old Greek culture and development. Philosophy has never gone beyond the Socratic level; poetry still calls Homer master; in every branch of literature the best models are still Greek models; there has been no art since Greek art died, save the Gothic architecture and the Renaissance in painting. We cannot escape from the influence of the Greeks if we would.

The stars in the heavens still bear the names given them from Grecian mythology; the legends and history of Greece are part of the common stock of the world's phrases, and the unlettered citizen who reads in the daily paper of the cup of Tantalus or of the sword of Damocles does not write to the editor to know what he means. The multifold millionaire does not name his yacht the Wabash or the Wamsutta, but recalls the sweet story of the snowy-footed Arcadian, Atalanta. Even the politician who would trace back the current of human freedom to its source does not stop with Thomas Jefferson or with Brutus: he must go back to Solon and Lycurgus, to Harmodius and Aristogiton.

And we are asked to believe that the language which holds and guards this wealth has no value in itself! The proposition is inherently absurd. It involves a contradiction in terms: it denies what it asserts. As long as the instincts of humanity lead upwards and the need of a higher life of the mind is recognized, the language and literature of Greece will have the value of standard gold, and the regret will be, not that time is lost in their study, but that the hard conditions of life unfortunately permit so few to become the masters of the treasure.—*N. Y. World.*

EDITORIAL NOTES.

THE thirty-second meeting of the American Association for the Advancement of Science will be held at Minneapolis, Minnesota, from the 15th to the 21st of this month. The officers this year are Prof. C. A. Young, President; F. W. Putnam, Permanent Secretary; J. R. Eastman, General Secretary, and William Lilly, Treasurer. The chairmen of the nine sections of Mathematics and Astronomy, Physics, Chemistry, Mechanical Science, Geology and Geography, Biology, Histology and Microscopy, Anthropology, and Economic Science and Statistics are the Vice-Presidents of the Association.

The headquarters will be at the State University. The citizens of Minneapolis have made liberal arrangements for the accommodation and entertainment of all who attend, and the railroads have made low rates in all directions, in addition to giving excursions to Minnetonka and Winnepeg at less than half fare. Without doubt the meeting will be an enjoyable one in every respect.

THE Kansas City Academy of Science has recently received from Thos. J. Wilson, Esq., a box of beautiful specimens of the fossil wood from the petrified forests of Arizona; also a box of valuable fossils from Mrs. Todd, of Fort Worth, Texas.

The Curator of the Academy, Mr. Sidney J. Hare, is now on a surveying expedition in Southwestern Kansas and may be relied upon for liberal contributions to its Museum. Dr. R. Wood Brown is performing the duties of Recording Secretary and acting Curator.

THE rain and wind-storms of June, 1883, will long be remembered as being abnormally universal, frequent and severe. In this locality the precipitation was extraordinary, rain having fallen upon thirteen days up to the 27th. The Missouri River on the 27th had risen to twenty-four feet six inches above low water mark, or within two feet eight inches of the highest point reached in 1881. The mountain freshets are reported on their way down.

PROF. F. W. CLARKE, for many years chemist of the Cincinnati University, has received the appointment of chemist to the U. S. Geological Survey, and has removed to Washton City. He has contributed several articles to the REVIEW within the past few years and in a recent letter says: "I owe you my sincere thanks for the REVIEW and if I can at any time help you with items I will do so."

REV. H. C. McCOOK, of Philadelphia, recently delivered a lecture upon "The Homes and Habits of Ants" before the Detroit Scientific Association and Griffith Microscopical Club, in which he gave some very graphic and interesting details, paying many high compliments to the ant for industry, intelligence, cleanliness, engineering skill, and various domestic virtues; among which the reporter selected the following: "Before marriage the female ant has wings, which are merely ornamental, and on becoming a matron she tears off these ornamental wings with her mandibles, and plunges into the ground, where she devotes her life to sober domestic duties, for which such gaudy attire would not have been suitable. All the work and all the fighting is done by the females and neuters. The males have no mandibles with which to work or fight, and so don't amount to much."

PROF. F. W. PUTNAM, Curator of the Peabody Museum, Cambridge, Mass., writes, July 5th: "I have compared the fragment of soapstone pot you sent me from New Mexico with the soapstone from which the Colorado and New England specimens are made, and it is not like either. I do not know the region from which the New Mexicans obtained their soapstone, and this is the only specimen I have seen from New Mexico, so far as I now remember."

THE American eclipse expedition returning from the central Pacific reached San Francisco June 11th. Prof. Holden reports no discovery of Vulcan. Prof. Hastings' observations prove the Sun's corona to be probably a phenomena of diffraction, the real corona being only a narrow ring around the Sun widened out by diffraction (not refraction) in the extensive halo actually observed.

MR. E. R. KNOWLES, the author of the articles in this number of the REVIEW entitled respectively "Père Hyacinthe and Catholicism" and "The Nature of the Existence of Matter," is a striking illustration of the peculiar adaptiveness of genius. An actor by profession and one who has already achieved quite a reputation in the east by his careful and artistic renditions of difficult characters, he has also found time to manifest his scholarship and his talent for polemical and metaphysical studies, as these articles sufficiently prove. Although quite young, he is a graduate of Princeton College, and already a successful business man and a promising artist and *literateur*.

MR. FLETCHER, in the *Mechanical World*, says that the light given by an ordinary gas-burner can be increased at least one-sixth simply by using in place of the ordinary upright burners those that throw the flame out horizontally. He has tested them in his works and offices until he is satisfied that a burner consuming five cubic feet of gas per hour with a horizontal flame gives a better light, and is better for work, than an upright flame consuming six cubic feet per hour.

EXPERIMENTS recently made in Egypt show that the stars are about one-fifth of a magnitude brighter there than in England. This difference, which is due to the greater clearness of the atmosphere, brings into view an immense number of faint stars, which are just too faint to be visible in the more murky climate. To secure the same advantage it is now proposed to place observatories on mountain tops above the lower and denser strata of the atmosphere. Hence we have the Lick Observatory on Mt. Hamilton, in California, and an observatory just erected on the slope of Mt. Ætna.

THE Arctic expedition ship Proteus was at St. Johns, N. F., actively preparing for Lady Franklin Bay on the 28th of June.

BOUND volumes of the REVIEW for the past year can now be had at this office upon the return of the back numbers of Volume VI., and the payment of one dollar.

CLUBS of four or more are allowed a discount of twenty-five per cent upon the regular subscription price of the REVIEW, and all subscribers to it can purchase other magazines and books at from fifteen to twenty-five per cent below the regular prices.

THE Missouri State Board of Agriculture, in pursuance of the purpose for which it was organized, the promotion of the agricultural interests of the State, will hold several Farmers' Institute meetings during the present year. Able specialists will deliver practical addresses on topics of constant interest to the working farmer. The Board desires to hold several meetings, one or more after harvest, during the month of August, and several during the early part of winter. All expenses of these Institute meetings, excepting hall hire, will be met by the Board. Meetings will be held where the interest manifested promises a good attendance. The Secretary is desirous of an early response, at Columbia, from those communities wishing an Institute meeting, that speakers may be engaged in season for an ample notice of the meeting to be given.

THE University of Missouri is about to undergo a much-needed improvement in its main building. The legislature at its last session appropriated $100,000 for the purpose, and the work is about to be commenced. When completed, this building will present a handsome front of 356 feet, the present frontage being but 156, and the interior changes will correspond in elegance and degree.

MR. SIMEON STETSON, of San Francisco, has written a political pamphlet entitled "The People's Power, or How to Wield the Ballot," which is very highly commended in several of the papers of that city. It is a work of some 64 pages, and is evidently the result of deep thought and extensive research. As the price is but 20 cents, the thoughtful voters of the country can readily supply themselves with it.

MR. HERBERT ROBINSON, of Linn County, Kansas, occupies nearly two columns of the *La Cygne Journal* with a description of certain ores of gold and silver found on his father's farm, giving the corroborative opinions of exports and the results of many assays made in Colorado, Montana, Kansas City, and New York, and closing with the affirmation that "within five years the Big Sugar Creek region in Linn County will be turning out as much gold and silver as some of the best mining districts in the Rocky Mountains."

MR. G. W. LETTERMAN, of St. Louis County, Mo., has recently shipped three hundred bushels of acorns and one hundred and twenty bushels of hickory nuts to Europe for seed.

THE main building of the Indiana University was struck by lightning on the 12th *ult.* and utterly destroyed, with all its libraries, museums, cabinets, and collections of all kinds. The library contained about 14,000 volumes, besides thousands of pamphlets and periodicals. The museum contained the Owen cabinet of 85,000 specimens, an entire University series of Ward's casts, Professor Jordan's collection of fishes, numbering over 30,000, and all of the new and costly apparatus of the laboratory. The loss will probably amount to $125,000.

AMONG the many striking and useful features of railway management introduced on the Southwestern lines by Mr. A. A. Talmage, Manager of Transportation, is one which provides for the careful qualitative analysis of all waters intended for use in the boilers of locomotives used on that system of roads. No tank is built till it is first ascertained that the water to supply it is fit for boiler use.

A PETRIFIED forest was recently discovered in the Buckskin Mountains on the Arizona side of the Colorado river, near where the latter cuts through the range. Petrified trees were found twenty inches in diameter, and it is said that there is not a bush, piece of sage brush, or grass in the entire forest—some 300 acres—that is not turned to stone!!!

PROF. JAMES P. MCLEAN, of Hamilton, Ohio, and Prof. French, of Clyde, Ohio, have been examining the big mound at Cahokia, Ills., near St. Louis, and also paid a visit to the collections of the St. Louis Historical Society. They are making a tour of inspection of all the Mound-builders' works in the Mississippi Valley.

THE greater portion of the philosophical, chemical, and astronomical apparatus of the celebrated Dr. Joseph Priestly, the discoverer of oxygen, has been sent by the family of his great grandson, the late Dr. Joseph Priestly, to the Smithsonian Institution, and will be prominently displayed in the grand national museum.

THE rain-fall of June, 1883, was in excess of any year on record in this portion of the country. At Topeka it was 7.05 inches, at Lawrence 7.73, and Leavenworth, 10.84. The average rainfall in the same month for 16 years past at Lawrence has been 5.11 inches, and at Leavenworth, for the past 13 years, 5.48 inches.

At the thirteenth annual meeting of the Troy Scientific Association, Mr. Thomas Pray, Jr., editor of *Cotton, Wool and Iron*, exhibited some photographs of cotton and wool fibres, executed by himself, which excited the admiration and enthusiasm of all who saw them, as representing these fibres more perfectly than is usual under the best microscope, unless in the most expert hands.

Prof. E. T. Nelson, of the Ohio Wesleyan University, reports 9,202 specimens added to its museum for the year ending June 15, 1883.

Alderman Hadley, of London, the famous electrician and capitalist, is in New York investigating the American system of telegraphing, and is largely interested in the new cables to be laid from New York to London soon, in connection with the Postal Telegraph Company's lines. He is also interested in a new line between New York and Chicago and New York and Cleveland, which is expected to compel the reduction of telegraphic rates, all through the East, at least.

We have received a note from the Secretary of the Tuscan Society of Natural History at Pisa, Italy, which is so complimentary in its character that we reproduce it literally:

"Pisa, 18 Jun, 1883.

"Sir:—The Societa Toscana di Scienza Naturali have only received of the Kansas Review Vol. III., No. 10; Vol. IV., No. 8; Vol. VI., No. 1, 4, 5. She your pray to sent the other party." ——— ——,

Secretary.

Robert Howell, of Nichols, N. Y., has twenty volumes of the U. S. Coast Survey Report, 1851 to 1870, for sale low, or for exchange for books on science, history or travel.

John P. Jones, now of Kingman, Kansas, who has furnished several valuable historical articles in the past, says: "I enclose $5.00 for the Review. I trust you will be able to keep its head above water until it becomes well enough appreciated to be a source of profit as well of pleasure to you."

We are indebted to Dr. Edwin R. Heath for copies of the Bulletins of the Royal Geographical Society of England for the months of January, February, March, April and May, 1883.

ITEMS FROM PERIODICALS.

Subscribers to the Review *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

The *Modern Argo*, of this city, is the best society weekly published in the west. It is edited by Mrs. Jennie M. Hicks, and its business manager is Mr. Isaac N. Hicks, both veterans in the newspaper business in the Missouri Valley. The *Argo* has deservedly a widely extended and a rapidly increasing circulation.

With its issue of July 5th, the *Art Interchange* entered upon its eleventh volume. During the five years of its publication this journal has grown from a four-paged sheet—without illustrations, supplement sheet, or "questions and answers" to one of sixteen pages, with a profusion of illustrations representative of both pictorial and decorative art, and an inquiry department, which, for fullness, accuracy, helpfulness, and diversity of subjects treated, is unrivalled. It is proposed in the present volume to continue the illustration of designs suitable for furniture and general decorations in answer to requests, and to continue also to issue "Notes and Queries Supplements."

The most important step in advance, however, is the publication at intervals of one month—after January, 1884, making twelve in the course of a year—of studies in color. These will include flower and figure subjects, and each design will be in several colors.

The *Western Scientist*, a monthly magazine devoted to the natural sciences is announced to appear very soon. It is to be published by the Western Scientist Co., at Ottumwa, Iowa, at $2.00 per annum.

THE *North American Review*, for August, opens with a very spirited and timely discussion of the subject of "Moral Instruction in the Public Schools," by Rev. Dr. R. Heber Newton, who offers a practical scheme for conveying ethical instruction without reference to religion tenets, and the Rev. Dr. Francis L. Patton, who maintains that the Bible must be made the basis of all moral teaching. Henry D. Lloyd exposes the tricks and frauds of speculation in grain, and maintains that they should be repressed by law. "Woman in Politics," by ex-Surgeon-General Wm. A. Hammond, is a caustic discussion of certain facts of nervous organization which in his opinion render the female sex unfitted for participation in public affairs. Hon. Francis A. Walker reviews "Henry George's Social Fallacies," criticizing in particular his doctrines regarding land-tenure and rent. The evils resulting from "Crude Methods of Legislation," both national and State, are pointed out by Simeon Sterne, who advocates the adoption of certain rules, both against lobbying and against the mischiefs of ill-considered law-making. Charles F. Wingate writes familiarly and warningly of "The Unsanitary Homes of the Rich," and there is a joint discussion of "Science and Prayer," by President Galusha Anderson and Thaddeus B. Wakeman.

THE *Magazine of American History* is now edited by Mrs. Martha J. Lamb, whose ability, good taste, literary skill, and extensive scholarship eminently fit her for the position. Her History of the City of New York long since established her reputation as an author, and her present undertaking, The History of Wall Street, will abundantly sustain that reputation.

W. O. AYRES, in *Cotton, Wool, and Iron*, in an exhaustive article upon "Our Future Sugar," says in conclusion: "But enough has already been accomplished to settle fully and fairly the fact that sugar, equal in every respect to that from sugar cane, can be made from sorghum; that there is no greater uncertainty and no greater skill required in the one case than in the other, neither is the expense of production greater; that an acre of land in New Jersey, Ohio, Iowa, or Kansas will yield as much profit from its sugar and molasses of sorghum, as an acre in Louisiana from its sugar cane."

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY is a creditable magazine, maintaining a standard of excellence under the editorial management of Theo. S. Case that places it among the best scientific publications in the country.—*Leavenworth Standard.*

THE *Atlantic Monthly* for August presents the following table of contents: A Roman Singer, III., IV., F. Marion Crawford. The Trustworthiness of Early Tradition, Brooke Herford. En Province, II., Henry James. Glints of Nahant, Charles F. Lummis. The Hare and the Tortoise, Sarah Orne Jewett. Academic Socialism, Herbert Tuttle. To a Hurt Child, Grace Denio Litchfield. Newport, III.–V., George Parsons Lathrop. The Gift of Tears, Mrs. S. M. B. Piatt. Reminescences of Thomas Couture, Ernest W. Longfellow. In the Old Dominion, F. C. Baylor. Study of a Cat-Bird, Olive Thorne Miller. Around the Spanish Coast. Charles Dudley Warner. A New History of the United States. John A. Dix. The Reminiscences of Ernest Renan. The Contributors' Club. Books of the Month.

To all lovers of exploration and travel who can read French we most cheerfully recommend *L' Exploration*, edited by M. Paul Tournafond, 6 Rue Cassette, Paris, France, 30 francs per annum.

KANSAS CITY

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PHILOSOPHY.

THE BACONIAN PHILOSOPHY.

J. D. PARKER, U. S. A.

The great current setting through our times, on whose bosom the world has been borne these last three centuries, is the Baconian philosophy. Francis Bacon, the founder of this system, was born at London, January 22, 1561, and was pronounced by Pope to be the wisest and brightest of mankind. Next to the first century, I believe this was the greatest epoch in human history. Three or four centuries ago our ancestors were little better than barbarians. Excepting the imperfectly developed elements of a religious faith, we find among the nations of Europe, a phase of civilization little preferable to that of the Orient. Profound and painful is the darkness of that period in all that pertains to true philosophy and true science. "Out of that darkness and chaos," says a recent writer, "have come all our civil and religious freedom, all our philanthrophy and benevolence, all our diffused comfort and luxury, most of our good manners and morals, and all the splendid achievements of our modern scientific investigation."

The Aristotelian Philosophy had held the world in chains for two thousand years. The ten categories of Aristotle were supposed to be the *ne plus ultra* of human wisdom. A vast fabric of astronomic fable had been built up, circle on epicircle, which only needed the touch of truth to dissolve like the morning dew.

Bacon while yet a student at Trinity College, Cambridge, conceived a thorough dislike to the Aristotelian Philosophy. "They learn nothing," he says, "at the universities, but to believe. They are like a becalmed ship, they never move but by the wind of other men's breath, and have no oars of their own to steer withal." In the *Novum Organum*, he affirms that, "The studies of men in such places are confined and pinned down to certain authors, from which if a man happen to differ, he is presently represented as a disturber and innovator." In a tract, in after years, on the defects of the universities, he proposes that a college be established for the discovery of new truth, to mix, as he characteristically remarks, "like a living spring with the stagnant waters." The methods of the preceding ages, in a word, had failed, the masters had groped amidst the darkness for a true philosophy and a true science in vain. It was reserved for Bacon, during the quietude of the Elizabethan Age, to rise like a sun and shine upon the world.

The method of the Baconian Philosophy was nearly antagonistic to that of the preceding age. The fruitlessness of the ancient logic, as an instrument of discovery, had been fully proved. "We must first," says Bacon, "collect a natural history, that is, whatever be the subject we intend to investigate, we must first set down all the facts we can gain upon it. Having done this, we must classify these into tables, so that we may expunge those which are useless to the question, and gather the 'vintage' of those which are really significant. These significant facts are further to be scrutinized with respect to their relative value and import, and to be illustrated whenever it is practicable, by actual experiment. This being done, the law of the phenomena will at once begin to appear. Thus, our knowledge must rise from the bare facts, as they are presented to our senses, upwards, through different degrees of generalization, till the most general form thereof is ascertained, and the top stone of the pyramid laid upon it."

The spirit of the Baconian Philosophy is to determine what is truth. Pilate propounded this same question of olden time, but Bacon says he did not wait for an answer. Under the Inductive Philosophy nature is patiently interrogated for her facts and laws. Time with resistless sweep may measure ages before a problem yields solution. And should it defy all processes of the world nature will beget and rear up some gifted mind to carry forward those processes to a higher plane. And truth is to be found at all hazards. She is to be bought at any price. The universe is to be laid under contribution. The secrets of nature are be forced. New appliances are to be constructed and new methods of analysis invented until we stand, if possible, face to face with the Absolute.

The Inductive Philosophy also possesses a liberal spirit. Its faith is as large as the Universe of God. All things are believed possible until proved impossible. All things are believed true until proved untrue. Nothing is rejected that stands the touchstone of observation, comparison and experiment. The chaff-heaps of antiquity are to be winnowed and every grain tried.

It also possesses a fearless spirit. All truth must be consistent with itself. No two facts of the universe can contradict each other. No two laws of the universe can disprove each other. The laws of life and chemistry may contend in building up and pulling down an organism, but if one prevails the other is held in abeyance. We must, therefore, be willing to follow, fearless of conflict, whithersoever truth may lead.

The spirit of the Inductive Philosophy is also fearless of human opinion. The most venerable errors of antiquity are to be removed. Systems that have been cherished and embalmed in the human heart for ages are to be overthrown. The most sacred shrines of the old world are to be desecrated, the idols in the temple of science to be thrown down and the foundations of the temple itself to be removed. Philosophies hoar with age, whose roots have been interwoven with all the past, and whose branches, like the Banyan tree, cover many nations, are to be rooted up.

The Inductive Philosophy lays its fearless hand even on Revelation, and gives it a new interpretation. The rocky leaves of the book of nature are turned, and the foot-prints of the Creator are traced as he went forth of old to draw out the world. The Author of Revelation piled the rocks, and the two records must agree.

The results of the Baconian Philosophy are almost beyond belief. But one department of science had attained any considerable development prior to the time of Bacon. The mathematics both pure and applied had been cultivated from the remotest antiquity. Euclid had gathered up the scattered elements of geometry, and raised it to a liberal science. Pythagoras had discovered the property of the right-angled triangle, if it had not been known to earlier Hindoo and Chinese authors. Hipparchus, the father of Trigonometry and Astronomy, had catalogued the stars by means of the naked eye, and invented the planisphere, and drawn parallels on the surface of the earth, leaving the results to Ptolemy his disciple. Archimedes had derived an approximate value of the quadrature of the circle. Thales had computed the length of the solar year and predicted eclipses. Even the Calculus, which has received such a wonderful development in modern times under Cauchy, Leibnitz, Newton, LaGrange, and Sir William Rowan Hamilton, is supposed to have had an Indian origin. The ancient world indeed contained nearly all the mathematical germs which have had such growth in modern times.

In Metaphysics, which occupied even a larger share of the attention of the scholars of antiquity, little progress had been made. Each successive generation had its disciples of Plato and Aristotle, who debated from age to age the same problems which ever divided those two rival schools of the Greeks. The science of mind had not been laid upon a true foundation, and no enduring fabric could be built thereon.

Of the Physical Sciences, not one except Astronomy had any real existence prior to the time of Bacon. Aristotle, the Plinys, and others had made vast collections of reported observations, but they contained more error than truth. Immense stores of traditional knowledge had been handed down from generation to generation, the Talmuds of science, which formed the capital of the savans of those days. As the inductive philosopher seated himself before this heap of rubbish to winnow out the grains of truth, a mighty task was laid upon him. Every premise must be thoroughly established, every observation re-observed, every experiment re-conducted, and every comparison re-collated. Nothing less than a new creation lay before him. Well may the works of Bacon be christened, *Novum Organum*, and *Instauratio Magna*.

We come now to consider: What is the tendency of the Baconian Philosophy? History informs us of a certain Greek philosopher who died because he could not account for the tides on the Ægean Sea. His system of philosophy was not sufficiently comprehensive to include the true cause of tides. In a similar way sometimes we are not in possession of a system of philosophy comprehensive enough to account for the commotions of our age. Little do we suspect that out of some system of philosophy, perhaps of the mediæval or ancient world, rolls the wave that breaks over us.

Materialism has characterized our age, as is shown in our schools of science, philosophy and religion. Oken and Lamarck and DeMaillet, and the unknown author of the *Vestiges of Creation* represent various phases of materialistic science. In philosophy, from the days of Locke, sensationalism has had a controlling influence over the human mind in Great Britain, has spread more or less over the continent and has reached our own shores. Various phases of materialistic philosophy are suggested by the names of Comte, Hobbs, Buckle, Spencer, Mill, and Draper. In religion some wiseacres have recently discovered that man is wholly made of the dust of the ground, just a breathing lump of clay. Whence comes this materialialism which has characterized our age?

The process of the Baconian Philosophy necessarily excluded everything contrary to the order of nature. It was assumed that observation, comparison and experiment would exhaust the data of the material world, and that the logical faculty of the human mind could solve all the problems of the same. The inductive philosopher deals only with facts and the laws of the same, or, technically, with the uniformities of succession and co-existence which obtain among phenomena. Adopting the *a posteriori* method, he ascends from particulars to generals, priding himself as a man of facts who looks upon ideas as the chaff of things. He holds firmly to the doctrine of human nescience. To him the senses are the sources and measure of human knowledge, the only avenues to things without. Thus conditioned, he can know nothing of things as they are in themselves absolutely, but only as they appear to his conditioned intelligence. Unfolding the mere appearance or conditions of things, he goes forward to expound them as the primary and radical elements of knowledge itself.

Finite mind is conditioned also in regard to the extent of its knowledge. The universe is represented as a "polygon with but one of its infinitesimal sides adjusted to man's capacity, and every attempt to embrace, even in thought, the Infinite and Absolute, can only recoil upon him in mere negation and contradiction." Investigations conducted on such a plan would necessarily be narrow and materialistic in their tendency. Hence probably flows that stream of materialism which has rolled on for more than two hundred years, tinging science, philosophy and religion and sweeping away the fairest fabrics of human mind.

And herein, I believe, lies the chief defect of the Baconian Philosophy. With all its proud monuments of science and art, with all its civil and religious freedom, with all its philanthropy and benevolence, its diffused comfort and luxury, in a word, amidst all the glorious light of a new civilization which seems to be spreading over the surface of the whole earth, grows this Upas tree of materialism whose leaves go forth to poison the nations.

Hobbs, the immediate successor of Bacon, made sensation the only basis of knowledge, and reduced the whole process of scientific investigation to the doctrine of bodies. Comte attempted to generalize the great law of human progress into three distinct stages—the theological, metaphysical, and positive. He attempted to solve all natural phenomena by material causes, as if he had attempted to climb up to heaven by a ladder whose top rested upon the summit of some neighboring mountain. Ignoring the supernatural, he was left without God in the world. He devised a species of scientific religion in which humanity universal was worshipped in public, but woman, as possessing the best traits of humanity, in private devotions! Darwin attempts to break down the immutablity of species, by making the accidents of development greater than the law, and thus opens the gate to the Development Theory which aims to derive man by developing lower into higher forms of life. Assuming Spontaneous Generation and the Nebular Hypothesis, the unknown author of the *Vestiges of Creation* drew out a world by the Development Theory and peopled it without a God. Thus flows in devious channels this stream of materialism, washing many lands with its turbid waters, and wrecking many barques freighted with the fairest hopes of life.

We come now to consider, if it be not presumption, how the Baconian Philosophy may be *re-adjusted*, so that it shall produce the highest results for truth and the world.

All lovers of truth, let me say in passing, must deplore the efforts of some men who endeavor to arrest scientific investigation when it seems to be dangerous, or threatens a popular creed. All history shows that the progress of ideas cannot be prevented by persecution. Every department of science is full of workers who cannot be intimidated by fear, or kept back from their self-appointed tasks by hunger, thirst or privation. Fired by an enthusiasm for what they consider truth, approved in their acts by their own moral sense, nothing can stay the course of their investigations. Not only is opposition to scientific investigation fruitless, but it does not become a philosopher to interfere in the working of problems which are to find solution in themselves. The problems of philosophy are to be conducted on philosophical principles, and the problems of science on scientific principles. Problems in each department contain all the elements necessary for a perfect solution. All interference from without is unphilosophical and hazardous, and many prove disastrous. Neither should we impugn the motives of men of science, because they carry their processes to the last analysis, in a word, work out their problems pure, and leave their co-ordination to others.

It is reasonable to conclude that, if human wisdom suffice, this problem of Inductive Philosophy will be carried to its logical results. It seems necessary that modern scientific investigation should exhaust all material means before it has recourse to those forces which lie beyond the purely physical. Let the world travel this side-track of materialism untill they reach the utmost limit, and then they will be content to turn upon the highway of truth. When men have tried in vain to refer all natural phenomena to material causes, when they have fully proved a negative, they will become cognizant of truth, not reached through purely material processes, and faith will be recognized as the highest and best form of knowledge. And failure to reach the result through material means will demonstrate the existence of things immaterial, and will produce a wider, deeper and more universal faith, I believe, than has ever prevailed on the earth. It is logical to conclude, then, that some grains of truth were left hidden in the chaff-heaps of antiquity, not winnowed out by the Baconian Philosophy, whose presence is the life and power and inspiration of scientific formulas. And this is the supreme question of the age: How shall the Baconian Philosophy be readjusted so that it shall contain the truth, the whole truth, and nothing but the truth?

If we turn the page of history we shall find two great distinctive tendencies of the philosophic mind in which have various forms maintained their identity. The first is Realism, which takes its rise in Aristotle, and reappears under a different method in Bacon, and comes out in the Sensationalism of Locke, and in the Positivism of Comte. The other tendency is Idealism, which takes its rise in Plato, and flows on through the Transcendentalism of Germany from Kant to Hegel, and reappears in the Absolutism of Cousin. These philosophers differ in many respects, but may be classed in one form or another as defenders of these two great systems of Realism and Idealism, or of Positivism and Absolutism. Aristotle gave more place to the phenomenal; Plato and his disciples to the metaphenomenal. The realist deals more with what appears to be real to the senses, the idealist with the ideal. The realist prides himself as a man of facts. The absolutist deals with things as they absolutely are, absolved or loosed from contingent relations. He looks upon phenomena as the mere husks of truth, unfolds things by the inner light of the soul, and is not to be deceived by his senses. Realism ignores the Absolute, or resolves it into contradictions; claims that all knowledge must flow into the mind through the senses, and thus eliminates the supernatural and falls into materialism. Idealism would go behind phenomena, and seize hold of the very cause or essence of things by an intuition of mind, claims that what is conceivable is comprehensible, and by a species of omniscience rises above the world on the swift wings of thought, until it ends its airy flight in Mysticism and Pantheism. If any one doubts the power of philosophy over the religious world, look at the Mysticism and Pantheism of Germany where Idealism or Transcendentalism obtains, and at the Materialism of England and of our own country, where the Sensationalism or Realism has prevailed.

It must be evident to philosophic minds that Idealism and Realism are only complemental parts of one whole. Substantially, both philosophies are true in what they affirm, and false in what they deny. These philosophies become false in becoming divorced from each other, and true as they shall be recomposed so as to hold each other in mutual check. The material system alone will drag the world down into an awful abyss, and Idealism alone will bear the world into clouds of Mysticism and Pantheism. But if the world can be buoyed up by Idealism and ballasted by Realism, it will move forward into a true science and a true philosophy, until the light of a pure religion shall cover the earth. If the Baconian Philosophy can be readjusted so that it shall induct all the necessary facts both of the material and immaterial worlds, then may we hope for that final system of philosophy which shall conserve all the truth of the past ages, and accept of all the truth that may be discovered in the ages to come. Let Realism be the stem, and Idealism the life, then shall the tree of a true knowledge spread out its branches and send forth its leaves for the healing of the nations.

ENGINEERING.

TRANSLATION OF A FRENCH REPORT OF THE PANAMA CANAL.[1]

IVON D. HEATH.

From all the reports of the officers of the Panama Canal Company the works there are very actively pushed. In the neighborhood of 6,000 workmen are found distributed in the various working-places. On its part the company is not inactive. It pursues its operations throughout the entire course of the line.

Two large American companies have each one obtained a special contract for constructing the way upon a course of seven miles—one upon the Atlantic side and the other upon the Pacific.

A certain number of miles of iron-way are already constructed, uniting the Panama railroad with the sites chosen for the deposit of the excavations. They are also excavating a new port about three miles from Aspinwall, the finishing of which will suffer but little delay.

As preliminary labor almost all the course of the canal has been cleared of the forest and staked out. Upon all the line they have constructed houses for the laborers and employes.

From the United States they receive daily at Aspinwall considerable quantities of material, consisting of locomotives, wagons for earth-working, woods for construction of frame-work, etc. etc.

Each steamer going from New York to Aspinwall has always something on board.

The health of the workmen is much better than last year. Inland at a cer-

1 Published at Paris, April 26, 1883, in *L'Exploration*, a Review of the Conquests of Civilization from all points of the globe.

tain distance from the coast the climate is more salubrious than upon the borders of the ocean.

The waters of the Chagres which would be able to innundate the canal will be restrained by a barrier which they will construct in the environs of Gamboa in one of the gorges of the mountain range.

All the machines of American construction sent to the isthmus have given full satisfaction to the company. Besides these machines the United States has furnished and will furnish yet a great quantity of other engines in order to complete the outfit.

As far as that which concerns the purchase of the Panama railroad, of the material and of the supplies of every nature made in the United States, the canal company has already paid in the neighborhood of 25,000,000 of dollars in gold.

Finally, the engineers of the company estimate that the canal will be entirely completed in seven round years unless, always, some events not altogether provided for should arise.

THE FLORIDA SHIP CANAL.

A Washington correspondent of the Nashville *American* brings to light the almost forgotten fact that the project of building a ship canal across the isthmus of Florida is by no means new. The subject was discussed and its feasibility determined as early as 1826.

A number of examinations and surveys of the proposed routes have been made. One referred to an ordinary canal of six feet depth, another to a large canal as part of a system of land-locked navigation between the Mississippi and the Atlantic, another to a ship canal of sufficient navigable depth to float the largest ocean-going steamer. The examinations have included all the available routes of the St. Mary's and St. John's Rivers, and all of the gulf coast outlets have been considered. The army engineers have heretofore selected the St. John's River route, while the present company favor the St. Mary's River as the eastern outlet. The first is said to be the shortest, but the latter the most available for safe communication. Congress in 1826 directed a survey to be made to ascertain the most eligible route across Florida by which to connect the Atlantic with the Gulf of Mexico by a canal for the transit of boats, and also ascertain the practicability of a ship canal. Two routes were directed to be examined—one from St. Mary's River to the Apalachicola River or bay, and the other from St. John's River by Vassoussa Bay, at the mouth of the Sewanee.

Another examination was ordered in 1852 of the St. John's route, and the report made demonstrated the practicability of the canal and an ample supply of water.

In 1879 Gen. Gilmore, under authority of Congress, made a survey of the St. Mary's River route. Gen. Gilmore's estimate of the cost of the work is much greater than that expected to be made by the new company. He places the cost at $50,000,000, while the present company expect the work to be done inside of $30,000,000.

Its construction will give shorter routes between the ports of the Gulf of Mexico and those of the Atlantic coast, both domestic and foreign. Its use by vessels will avoid the dangers of the passage through the Florida Straits. The distances from New Orleans to New York by this canal would be shortened 497 miles, and between New Orleans and Liverpool 412 miles. Gen. Stone, the engineer of the company, is expected to have his report of the recent surveys ready in a few weeks, and a meeting of the directors will be held in this city sometime during the month of August to hear and act upon this report.—*National Republican.*

THE STORAGE OF WIND-POWER.

The great question of all questions at the present day, in the line of invention and mechanical application, is: How can we best turn to account the natural forces which are in play about us? Setting aside for the present the direct use of electricity as a motive power, we have two fluids at our command, air and water. Both have from time immemorial been pressed into the service of man, and yet even at this moment, with all the modern advances in practical science, we are only on the threshold of the workshop in which we ought to have full command. It is not too much to say that of the power exerted by the movements of water and of air throughout the world, the percentage utilized is so small as to be practically inappreciable. Let our inventors look to this, for it is a field which promises well.

The idea of using the power of water-falls at a distance, transmitting the energy by means of—say compressed air, or electric wires—has been often suggested and tried, but thus far with no very satisfactory results. The loss of power through the agents employed in transmission has been so great as to much impair the economic value. But let us take up another line of thought, and see if we cannot start some inventive brain into a plan which will bring out something practical. The power to which reference is made needs no transportation; it is ready at hand; it is simply the wind.

It seems incomprehensible that such a ready and potent agent should escape practical use so completely as it does. The probable reason for this is that the power is destitute of all uniformity, and has on that account hitherto been deemed unmanageable; sometimes furious, sometimes absolutely nothing, and at all times unsteady and capricious.

Before referring again to this feature, let us estimate for a moment the amount of power at our command, within a given space, *if we can only control and utilize it.* We will assume an area 40 by 150 feet, no larger than the flat top of many a manufacturing establishment, store, etc. Within this extent it is entirely practicable to place thirty-two wind-wheels, each twelve feet high by eight feet in diameter, and so arrange them that each shall have full sweep of the wind from whatever quarter it may blow. The wheels here contemplated would revolve on vertical axles—or horizontal if preferred—with fixed blades, one-half shielded and turning so as to suit the direction of the current. They would need no attendance, no brake, no check, let them spin with the utmost fury of a gale, or lie still in a calm. Rapid motion could do no harm, only increasing their efficiency; whenever they turned they would do work, when they lay still they would do nothing. Each wheel would drive an air-pump of size suited to its power, and each stroke of the piston would send its given quantity of air into the common reservoir provided. That reservoir becomes then a magazine of compressed air whose energy is reported by the gauge, and is used by any of the means now so well known.

A wind-wheel of the size stated carries on each of its blades a surface of forty-eight feet. The pressure of wind in what is known as a "strong breeze" is about two pounds per square foot, and its rate of motion about 1,750 feet per minute. It is easy to see, therefore, that theoretically the efficiency of such a while in such a wind is safely reckoned at five-horse power.

But here comes in the difficulty, and it is *the* difficulty of all and must be overcome, or this power is of practically no value in the line of which we have been speaking. The power is capricious, and unless we can steady it no form of business can depend on it for service. How shall we *store* the power that may come to us by day or by night, Sundays and week days, gathering it at the time when we do not need it and preserving it till we do? This is the problem. Who is the man to solve it. Surely it should not be set aside as too difficult for trial.

Why should it not be dynamized into electricity? No distant transmission with its loss of energy comes into play, for a line of shafting can be driven directly on the spot. It is true the whole field of electric storage is yet too little explored to answer this question on the instant, but is it not worth considering?

Other modes of turning to account the compressed air, and using it only as needed, are also within our reach.

A factory or other building, of the size already given, with the wind-wheels on its roof, taking the average rate of the wind as it is known to be in our region and climate, has at its command, if it can *store* the power, at a fair and moderate estimate, 4,200 horse power per week, thus giving it a 70 horse power engine for six days of ten hours each. And this power is without engineer, without fuel, without labor; practically without expense.

Store the wind-power, and render it of even application, and all this is perfectly possible. Shall we admit that this cannot be done?—*W. O. A. in Scientific American.*

THE GUNNISON ROLLING MILLS.

This company is composed of such men as Gerard B. Allen, Ben. W. Lewis, J. W. Harrison and Thomas Howard, of St. Louis, and eastern manufacturers and capitalists of equal prominence. The company has purchased 2,000 acres of coal land in Gunnison County, Colorado, with five veins of an aggregate thickness of twenty-eight feet, making the property equivalent in production to an area of 10,000 acres. The coal is equal to the finest Pennsylvania anthracite, and when coked is one and a half per cent better than the best Connelsville. The coal is at Crested Butte, adjoining a valuable tract of land which abounds with iron ore of a quality that is not surpassed by the best Missouri, and yields a return of from sixty to sixty-eight per cent. These valuable deposits were acquired some time ago after the return of Mr. Ben. W. Lewis, who spent several months in examining the geological formation and the adaptability of the deposits to the manufacture of steel. On his recommendation the Gunnison Coal and Steel Company was formed for the purpose of conducting a general coking business and for the erection of steel works on a broad-gauge scale. Work has been commenced at the mines in the erection of houses and cottages for the employes, and before the end of the year it is believed that about 300 men will be engaged. Next year the steel works will be in operation and the force increased to several thousand hands. The capitalists at the head of the Gunnison Company are quite enthusiastic over the prospects, and say there is not another corporation which possesses such striking advantages to manufacture cheap steel. The coal and iron is situated on a down-grade on the lines of the Denver & Rio Grande and Union Pacific, about twenty miles from the city of Gunnison, where 150 acres of ground have been purchased for the rail-mills. There is a good demand for rails in the west, and with the numerous trans-continental trunk lines completed, an impetus will be given to steel and iron productions of every kind. The deposits of coal and iron are on the hillside, and can be easily reached without expensive shafting or drifting.—*Globe-Democrat.*

MINING SURVEYS.

The Commissioner of the general land office has ruled that the fact that a mining survey upon which is an application for a patent, conflicts with a prior survey does not prevent the application from including the conflicting area in his application, provided no application for patent upon such previous survey has already been made. Priority of application and not priority of survey governs in such matters. Of course a survey must show all conflicts with any previous surveys; but the mere showing of conflict does not divest the applicant of any legal rights.—*La Plata Miner.*

ASPHALTUM PAVEMENTS.

As the work of reconstructing Pine Street, St. Louis, with asphaltum has commenced, a description of the new pavement may not be without interest. The contract under which the work is being done, after providing for a foundation of cement, mortar and concrete, provides that the pavement shall be completed as follows:

Upon the concrete foundation thus prepared shall be laid the wearing surface or pavement proper, the basis of which or paving cement must be pure Trinidad asphaltum unmixed with any of the products of coal tar. The wearing surface shall be composed of: 1. Refined Trinidad asphaltum. 2. Heavy petroleum oil. 3. Fine sand, containing not more than 1 per centum of hydro-silicate of alumina. 4. Fine powder of carbonate of lime.

The Trinidad asphaltum (so-called), whether crude or refined, as found in this market, contains from 20 to 35 per cent of impurities, and is especially refined and brought to an uniform standard of purity and gravity.

The heavy petroleum oil, which may be the residuum by distillation of the petroleum oils as found in the market, generally contains water, light oils, coke and a gummy substance soluble in water. This petroleum oil is freed from all impurities and brought to a specific gravity of from 18° to 22° Beaume, and a fire test of 250° F.

By melting and mixing these two hydrocarbons, petroleum oil and asphaltum, the matrix of the pavement, called asphaltic cement, is manufactured, which cement has a fire test of 250° F., and at a temperature of 60° F. has a specific gravity of 1.19.

They are mixed in the following proportions by weight: Pure asphalt, 100 parts; heavy petroleum oil, 15 to 20 parts.

The asphaltic cement being made in the manner above described, the pavement-mixture is formed of the following materials, and in proportion stated: Asphaltic cement, from 12 to 15; sand, from 83 to 80; pulverized carbonate of lime, from 5 to 15.

In order to make the pavement homogeneous, the proportion of asphaltic cement must be varied according to the quality and character of the sand. The sand and asphaltic cement are heated separately to about 300° F. The pulverized carbonate of lime, while cold, is mixed with the hot sand in the required proportions, and is then mixed with the asphaltic cement at the required temperature and in the proper proportion, in a suitable apparatus, which will effect a perfect mixture.

The pavement-mixture, prepared in the manner thus indicated, shall be laid on the foundation in two coats. The first coat, called cushion-coat, shall contain from 2 to 4 per cent more asphaltic cement than given above; it shall be laid to such depth as will give a thickness of half an inch after being consolidated by a roller.

The second coat, called surface-coat, prepared as above specified, shall be laid on the cushion-coat; it shall be brought to the ground in carts, at a temperature of about 250° F., and if the temperature of the air is less than 50°, iron carts with heating apparatus shall be used in order to maintain the proper temperature of the mixture, it shall then be carefully spread, by means of hot iron rakes, in such manner as to give a uniform and regular grade, and to such depth that after having received its ultimate compression, it shall have a thickness of two inches. The surface shall then be compressed by hand rollers; after which a small amount of hydraulic cement shall be swept over it, and it shall then be thoroughly compressed by a steam roller, weighing not less than 250 pounds to the inch-run, the rolling being continued for not less than five hours for every 1,000 yards of surface.

The powdered carbonate of lime shall be of such degree of fineness that 5 to 15 per cent by weight of the entire mixture for the pavement shall be an impalpable powder of limestone, and the whole of it shall pass a No. 26 screen. The sand shall be of such size that none of it shall pass a No. 80 screen, and the whole of it shall pass a No. 10 screen. In order to make the gutters, which are consolidated but little by traffic, entirely impervious to water, a width of twelve inches next the curb shall be coated with hot pure asphalt and smoothed with hot smoothing irons, in order to saturate the pavement to a certain depth with an excess of asphalt.

ANTHROPOLOGY.

THE CAVE-DWELLERS OF THE SAN FRANCISCO MOUNTAINS.

GENERAL M. T. THOMAS.

A considerable number of these ancient dwellings are found in the vicinity of Flagstaff, and at one point, about eight miles northwest of that station, a village of fifty or more caves is still in a fair state of preservation.

This village is located on the point of a sharp ridge of land rising quite abruptly above the ordinary level of the mountain range about 500 feet. It is not by any means upon the highest part of the ridge, neither could it have been selected as a defensible position, but principally on account of the character of the material in which the caves have been excavated.

This material is partly lava scoria, an occasional solid lava rock, the whole substance being partially cemented by heat with earthy substances sufficiently compact to render the roof and wall of the caves safe and permanent.

The caves in this particular village cover a space about 200 feet along the crest of the ridge and extend down its face, which descends at an angle of about forty-five degrees, for about 100 feet.

The largest cave, which is about fifteen feet square, is nearest the crest of the ridge, occupying the post of honor, overlooking all the balance of the village, and was undoubtedly the habitation of the governor, chief, or head man; the other caves are stuck in below each other so close that the rear of some of them are nearly under the front of those higher up the hill. As the descent is made the caves become smaller and are rudely constructed, or excavated, until they degenerate almost to ordinary bears' dens. This shows conclusively that even among the ancient cave-dwellers the autocrat from his fifteen-foot parlor, with its alcove sleeping quarters, looked down with contempt upon the ignorant poor folks whose six by eight single room was found a hundred feet below him on the hill-side.

All the larger and more respectable dwellings have from one to three or four little alcoves excavated from the sides of the main room; they are about four feet wide, three feet high, and extend back five feet, and furnished the sleeping accommodations for the family.

The excavation of these caves was probably quite a tedious operation, but certainly not a difficult one, as the material gives way readily to light blows of any pointed tool, and when a solid rock was encountered, it was either dug out and removed whole, or if part of it projected from the wall it was broken off by blows from a heavy stone. The only tools used by the excavators of these caves were rude hammers made by selecting a stone near the size and shape wanted, and then by rubbing or grinding, completing for use, and cutting a groove around it sufficiently deep to sustain a handle lashed to it with rawhide thongs. Some of these rude hammers are still found about the mines.

In constructing the cave a narrow approach is made, inclining downward until a sufficient elevation is presented, when a doorway about two feet wide by three or four feet high is formed; after leaving walls of about one foot the rooms are commenced and excavated of the required size.

Some of the large caves have a small passage-way leading from one to another; they are only large enough to allow a human body to crawl through, and as they are near the top of the rooms were properly more for convenience of neighborly gossip than anything else. The loose earth and broken stones taken from the caves was carried out and deposited over on the rear face of the ridge; the solid piles of stone were used to erect rough stone walls about the entrance to the caves, and along the ridge a wall is built continuously back of the whole village about three feet high. No mortar or plaster of any kind or description was ever used by these people.

The caves, considering what their age must be, are still in a remarkable state of preservation. The rains and winds have partially filled some of them but they can nearly all be entered without difficulty, and the walls and roofs are found in as perfect condition as the day they were abandoned.

As to the people who excavated and inhabited these dwellings, it is utterly impossible to know much; yet the proof of a few characteristics are sufficiently established. They were a people of medium or rather inferior size, which is proved by the low erection of the rooms they inhabited and the alcoves in which they slept, neither being adapted to people over five feet high. They were a working people, fond of their homes and society, because they lived in compact villages, made pottery and cultivated the soil.

The ground is literally strewn with fragments of broken pottery in form and quality embracing all the styles of that made by the Pueblo Indians of to-day. This pottery has one and only one distinctive feature; it is, when painted at all, only painted on the inside.

It is sometimes roughly chased on the outside, but the coloring is on the inside. In all other respects the earthy pigments, mixed with chamber lye, furnished the material and it was laid on with sharp sticks for brushes, the same as the Indians of to-day do their work.

That they were agriculturists is proved by the Me-hot-tas (left in the caves) on which they ground their grain, and also the proximity of their villages to extensive areas of land well adapted to cultivation.

Their supply of water came from lakes and springs which have disappeared through various causes. Some of the lakes (or, as they are now called, tanks) were formed by the construction of dams across the foot of valleys—others were natural formations, but in all cases the marks are still plainly visible to the ordinary reader of nature's evolutions.

The only evidences they have left of any warlike implements are a few very small stone arrow-heads, which could only have been used in hunting small game.

The decaying remnants of the bones of both birds and animals, from the smallest wren or gopher up to the deer and antelope, are found by digging in the debris around their dwellings—but so far I have been unable to find the slightest trace of any human graves or skeletons, and although they were a people who used but little fire, probably none at all inside their dwellings, that they cremated the bodies of their dead seems probable.

These people deliberately abandoned their homes, taking with them all their household goods—they could not have been either destroyed or driven away, or more evidences of their possession would have been left behind.

These caves must have been constructed and inhabited within the last thousand years, and it is not at all improbable that they were still occupied five or even three hundred years ago.

The elements are not so gentle either in winter or summer among these mountain peaks as to leave such works—exposed as they are to their fury—without making serious efforts toward their obliteration, and yet these works are in a remarkable state of preservation to have stood even one thousand years. Aside from the actual dwellers in the caves, a part of these people lived in detached hamlets and single houses, scattered over the plain at considerable distances. The location and general characteristics of these lone huts would lead to the supposition that they were the temporary houses of herders, while the hamlets, ranging from three or four to a dozen houses, would indicate established settlement.

The houses were commenced by excavating one or two feet into the earth, the size required for the building, which was usually from six to eight feet wide and from twelve to twenty feet long, rough walls were built up of stone, and in some instances they were arched over with the same material and then the whole structure covered with earth, no mortar being used in the construction. Near these hamlets the now dry water tanks are always found, the same broken pottery and the same rude mills for grinding corn.

It would be an easy matter to invent legends and traditions to account for the disappearance of the cave-dwellers, but as plenty of such literature can be had by your readers at ten cents a volume, with your permission I will follow these people one step farther in their progress along the course of time, only saying in the conclusion of this article that as cave-dwellers they were a simple, peaceful, industrious people, knowing but few of the arts of civilization, but following these perseveringly and successfully until natural causes forced them to take a step in advance.—*Albuquerque Journal.*

REMARKABLE PROGRESS OF AMERICAN ARCHÆOLOGY.

The fourth annual report of the Archæological Institute of America has just been distributed among the members. It appears from this report that both the American and the classical researches of the Institute have been prosecuted with marked success. Mr. Bandelier is still at work in New Mexico, and in a letter dated San Juan, April 9, 1883, he outlines his further progress as follows:

"From Tucson, to which place I am now on my way, I shall go via Georgetown to Chihuahua and thence to Casas Grandes. After completion of my work there I shall return to Tucson, and thence ride down zigzag through Sonora Sinaloa, Michoacan, etc., to the City of Mexico. From this city I propose to turn upward again, following the route of Cortez to Vera Cruz, and thence along the coast, via Cintla, Misantla, Papantla, through the Huaxteco country to Monterey. In that manner I shall have surveyed the whole of Mexico north of the nineteenth parallel of latitude." The report further states that "should Mr. Bandelier be able to accomplish this proposed journey during the present year, one of the most important objects of the Institute in the investigations intrusted to him will have been attained. A general survey of the Pueblo settlements from their northern limit as far as the City of Mexico will have been made by a competent observer, and many points hitherto in doubt—not only in regard to the Indians, but also concerning the early Spanish discoveries and settlement of the country—will have been determined." As the modernization of New Mexico and Mexico is progressing rapidly, it is, indeed, fortunate that Mr. Bandelier's work was not longer deferred. Unhappily, however, the income of the Institute is so precarious that its labors will soon have to cease unless it receives more adequate support. The valuable report by Mr. Bandelier upon his studies in Mexico in 1881 is partly in type, but its publication will have to be abandoned, as a sum of not less that $500 is needed to complete it.

The firman under which the investigations at Assos were carried on expired in May, and all that remained to be done was to close the works, to complete the drawings, and to make the division with the Turkish authorities of the antiquities discovered by the expedition. "The instructions originally given to the director of the expedition," says the report, "to deal with scrupulous honesty with the Turks, and to comply literally with the terms of the firman, have been strictly followed in spite of the example of other expeditions and of the temptations afforded to secure by underhand dealing antiquities of great interest to western scholars." The committee thinks that this course has been appreciated by the Turkish authorities, and one may well imagine their surprise at such unusual conduct, when it is considered that all former expeditions engaged without scruple in shameful contest in knavery, and then plumed themselves upon coming out best. The late Turkish Minister at Washington, Aristarchi Bey, has promised to promote a favorable consideration of the desire of the Institute that the sculptures of the temple at Assos should be ceded to it, and the United States Government, through its representative at Constantinople, has also interested itself in the matter. In order to promote the acquisition of as large a share of the antiquities as as possible, the Boston Museum of Fine Arts has placed $2,000 at the disposal of the Institute, the objects secured by the latter to be presented to the museum. Among the latter discoveries at Assos reported by Mr. Clarke, who is at the head of the expedition, the greatest interest seems to attach to a number of *figurini*, most of them archaic, but one of them, in Mr. Clarke's opinion, belonging to the best age of Greek art. The little statue is described as truly beautiful. A naked boy sits upon the back of a proudly out-stepping horse, in an easy, graceful posture. The animal has a plume of some kind upon his head, the bridle being painted in black lines. The boy's body is pink all over, his hair is a rich reddish brown, eyebrows and lids black. The figure * * * * is perfect in preservation; it has not a nick or scratch."

The second annual report of the Committee on the American School of Classical Studies at Athens, which is appended, records the successful organization and actual operation of the school, "with auspices in all respects favorable' —a somewhat enthusiastic assertion, in view of the pressing appeal for funds immediately following. The school has a yearly revenue of $3,500 contributed by fourteen collages, but an endowment is needed to render feasible the appointment of a permanent secretary. The committee "venture, therefore, to appeal to the richer portion of our community to provide the Institute with the means for this object. It would be a distinction greatly to be coveted to have established a foundation of this sort, which might perpetuate the name of its founder through successive generations as that of one who had not merely the means, but the will, to contribute toward the certain promotion of the higher intellectual interests of his country."

The financial condition of the Institute, generally speaking, is far from satistory, and its work, the carrying on of which is largely due to the self-sacrificing spirit of its agents, will have to be suspended unless there is a heartier response to the appeals for money. The committee state that "they are unwilling to repeat such appeals, and they have resolved that this shall be the last, at least until a considerable period of years shall have elapsed. * * * * * It cannot but be felt as a matter of reproach to a community so wealthy and so generally intelligent as our own, that, after the Institute has shown itself capable of conducting investigations so interesting and so successful as those which it has directed in this country and in Asia Minor, it is left without the means to carry out new designs of a similar nature, and is compelled to withdraw from fields in which so much still remains to be discovered, and to leave others to reap a harvest the fruits of which America ought to be desirous to secure, at least in part for herself."

The membership of the Institute consists at present of ninety-four life members, who pay $100 upon admission, and 251 ordinary members, whose dues are $10 a year. The list of foreign honorary members contains some of the names best known in the fields of classical archæology and history. The number of ordinary members has been considerably increased during the past year, especially in New York. The address of the Secretary, Mr. E. H. Greenleaf, is care of the Museum of Fine Arts, Boston, Mass.

PREHISTORIC REMAINS FROM SOUTHEAST MISSOURI.

Hon. Wm. McAdams, the geologist, has just returned from a sojourn of several weeks in southeast Missouri, and brought with him a large number of geological specimens and prehistoric remains, some of which are remarkable. He was camped a good part of the time at the Salt Springs on the Saline Creek, Mo. These curious salt springs seem to have been a great resort for prehistoric animals, such as the mastodon, mammoth and other curious creatures now entirely extinct. The vicinity for a circuit of several miles is cut up by deep ravines, the remains of the trails and paths of the animals in olden times going to the salt deposits. Besides the huge bones of mastodons, we were shown the portion of a jaw containing four perfect teeth, belonging, the gentleman thinks, to some extinct carnivorous animal much larger than our greatest bear. Other teeth of curious shape were shown. One of the most interesting specimens found on the Saline in connection with the remains of the mastodon, is a mass of singular substance known as adipocere, which seems to be tallow or fatty matter, assuming a peculiar form like hard castile soap. Under certain conditions fatty matter has been found, after great lapse of time, to have taken on a mineral character, and we have in this instance portions of the body of the animal preserved. Prof. Mars, the chemist, after analyzing portions of this singular substance, pronounces it adipocere, and most probably the mastodon's fat.

These springs were also a great resort of the aborigines and mound-builders, and the ground about the oozing brine, to the depth of three or four feet, is filled with the remains of the peculiar earthen vessels used by the mound-builders in salt-making. In the woods about, for the whole vicinity is covered with a forest, are many mounds and earthworks. From one small mound two of the earthen salt-kettles were obtained. They were shaped like shallow pans, an inch and a half in thickness and near four feet across the rim. In the vicinity a cavern was explored, which proved to have been a strong-hold or retreat for these ancient people, for weapons and implements of stone were found. Near the entrance, on the smooth white walls of the cavern, were a number of hieroglyphic characters deeply cut in the rock, tracks of human feet of unusual size, also of birds; the picture of a bird with outstretched wings, representations of the sun, moon, and other strange devices. These singular carvings were cut off the rock and brought away by the gentleman to add their interest to his great collection.—*Alton Telegraph.*

PREHISTORIC IMMIGRANTS.

M. de Nadaillac, who has recently published an excellent work on "Prehistoric America," says that in America, as in Europe, all serious proof fails of the existence of man at an earlier period than the quaternary. "From the earliest times," he continues, "themselves so obscure, we see with some astonishment the civilizations of the old and new world developing themselves, so to speak, in parallel lines, following the same phases, and arriving at the same results. What have been the relations between these races? Here, also, we are confronted by difficult problems; but though we are often reduced to hypothesis to explain them, we can confidently affirm that these relations have existed, that America has been successively peopled by diverse races of very different types. Among the common elements the most important, in number and influence, are the Asiatic immigrations. These immigrations of yellow brachycephalous races are incontestable, and have certainly lasted for ages. The greater part have taken place from the islands of the north; the several peoples of Nahuatl races, descending successively toward the south, are the most direct consequences of these migrations. But before the arrival of these Americans other men occupied the American continent for a considerable time; the Esquimaux of the north, the Botocudos and Patagonians in the south, may well be representatives of this race, crowded back, like the Basques and Finns in our own continent, by conquering strangers. We do not seek to conceal how precarious these hypotheses still are, and what need there is for confirmation of the proofs we possess. After long and patient labors we must end in the words of the American *savant*, 'The New World is a great mystery.'" —*London Athenæum.*

GEOLOGY.

THE U. S. GEOLOGICAL SURVEY OF THE LEADVILLE MINING DISTRICT.

The recent geological survey made by Prof. S. F. Emmons of the Leadville mineral district, has produced a marked change in opinion in regard to the extent of the mineral deposits of that camp, as well as to the nature and character of the deposits. His report for 1882, published by the Department of the Interior upon "The Geology and Mining Industry of Leadville, Lake Co., Colorado," has clearly and sharply defined the line of future investigation upon the subject. The effect of this valuable work in clearing the field of the numerous untenable theories that cumbered local investigation is just now becoming apparent in the direction and impetus it gives to exploration and development by mine-owners and operators. With the facts given in his report before them, they go forward with a confidence hitherto unfelt. Every stone is a sermon of meaning instead of an enigma when studied in the light of the facts collated by him. In the maps accompanying his report he lays bare the surface of the rocks, and presents them as they exist hundreds of feet below the surface presented to the eye, showing the geological formation with its out-crops, dips, faults, breaks, and trends, so perfectly that it is fast becoming a chart to direct exploration and development. He has cut the mountains into sections, presenting the broken and disturbed present condition of the strata, in contrast with the natural stratification existing before the great upheaval. With these maps and accompanying explanations the displacements in the formations so often occurring, no longer puzzle the miner.

But the most important feature of Prof. Emmons' work is in demonstrating the extension and existence of the mineral bearing formation to the south of the present producing area as far as Weston's Pass, and to the west under the City of Leadville to the Arkansas River. This he declares in the naturally cautious words of a scientific man, but his language leads by inference irresistibly to that conclusion. And recent developments in the territory lying south of Iowa Gulch and on either side of Empire Gulch have proven the correctness of his statements. No one can ride over the territory lying south of Iowa Gulch, as the writer has done, and note the exact likeness of the geological formation to that of the producing area adjoining it on the north, and see the great outcrops of iron-limestone, the exact counterpart of those on Fryer, Carbonate, and Iron Hills, without being impressed with the conviction that the slopes of Empire Gulch will soon develop into a second carbonate camp as busy and fruitful as the one at Leadville, adjoining it on the north.

In regard to the mineral deposit under and west of the City of Leadville he says: "The determination of the existence or non-existence of the blue limestone beneath the City of Leadville, is of prime importance, for the reason that so many rich bonanzas have already been developed at that horizon on its eastern borders, which it is reasonable to suppose once extended farther west, and that thus far the richness of the horizon seems to increase with its distance from the crest of the range. The evidence gathered upon this point will therefore be given in considerable detail."

"It is sufficiently well proved by the general geological structure of the region that the blue limestone originally extended to the west of Leadville, its probable limits being a line drawn from the mouth of the east fork of the Arkansas in a southeast direction to a point just west of Weston's Pass."

The value of this report is greatly enhanced by reason of its being done by and under the personal supervision of a government official.

The ore of Leadville is described by Mr. Emmons in his previous report, for 1881, as principally argentiferous galena and its secondary products, lead carbonate, silver chloride, and, less abundantly, lead sulphate or anglesite, pyromorphite, minium, zinc blende and calamine. The gangue, or material mixed with or holding the ore, consists of hydrated iron oxides or manganese oxides, silica and clay, all secondary products, the clay coming from the decomposed porphyry. The cavities in the limestone were made by the eroding solutions which introduce the ores; the action commenced at the top of the limestone adjoining the sheet of porphyry, and from this plane worked downward into the limestone. The materials of the ores were taken from "circulating waters, which, in their passage through the various bodies of eruptive rocks, took up certain metals in solution, and, concentrating along bedding planes, by a metamorphic or pseudomorphic action of replacement, deposited these metals as sulphides along the contact or upper surface, and to greater or less depth below that surface, of beds generally of limestone or dolomite but sometimes also of siliceous rocks." Dikes intersecting the ore-bearing formation "seem to favor the concentration of rich ore-bodies or bonanzas in their vicinity;" but the planes of faults afford no deposits of importance, and evidently for the reason that "their origin is later than that of the original ore-deposits." Thus the intrusion of the igneous sheets preceded the production of the ore-deposits and of the cavities containing them; and the production of the ores antedated the era of great disturbance which closed the Lignitic period or the Cretaceous, and which has continued to be followed by feeble movements until the present time; even since the opening, according to some evidence, of the Leadville mines.

These ores occur, according to the same authority, underneath a porphyry sheet and chiefly in cavities penetrating the lowest member of the carboniferous formation, the *blue* limestone—but occasionally also underneath the same porphyry in the *white* or silurian limestone and the Cambrian quartzite. The ore deposits penetrate into the limestone to varying depths from its plane of contact with the overlying igneous rock, sometimes following courses of natural joints or cleavage planes.

The following tables, taken from the *Engineering and Mining Journal*, give the bullion output of Leadville for the year ended December 30, 1882:

QUANTITY.

	POUNDS OF BULLION.	POUNDS OF LEAD.	TONS OF ORE.	OUNCES OF SILVER.	OUNCES OF GOLD.
Total 1st quarter . . .	23,487,082	23,380,743	12,924	2,042,323	3,056
Total 2d quarter . . .	20,510,096	20,415,647	12,175	1,838,596	2,886
Total 3d quarter . . .	22,713,006	22,605,015	28,050	1,743,876	6,548
Total 4th quarter . . .	19,747,065	19,646,027	36,953	1,648,454	3,923
Total for year 1882 . .	86,457,349	86,047,412	90,101	7,273,249	16,413

VALUE.

	VALUE OF LEAD.	VALUE OF SILVER.	VALUE OF GOLD.	VALUE OF ORE.	TOTAL VALUE.
Total 1st quarter . . .	$1,169,037	$2,328,248	$ 61,120	$ 485,762	$ 4,044,167
Total 2d quarter . . .	1,020,779	2,093,301	49,720	599,059	3,773,772
Total 3d quarter . . .	1,130,251	1,988,142	130,960	1,326,111	4,575,334
Total 4th quarter . . .	942,977	1,827,561	78,457	1,885,134	4,734,129
Total for year 1882 . .	$4,263,044	$8,237,252	$320,257	$4,296,066	$17,127,402

Total for 1881 amounted to $13,170,576, showing an increase this year of $3,956,826.

A GEOLOGICAL GUIDE TO MINE PROSPECTORS.

PROFESSOR REUBEN WEISER.

* * * * * * *

We may inquire at this point as to the kind of rock, or rock formation, where silver or gold is likely to be found. This ought to be the first inquiry with the prospector who does not wish to throw away his time and money. The precious metals are found in nearly all the geologic formations, but in some more than others. Prof. J. D. Dana says, "silver veins often intersect trachite, porphyry and other eruptive rock, or the sedimentary formation in the vicinity of such rocks." Trachite and porphyry are ancient lavas, and are found only in eruptive formations and outflows. Feldspar is the principal ingredient of trachite. It is a rough rock and has a bluish yellow color.

Porphyry may contain silica and limestone. But silver is found most frequently in the gneissoid granite. Gneiss rock (pronounced nice) is a striated rock. It is found sometimes striped with black, red gray or white. Whenever you see a granite rock striped with these colors you may know that it is a gneiss rock. Silver is also found in amorphose granite; that is granite not striated. It is also found in limestone and in porphyry, in sandstone, in trap rock and in some shales. Silver and gold are found in all the geologic formations, from the oldest Azoic up to the most recent Tertiary. The principal gangue matter in silver lodes is calcite, which is carbonate of lime, pearl, fluor and heavy spar, which is sulphate of barium. This is easily known by its weight. It is about as heavy as solid iron. The fluor spar is known by its brilliant colors of blue, green and yellow. The composition of heavy spar is 34–3 trioxide of sulphur, and 65–7 of baryta. Calcite in a vein is a good silver indication. You seldom see a good vein without it. Iron is also found in the gangue matter of gold and silver mines.

But it may be asked, are there any surface indications of silver or gold mines or lodes? To this we answer yes, sometimes, but not very often. At one time in the remote ages of the past, before the disintegration of the rocks took place, and before the age of the glacial drift period, most of the fissure veins might have been seen on the surface. But now the debris from the eroded rocks, and the fragments of rock that have rolled down from the mountains, and the glacial drift have covered the surface veins far out of sight. In Lake County, near and at Leadville, the glacial drift is from 30 to 309 feet deep. And of course in order to reach the rock you must go through that drift. This drift is found on the tops of the highest mountains around Leadville. I have found this drift on the top of the mountain that runs up from Little Evan's Gulch at an altitude of nearly 13,000 feet. This shows, I think, clearly that that mountain has been elevated since the Glacial Age. So where the debris of the eroded rocks or the glacial drift have covered the lodes the prospector has no guide to the veins. He must then, in order to succeed, resort to other means. But what other means are there within his reach? We answer, the mines that are already opened. From these he may form a pretty good idea of the place where other veins are likely to exist. He must study the composition of the rocks in which good mines are found, the character of the gangue or crevice matter, the dip and trend of good mines. All these things have their importance, and none of them should be overlooked. After a locality or a mineral bearing mountain has been pretty thoroughly explored by shafts and tunnels, it is no hard matter to tell on which side of the mountain the most mineral is likely to be found. It is the opinion of practical scientists that as a general rule the south and southeastern exposure of a silver bearing mountain is better than a northern or northwestern. I give this for what it is worth. My own experience agrees with this, and I think it will hold good in all mining countries. The practical geologist, in looking for mines, will of course be guided by the openings that have been made by others, and from the blunders they have made he can learn wisdom.

It would do the energetic prospector no harm to get himself a work on geology, say Steel's or Gray and Adam's, or Hitchcock's, and study it. Such a course would save him many a hard day's work. He would not then, as is now too often the case, be found digging and delving in places where, in the very nature of things, there can be no mineral. It is a false maxim to say that mineral may be found in one place as in another. It is only where geology has placed it, and nowhere else.—*Philadelphia Mining Journal.*

PROCEEDINGS OF SOCIETIES.

THE THIRTY-SECOND ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

This meeting was held at the beautiful and prosperous city of Minneapolis, Minnesota, commencing August 15th and closing on the 22d. In many respects the meeting was a very successful and satisfactory one, though the attendance was smaller than usual. Most of the prominent members were present, however, and the papers read were fairly up to the standard of previous sessions.

On Wednesday morning at 10 o'clock the general session of the Association met at the University of Minnesota, about two miles from the centre of the city, and was called to order by the retiring president, Dr. J. W. Dawson, of Montreal. The chapel was well filled with members of the Association and citizens. Seated upon the platform were the past presidents of the Association, the present officers, Bishop C. D. Foss, Gov. Hubbard, Mayor Ames, President W. W. Folwell, Dr. A. F. Elliott, Mr. C. M. Loring and Geo. A. Pillsbury, of the local committee.

The retiring president, after calling the meeting to order, called to the chair the president elect, Prof. C. A. Young, of Princeton. Prof. Young stepped forward and thanked the Association for the honor conferred and promised to discharge the duties of the position to the best of his ability. We are met here, he said, for an important purpose. We are not here for mere amusement or the gratification of our tastes, but to consider carefully great scientific questions which are of political interest and value to the world. We must be industrious, conscientious and assiduous in our work and discussions, and give all to our sessions the dignified character which becomes us as scientists. We shall do some playing as well as much working, and I trust our meeting will be full of interest and of lasting value.

Bishop Foss then offered prayer, invoking the Divine blessing upon the Association, its deliberations and all the varied interests represented by it.

After this addresses of welcome were made by Mr. Geo. A. Pillsbury, the chairman of the Local Committee, Governor Hubbard, Mayor Ames and Dr. Folwell, President of the State University, which were formally and handsomely responded to by President Young.

After some detail business and the reading of the Annual Reports of the various officers the meeting adjourned and the several sections met and organized for their regular work in the different rooms assigned to them in the University building.

In the evening Prof. J. W. Dawson, LL.D., the retiring president, delivered the annual address before a large audience in the Westminster Church, one of the finest churches in the West, upon the subject:

SOME UNSOLVED PROBLEMS IN GEOLOGY.

It is not practicable to give the full address, as it would make at least thirty pages of the REVIEW, but it is believed that the abstract given below covers its main points:

Ladies and Gentlemen of the American Association for the Advancement of Science:

There is no department of physical or biological science with which geology is not allied, or at least upon which the geologist may not presume to trespass. When, therefore, I announce as my subject on the present occasion some of the unsolved problems of this universal science, you need not be surprised if I should be somewhat discursive.

Perhaps I shall begin at the utmost limiits of my subject by remarking that in matters of physical and natural science we are met at the outset with the scarcely solved question as to our own place in the nature which we study, and the bearing of this on the difficulties we encounter. The organism of man is decidedly a part of nature. We place ourself, in this aspect, in the sub-kingdom vertebrata and class mammalia, and recognize the fact that man is the terminal link in a chain of being, extending throughout geological time. But the organism is not all of man, and when we regard man as a scientific animal we raise a new question. If the human mind is a part of nature, then it is subject to natural law, and nature includes mind as well as matter. On the other hand, without being absolute idealists, we may hold that mind is more important than matter, and nearer to the real essence of things. Our science is in any case necessarily dualistic, being the product of the reaction of mind on nature, and must be largely subjective and anthropomorphic. Hence, no doubt, arise much of the controversy of science and much of the unsolved difficulty.

Fortunately, as a geologist, I do not need to invite your attention to those transcendental questions which relate to the ultimate constitution of matter. This record of geology covers but a small part of the history of the earth and the system to which it belongs, nor does it enter at all into the more recondite problems involved; still it forms, I believe, some necessary preparation at least to the comprehension of these. But if we are content to start with a number of organisms ready made—a somewhat humiliating start, however—we still have to ask, How do these vary so as to give new species? It is a singular illusion in this matter, of men who profess to be believers in natural law, that variation may be boundless, aimless and fortuitous, and that it is by spontaneous selection from varieties thus produced that development arises. But surely the supposition of mere chance and magic is unworthy of science. Varieties must have causes, and their causes and their effects must be regulated by some law or laws. Now it is easy to see that they cannot be caused by a mere innate tendency in the organism itself. Every organism is so nicely equilibrated that it has no such spontaneous tendency, except within the limits set by its growth and the law of its periodical changes. There may, however, be equilibrium more or less stable. I believe all attempts hitherto made have failed to account for the fixity of certain, nay, of very many, types throughout geological time, but the mere consideration that one may be in a more stable state of equilibrium than another, so far explains it. A rocking stone has no more spontaneous tendency to move than an ordinary boulder, but it may be made to move with a touch. So it probably is with organisms. But if so, then the causes of variation are external, as in many cases we actually know them to be, and they must depend on instability or change in surroundings, and this so arranged as not to be too extreme in amount and to operate in some determinate direction. Observe how remarkable the unity of the adjustments involved in such a supposition; how superior they must be to our rude and always more or less unsuccessful attempts to produce and carry forward varieties and races in definite directions. This cannot be chance. If it exists it must depend on plans deeply laid in the nature of things, else it would be most monstrous magic and causeless miracle.

Another caution which a palæontologist has occasion to give with regard to theories of life, has reference to the tendency of biologists to infer that animals and plants were introduced under embryonic forms, and at first in few and imperfect species. Facts do not substantiate this. The first appearance of leading types of life is rarely embryonic. On the contrary, they often appear in highly perfect and specialized forms, often however of composite type and expressing characters afterwards so separated as to belong to higher groups. Again, we are now prepared to say that the struggle for existence, however plausible as a theory, when put before us in connection with the productiveness of animals and the few survivors ot their multitudinous progeny, has not been the determining cause of the introduction of new species.

No conclusions of geology seem more certain than that great changes of climate have occurred in the course of geological time, and the evidence of this in that comparatively modern period which immediately preceded the human age is so striking that it has come to be known as pre-eminently the ice-age; while in the preceding tertiary periods, temperate conditions seem to have prevailed even to the pole. Of the many theories as to these changes which have been proposed, two seem at present to divide the suffrages of geologists, either alone or combined with each other. These are (1) the theory of the precession of the equinoxes in connection with the varying eccentricity of the earth's orbit, advocated more especially by Croll; and (2) the different distribution of land and water as affecting the reception and radiation of heat and the ocean currents, a theory ably propounded by Lyell, and subsequently extensively adopted either alone or with the previous one. One of these views may be called the astronomical, the other the geographical. I confess that I am inclined to accept the second or Lyellian theory for such reasons as follows: (1) Great elevations and depressions of land have occurred in and since the Pleistocene, while the alleged astronomical changes are not certain, more especially in regard to their probable effect on the earth; (2) When the rival theories are tested by the present phenomena of the southern polar region and the North Atlantic there seem to be geographical causes adequate to account for all except extreme and unproved glacial conditions; (3) The astronomical cause would suppose regularly recurring glacial periods of which there is no evidence, and it would give to the latest glacial age an antiquity which seems at variance with all other facts; (4) In those more northern regions where glacial phenomena are most pronounced, the theory of floating sheets of ice, with local glaciers descending to the sea, seems to meet all the conditions of the case, and these would be obtained, in the North Atlantic at least, by very moderate changes of level, causing, for example, the equatorial current to flow into the Pacific, instead of running northward as a gulf stream; (5) The geographical theory allows the supposition not merely of vicissitudes of climate quickly following each other in unison with the movements of the surface, but allows also of that near local approximation of regions wholly covered with ice and snow, and others comparatively temperate, which we see at present in the north. This last consideration suggests a question which might afford scope for another address of an hour's duration—the question how long time has elapsed since the close of the glacial period. Recently the opinion has been gaining ground that the close of the ice age is very recent. Such reasons as the following lead to this conclusion: The amount of atmospheric decay of rocks and of denudation in general which have occurred since the close of the glacial period are scarcely appreciable. Little erosion of river valleys or of coast terraces has occurred. The calculated recession of waterfalls and of production of lake ridges lead to the same conclusions So do the recent state of bones and shells in the Pleistocene deposits and the perfectly modern facies of their fossils. On such evidence the cessation of the glacial cold and settlement of our continents at their present levels are events which may have occured not more than 6,000 or 7,000 years ago, though such time estimates are proverbially uncertain in geology. This subject also carries with it the greatest of all geological problems, next to the origin of life, namely, the origin and early history of man. Such questions cannot be discussed in the closing sentences of an hour's address.

In conclusion, science is light, and light is good, but it must be carried high, else it will fail to enlighten the world. Let us strive to raise it high enough to shine over every obstruction which casts any shadow on the true interests of humanity. Above all, let us hold up light and not stand in it ourselves.

The exercises of the day and evening were pleasantly supplemented by a public reception by the members of the Association, under the auspices of the local committee, in the parlors of the Nicollet House. The reception was entirely informal. After listening to Prof. Dawson's address, the members of the Association proceeded to the hotel where they found awaiting them a large company of Minneapolitans, including many leading citizens, with ladies.

ANTHROPOLOGY.

SCOPE AND VALUE OF ANTHROPOLOGICAL STUDIES.

PROF. OTIS T. MASON.

Abstract: Read before Section H, Wednesday, August 16th.

Professor Mason began by saying that everything which presented itself before human consciousness is subjected to a process of weighing and measuring. Before giving up their lives to any study men wish to know what good, or honor, or happiness would result. The speaker then defined anthropology to be the application of the instrumentalities and methods of natural history to the inductive study of man, not merely taking a superficial view, collecting old things because they are old, nor running after curiosities, but the patient investigation of mankind, just as if our race were a group of unintelligent animals. The horse was adduced as an example of what patient study would accomplish when concentrated upon a single group. A series of topics was drawn up, the consideration of which would constitute a science of hippology. Returning to the human race it was assumed that humanity had an origin and therefore a whole series of problems would arise concerning that fact; many of these questions were stated by the speaker. The past has a record between the beginning and the first recorded history, written in graves and remains of art, another great congeries of questions grew out of this fact, and the professor stated the principal among them. The human animal has a life-history, a biology; it has a mind-history, a physchology; a history of expression, a glossology; a history of segregations, an ethnology; a progress in artistic refinement and ability, a technology; a social evolution, or sociology; an eventful life in the presence of the unseen world, a mythology; a balancing of harmonies with the outer world, or hexiology. Considering each of these topics briefly, Prof. Mason stated what were the latest and most imporant queries under each head concerning which the anthropologists are vexing their minds.

After this epitome of the topics included in anthropology it was next shown what are the advantages to be gained by so much nicety of observation: by such multifarious and extended records, and by so much philosophizing. The first advantage is that all studies are improved by study. Men will study man. It is a most fascinating subject, has been pursued always, and ever will be to the end of time. The mission of the anthropologist, therefore, is not so much to encourage the study of man, but to regulate it so that some permanent good, some beneficent truths, will be the result. All sciences began with vain speculations—astronomy with astrology, chemistry with alchemy, theology with mythology.

While paying a glowing tribute to those who worked with insufficient light, Prof. Mason called attention to the fact that twenty years antiquate a man nowadays as effectually as did centuries in former times. Quite an extended report was given of the work now being thoroughly done in every department of anthropology throughout our country.

The second benefit of anthropology is its good effect on human weal. The study of climatology already begins to enable those who direct political movements to thwart the destructive energies of nature and to add to the natural selection of physical forces the effective co-operation of human design. A better knowledge of the religions of peoples puts in the hand of the statesman and the missionary a more effectual means of amelioration. Those who have to deal with uncivilized people on reservations and in colonies, win their confidence better by knowing their political organization. The history of civilization is in one sense a history of industrial accretions which can be read backwards by the elimination of inventions in the inverse order of their addition. So much is said about race and race prejudice that only by a correct analysis of what race really is can we hope to arrive at a proper disposition of the problem. Thus throughout every part of this anthropologic domain, knowledge wide and deep is to humanity both a safeguard and a positive boon.

The third and most interesting point in this part of the paper was that anthropology afforded opportunity for the exercise of the most diversified talent. The speaker showed that every one in the audience, by his occupation or natural gifts, was thus qualified to be an expert in anthropology. Some very interesting illustrations of this point were given, such as the identification of all the birds in the mound-pipes by Mr. Henshaw; the explanation of the designs on the shell ornaments, by Mr. Holmes, the artist; the explanation of the true history of savage invention, by Mr. Seely, a patent examiner, and the order of elaboration in savage weapons, by Gen. Pitt Rivers. Mothers, teachers, physicians, tradesmen, lawyers, legislators, and clergymen, were urged to conduct a series of anthropologic experiments.

The last advantage to which Prof. Mason alluded was the assistance which such studies lend to philanthropy and legislation. Science now has her missionaries as well as religion. It was the demonstration by science that the Indians are not dying out which revolutionized public sentiment in their favor. The genuine sympathy necessary to constitute a good scientific observer redounds to the permanent good of those who are under scrutiny.

The closing portion of the address related to the future of anthropology. In the study of the anthropocosmos, as in other studies, we are brought face to face with the inscrutable. In these voyages of discovery we have no right to expect that we shall ever find a passage to the ultimate truth. With all our sciences comes the consciousness of new ignorances. There is more known to be unknown now than when the wisest men knew that they did not understand many things well known to us. So will it ever be. We are just on the threshold of applying the instruments of precision to the study of man. But there is no *Ultima*

Thule in science. Still, we should not utter the words *ignoramus et ignoramibus* as a wail of despair. To all they should be the sweet voice of hope. Fresh, buoyant, vigorous science should feel that it is on a pleasant journey, whose destination may remain unknown, but every mile of whose progress unfolds new vistas of beauty and variety in nature, each transcending its predecessors.

THE MISSOURI RIVER MOUNDS, CONSIDERED FROM A GEOLOGICAL STANDPOINT.

JUDGE E. P. WEST.

Read before Section H, Friday, August 18th.

In treating of the Missouri River mounds and mound-builders, I shall confine myself, mainly, to my personal observations, made in the fall of 1881 and summer of 1882, during an exploration of the river banks between Omaha and St. Louis. The expedition was undertaken for the Kansas City *Times*, and an account of it was published in that paper in a series of nine articles pending the work.

This paper will be confined, in a great measure, to the age of the mounds as indicated by the geological formations with which they stand invariably associated. In extent, these monuments of the past ages, in one unbroken chain, form conspicuous land-marks, crowning the river-bluffs from Omaha, Neb., to St. Louis, Mo., and, as the writer believes, upwards on the Missouri River and and upward and downward on the Mississippi River, and on their respective tributaries on both sides, co-extensive with the Loess and Terrace formations bordering them. They are found on the highest loess bluffs overlooking the streams, and on the old terraces of the Champlain era near them, and nowhere else; without exception, they are associated with these geological formations and none other.

But this fact would be without significance were it not for other facts with which it stands connected. The Loess hills are still standing in graceful sequence along the rivers, and the Terraces form broad and picturesque steps in the valleys, and have stood so for long ages inviting, as they are still inviting, man's restless energy to erect his monuments upon them. Cities, towns, villages, and beautiful country homes, are now continually springing into being upon them at the touch of modern civilization; but history records the age of this work, and we speak of it in our daily intercourse. Not so with the other monuments I have alluded to. We question history about them, but it is silent. We question the seers and wise men of the aborigines of the continent, but they, too, and their traditions, are silent; they can give us no farther account of them than, that "they were there in the time of our fathers;" and their traditions can say no more. They are older than history, they are older than tradition; and in the absence of both history and tradition how can we approximate their age. The builders have long reposed in the silence of death, and their stage of action is buried in the deep recesses of the past, but they alone can tell us, not by words or writing, but by their work and by their sepulchres, which have kindly preserved their remains from the ravages of time for our instruction.

Our structures and monuments upon the earth's surface are not confined to the loess deposits and terrace steps, but are spread alike, indifferently, over all the geological formations. The modern Indian erects his wigwam upon the recent alluvium, and the valleys and plains, wrought out by all the ages, with equal indifference, showing no preference, whatever, for the loess bluffs, or the terrace tables. Not so with the extinct race of mound-builders of the Missouri River. They chose the summits of the loess hills, or the terrace plains, only, for an abiding place. Why this preference? It could hardly be that any peculiarity of the soil or the formation itself influenced them, and we must look to extrinsic conditions to explain their choice.

It is a fact not disputed by geologists, that the loess deposit was made in lakes of still water, and that terraces were formed by shore-washings, and exposed by subsequent elevations of the land or subsidence of the water. May we not look, then, to these lakes for an explanation of the manifest and invariable preference shown? Mav we not regard the Missouri River mound-builders as a race of lake-shore dwellers, made so from considerations of a food supply?

Many facts point to this conclusion, besides the persistent association of the mounds with the geological formations before named, *e. g.*: the black vegetable mold is as thick on the mounds as over the adjacent lands. The trees growing on them are as large and as old as those of the surrounding forests. But all this might be covered by a period of five hundred years, and would not, necessarily, extend back to the lake era. But other facts, which may be superadded, are more conclusive. Stone implements have been frequently found in the loess from three to thirty feet below the suface, under conditions which leave but little doubt of their having been lost in the lakes of the Champlain era, and covered in where found, by the super-accumulation of their deposits. Human bones were found in Kansas City in a loess hill-side, not remote from the summit, eighteen feet beneath the surface, and within ten feet above the base of the deposit, under conditions that lead to the belief that they were engulfed and subsequently buried in the same way.

The bones, teeth, and tusks, of extinct mammals, and three or four varieties of Helix, identical with living species, are often encountered at depths varying from five to more than a hundred feet below the surface.

A vase of antique pottery was found at White Cloud, Kansas, in a loess hill, near its summit, fifteen feet below the surface, in clay which had every indication of having remained undisturbed from the time of its primary deposit. Another vase, precisely similar in every respect, was found in an artificial mound, standing on the summit of the bluff overlooking that place and the Missouri River, about one-half mile distant from where the first named vase was found, but at a much greater elevation of the bluff. Another vase, of the same antique work, was found, in sinking a well, on a broad, low terrace, at Manhattan, Kansas, at a depth of nine feet. Dr. Parr, of Weston, Missouri, found a similar vase in opening a mound situated on the summit of the bluff overlooking that place and the Missouri River. The vase contained within it the vertebræ of a fish, and some shell beads. The chief importance to be attached to Dr. Parr's find, as I have elsewhere, in another article, stated, is in the contents of the vase. It has been the custom of barbarous and semi-barbarous people to make provision for their departed friends, on their supposed long journey to the spirit land. The food provided is that which the people habitually use, and such a people invariably use the food which is most accessible to them. Hence, our modern tribes, who inhabit fertile districts, such as Missouri and Kansas, subsist almost entirely upon terrestrial animals, because such food is more accessible to them than any other; and they would never have thought of sustaining a friend departing for the land of spirits upon fish. But at the close of the loess deposit, prior thereto, and for a considerable time after its completion, conditions were different, and fish must have been more abundant and more accessible than terrestrial animals, hence the subsistence provided for the tenant of the Weston mound for his subsistence to the mystic land.

It is not probable that any monument of primitive man will be found east of the Rocky Mountain range, and north of the fortieth degree of north latitude, older than the Champlain era, unless it may be in caves, or scattered in the glacial drift. It is highly probable, on the other hand, that all of the mounds in Kansas, Nebraska, Iowa, Missouri, Illinois, Wisconsin, Michigan, Indiana, and Ohio, north of that line, are about the same age, and correspond, within a few hundred years, at most, with the age of the Missouri River mounds, and stand associated with equivalent geological formations, *i. e.*, they were all built fringing upon lakes which had a synchronous existence in the Champlain era.

In view of these facts, we have reason to believe that the occupancy of the mound-builders began prior to the subsidence of the Missouri River and Kansas lakes, and that it was not continued long thereafter. It must have begun previous to the subsidence, otherwise the remains and implements of this mysterious people would not be found in positions, as they are found, in the undisturbed primitive deposits. The changed conditions which followed the subsidence precludes the idea of their continuance much later without changed habits and modes of life.

Their ingress was, probably, from the south, and extended northward after the close of the glacial period, however, and whenever man originally appeared on the continent. Outward, physical conditions determine, in a great measure, the modes of life of a primitive people. And this simple race, turning northward after the close of the ice reign, found the warm Champlain lakes filled with fish, inviting an occupancy along their hospitable shores. Here they erected their mysterious abodes, and drew their principal food-supply from the lakes. But time moved on with its relentless changes, the lakes were drained, and the supply of food they afforded was diminished, while, on the other hand, the productions of the land increased in a corresponding ratio. Conditions were changed, and the lake-dwellers, consequently, suffered extinction, or were forced to change their mode of life. Their distinctive characteristics, at any rate, ceased long before the European touched foot upon this continent. Were they exterminated by neighboring nomadic tribes, or did they become themselves nomadic in their habits? We may never know, but their total and tragic extinction is most probable.

BIOLOGY.

AGRICULTURAL BOTANY.

DR. E. L. STURTEVANT.

Read before Section F, Thursday, August 17th.

If kitchen garden plants be closely studied in many varieties, it will be found that selection has differentiated the various natural species in accordance with desired uses.

It will be noticed that while there is a striking uniformity within varieties in those portions of the plant which have not been selected for improvement, there is a great variation between these portions which have secured attention on account of their uses. Thus, in forty-five varieties of onions growing side by side, the foliage is all similar, yet the bulbs vary in size, color, shape and habit of formation. The twenty-two varieties of carrots present like foliage, yet unlike roots. In sixty kinds of lettuce a likeness of bloom and great unlikeness between plants while of edible size. Among sixty-six kinds of tomatoes, a sameness of bloom, certain varieties in foliage and growth habit, and a very marked diversity in form of fruit borne. It follows from a careful observation of over 1,100 named varieties of kitchen-garden plants, that two series of variations can be distinguished: The least marked, the normal variations that occur between the parts not subjected to conscious selection as being of little account for use; the very marked, or artificial variations that are produced by conscious selection exerted upon the parts which are valued for their use, and which selection has been exercised most stringently upon form. It will be further noticed that according as selection for the same purpose has been exercised upon the various parts a parallelism of development has taken place between plants of different species, genera and orders. This parallelism of development points to a unity of arrangement in the forces by which the correspondences are produced.

The effect of selection concentrated upon visible forms has been to produce and fix changes from the natural plant to such an extent as in cases to mask the original species so that historical data must supplement morphological data in order to connect the genetic record. Thus, for illustration, there at first seems no specific connection between certain cultivated kales, cabbages and cauliflowers, while a specific connection of these with the ruta-baga seems uncertain. It is only as these forms are produced through the sowing of the seed of Brassica Oleracea that their close connection becomes manifested.

In the case of some long cultivated plants the original prototype is unknown, and can be sought but by conjecture. Such is the case with many of our cereals, with lettuce, etc.

In some plants selection has been exerted in different directions, as, for illustration, with the beet, whereby the root-beet and the leaf-beet have been produced; the celery and the celeriac; the parsley and the Hamburg parsley, the onion and the top-onion, etc.

It is clearly evident that conscious selection is a powerful agency for the changing of form, and by long exercise can overcome the form or type affixed by nature to a species. The direction of this change and its consequences are determined by man in the direction toward usefulness to him as distinct from nature's intent toward the maintenance of the species.

We hence have a different set of motives governing the domesticated plant than those which govern the feral plant. The individuals of a natural species cluster about a common type, held in place by a natural environment, reacting with the force transmitted by heredity. The individuals of an artificial (domesticated variety) cluster about a common type formed and continued through man's agency, whereby an assisted environment reacts upon heredity modified by selection in influencing plant form, and in the feral plant, genetic resemblance, as observed or inferred, furnishes a method of classification in accord with the law of evolution as expressing harmonies of action of special causes. Through the reaction of natural heredity with natural environment, classes are already formed for us and but await our discovery.

In the domesticated plant, the power of intelligence to eliminate, modify and direct the action of natural laws under a given purpose, introduces a new factor to influence plant growth, and forms designed for uses most genetic, producing resemblances in those portions of the plant where change means value to man. In accordance with the law of evolution, but under a new application, form becomes paramount as a motive over genesis; usefulness, freed from the motive of self-maintenance, becomes paramount over the motive of continuance of the species. Through the reaction of an assisted heredity with the artificial environment, including conscious selection in artificial plants, classes are already formed for us, and but await our discovery. If in nature, classes are formed through genetic data as paramount, then the natural system is in force for classification. If, under art, classes are formed through human selection based upon form as paramount, then an artificial system of classification is as truly scientific, and expresses, in like manner, as true a set of relations, but relations of a different character, as does the natural system. In a scientific artificial arrangement we seize upon a quality or qualities which yield us information as to the motive or development for uses, and furnish signs of natural laws as modified and influenced by man, and form of selected parts furnish the key; in a scientific natural arrangement we seize upon a quality or qualities which through correlations yield signs of natural laws, and the floral organs as indicative of the motive of the wild plant's life furnishes the key. If these views are correctly stated, then it is seen that an agricultural botany as an annex to the natural botany is imperatively required for the purpose of furthering classification and identification of domesticated plants, and such an annex must vary in its methods as widely from the methods of the natural botany as cultivated plants vary from feral plants, the key to the motive being in one case the use, while in the other the floral organs.

GEOLOGY AND PALÆONTOLOGY.

THE GLACIAL PERIOD.

PROF. I. C. WHITE.

Read before Section E, August 17th.

[The Geological Section is universally conceded to be the one in which the newest and most interesting scientific facts have been brought out. A matter of special interest which it has discussed has been the theories of the glacial period of North America. It may be interesting to briefly review the history of these theories. It was noticed three or four decades ago by the eminent naturalist, Agassiz, that through the United States north of the Ohio River, there were scattered formations of gravels, boulders, sandstones and clays, which were in geological positions and relations similar to those at the foot of European glaciers. These deposits were utterly dissimilar from any of the prevailing formations of the surrounding country. The question then was, whence came these strange visitors? It was found that to the north of these deposits were large formations of the same kind of material, which seemed to indicate that some mighty force had torn these boulders, etc., from their original beds and carried them south, sometimes a mile, sometimes 1000 miles. The hypothesis was then suggested that this was the work of a number of geologists who had made desultory surveys of these formations, but no scientific survey of them had been made up to seven or eight years ago, when Prof. Chamberlin, then of Beloit College, and Prof. Cook, of New Jersey, set out to make a thorough study of this glacial hypothesis. Prof. Chamberlin went to Europe to examine the beds of glaciers there in order to thoroughly prepare himself for original investigation. The study of these formations was exceedingly careful and painstaking, extending from Cape Cod and Long Island to the Sierra Nevada Mountains. Up to this time, two theories had each their advocates—that these formations were dropped from glaciers moving south, and that they were deposited by icebergs. The work of these two explorers, however, brought forth such an array of facts as to positively show that this was the work of ice, and that the glacier theory was the only tenable one.

In this exploration the professors received valuable assistance from Mr. Warren Upham, now Prof. Winchell's assistant at the Minnesota State University. Prof. Chamberlin is still prosecuting this search under the United States Government, and is recognized as one of the most thorough and erudite geologists connected with the government survey. Prof. Chamberlin and Mr. Upham have read papers in the geological section on this subject, which papers have already been reported. A valuable addition to the literature was a paper read Friday, August 17th. It was written by Prof. I. C. White, and considered the surface deposits along the Monongahela River and other West Virginia tributaries of the Ohio on the hypothesis of a glacial dam across the Ohio valley near Cincinnati. The following is the paper in full:]

In a paper read before the Boston Society of Natural History, March 7, 1883, Rev. G. F. Wright has shown that the southern rim of the great northern ice sheet crossed the Ohio River near the site of New Richmond, a few miles above Cincinnati. Mr. Wright believes that one effect of this invasion of the Ohio valley by the glacial ice, was to form an immense dam of ice and morainic debris, 500 or 600 feet high, which effectually closed the old channelway, and set back the water of the Ohio and its tributaries until rising to the level of the Licking River divide, it probably found an outlet through Kentucky, around the glacial dam. As this divide is 500 or 600 feet higher than the present bed of the Ohio at Cincinnati, Mr. Wright states that the site of Pittsburg would have been submerged to the depth of 300 feet; and adds: "It remains to be seen how much light this may shed upon the terraces which mark the Ohio and its tributaries in western Pennsylvania."

Having resided for nearly a score of years in the valley of the Monongahela River, the writer is necessarily familiar with its terraces and surface deposits in general; and in reply to the above query of the eminent glacialist, would answer that his admirable work throws a flood of light upon the Monongahela terraces, and proffers for them, and the deposits along other tributaries of the Ohio, the only satisfactory explanation that has ever been advanced.

Of course, if the Ohio River was ever so obstructed for any considerable period of time, it would follow, as a necessary result, that many of the tributary streams and the Ohio itself, above the limit of the dam, would have their old valleys silted up with vast heaps of trash—clay, sand, gravel, boulders, drifted logs, and other rubbish—carried down by the streams from the regions not sheeted with ice, and dumped into the great inland lake-stream which extended from Cincinnati far up toward the sources of the Monongahela.

That the valley of the latter stream has been refilled with trash during some period of its history to a height of 250 or 300 feet above its present bed, the evidence is most conclusive, for the remnants of this deposit still cover the surface to a great depth in long lines of terraces extending from Pittsburg, Pa., southward along the river to Fairmont, W. Va., a distance of 130 miles, and very probably much further, as I have never examined the river valley above the latter town.

The striking peculiarity of these terrace deposits is that they suddenly disappear at an elevation of 1050 or 1075 feet above tide, not a single rounded and transported boulder ever being found above the latter horizon, though occurring in countless numbers below this level.

The hills along the river often rise 300 or 400 feet higher than the upper limit of the deposits, so that there can be no mistake about the elevation at which the terrace deposits disappear. The composition of these great heaps of surface debris is, along the immediate valley of the river, a heterogeneous mixture of sand, clay, gravel, rounded boulders of sandstone of every size, from an inch in diameter up to four feet, pieces of coal, leaves, logs of wood, and every other species of rubbish usually transported by streams. Back from the channel of the river, however, and especially where the surface configuration would make quiet water, there occur thick deposits of very fine, bluish white clay, in which great numbers of leaves are most beautifully preserved. These clays have been extensively used for the manufacture of pottery at Geneva and Greensboro, Pa., and also to some extent at Morgantown and Fairmont, W. Va. Though the clay deposits occur at nearly every horizon they are purest near the upper limit of the terraces, and these are consequently the only ones that have hitherto been much explored.

In the vicinity of Morgantown, terraces of transported material occur at the following approximate (measured by barometer) elevations:

	Feet above River.	Feet above Tide.
First terrace	30	800
Second terrace	75	865
Third terrace	175	965
Fourth terrace	200	990
Fifth terrace	275	1065

The accompanying cross section of the Monongahela valley, near Morgantown, exhibits the relations of the terrace deposits to each other and to the river channel.

The first terrace is the present flood plain of the river, consisting principally of fine sand, mud and gravel. It seems to possess some respectable antiquity, however, since Mr. Walter Hough, one of my students, dug some teeth and bones from five feet below its top, which were identified by Prof. O. C. Marsh as the remains of a species of peccary, an animal that has not inhabited the region in question within the American historic epoch.

All of the other terraces have thick deposits of transported material wherever the original contour of the surface has favored its preservation from erosion. From the top of the fourth terrace Mr. Keck dug a well through seventy feet of clay, gravel and boulders without finding bed-rock. He also encountered logs of wood in a soft or semi-rotten condition near the bottom.

Many other wells on the third terrace have been sunk to depths of twenty and thirty feet without reaching bed rock.

The fifth terrace of this Morgantown series mark the height to which the pre-glacial valley of the Monongahela was silted up partially or entirely during the existence of the glacial dam at Cincinnati, since as already stated, no clay beds, rounded boulders or other transported material are ever found above its top, but instead only angular fragments of the country rock, and thin coverings of surface material which has accumulated *in situ*.

Owing to the considerable elevation—275 feet—of the fifth terrace above the present river bed, its deposits are frequently found far inland from the Monongahela, on tributary streams. A very extensive deposit of this kind occurs on a tributary one mile and a half northeast from Morgantown, and the region, which includes three or four square miles, is significantly known as the "flats." The elevation of the "flats" is 275 feet above the river or 1065 feet above tide. The deposits on this area consist almost entirely of clays and fine sandy material, there being very few boulders intermingled. The depth of the deposit is unknown, since a well sunk on the land of Mr. Baker passed through alternate beds of clay, fine sand and muddy trash to a depth of sixty-five feet without reaching bed-rock. In some portions of the clays which make up this deposit, the leaves of our common forest trees, are found most beautifully preserved. Whether or not they show any variations from the species now growing in that region, the writer has not yet had time to determine, but when a larger collection has been obtained, this subject will receive the attention that it deserves, since if the date of the glacial epoch be very remote, the species must necessarily show some divergence from the present flora.

Of animal remains the only fragment yet discovered in this highest of the terraces is the tooth of a mastodon, dug up near Stewartstown, seven miles northeast from Morgantown.

The other tributaries of the Monongahela, on which the writer has noted the clay and other deposits of the fifth terrace, are Decker's, Dunkard, Whitely, Muddy, and Ten Mile Creeks, and in each case the deposits disappear at the same absolute level at which they cease along the river.

The Great Kanawha River, another principal tributary of the Ohio, draining a region that was never glaciated, also exhibits water-worn boulder deposits which disappear at 200—300 feet above the present level of that stream, though I have not determined the exact limit.

The glacial dam at Cincinnati presents a complete explanation for the origin of Teazes valley, an ancient, deserted river channel twenty miles long and one to two miles wide, which leaves the great Kanawha fifteen miles below Charleston, W. Va., at Scany, and passing through Putnam and Cabell Counties, extends to the valley of Mud River, a tributary of the Guyandotte which empties into the Ohio at Huntington.

This valley, although having an elevation of 200 feet or more above the Kanawha, is filled to a great depth with rounded boulders sandstone, chert, cannel coal, and other trash which has plainly been transported down the Kanawha from above Charleston, so that although it was clearly seen that the water of the

Kanawha had once found an outlet to the Ohio by the way of this valley and the Mud and Guyandotte Rivers, yet why this ancient channel should have been abandoned for the present much more circuitous one had always remained a mystery until Mr. Wright furnished the key in his discovery of the great ice dam at Cincinnati. For it is now cler that such a barier would set back the water of the Kanawha until rising above the divide which have previously separated it from Mud River, it sent an arm across to the Ohio by way of the Guyandotte, fifty miles below, where the other arm and main stream reached the same river at the present mouth of the Kanawha, thus converting portions of Putnam, Mason and Cabell Counties into a large triangular island, the base of which was formed by the swollen Ohio, and the sides by the two arms of the Great Kanawha. The melting away of the Cincinnati dam withdrew the water from the western or Mud-Guyandotte arm of the Kanawha, leaving the abandoned valley high and dry, but littered up with transported trash as we now see it, while the Kanawha continued on to the Ohio in its present and pre-glacial outlet.

A summary view of these and other facts in the writer's possession seem to prove beyond any reasonable doubt that Mr. Wright's hypothesis concerning the damming up of the Ohio by the glacial ice in the region of Cincinnati was an actual reality; that during the period of its continuance the principal tributaries of the Ohio had their valleys filled with sediment carried down and dumped into them by the mountain torrents and other streams which drained the area south from the glaciated region; that subsequently when the barrier disappeared, the rivers recut their channels through the silt deposits, probably by spasmodic lowering of the dam in such a manner as to leave the deposits in a series of more or less regular terraces which in favored localities subsequent erosion has failed to obliterate, though from steep slopes it has removed their every trace.

The elevation of this dam at Cincinnati as determined from the upper limit of the fifth Monongahela River terrace, would be somewhere between 1050 feet and 1075 feet above tide, or about 625 feet above low water there in the present Ohio.

THE EVIDENCE FOR EVOLUTION FOUND IN THE HISTORY OF EXTINCT MAMMALIA.

PROFESSOR E. D. COPE.

Abstract: Read in General Session, Monday, August 20th.

The speaker, in commencing, said that the subject of evolution divided itself naturally into two parts—first, the question of the fact of evolution, and secondly, the question of the mode and active cause of evolution. The fact of evolution was believed by a majority of the cultivators of biological sciences at the present time.

The doctrine of evolution, succinctly stated, means the doctrine of direct descent of organic species from pre-existent species in succession from an early period in the world's history. That such has been the case is rendered certain by the variations of form and other characters which are so commonly met with in animals and plants, whose descent we can observe. To believe that species were originally created distinct requires that those varieties should also have been distinctly created, which we know not to have been the case. While we cannot observe these changes in fossil species, we frequently find variations in them of a character identical with those seen in living species: and we can properly infer that the origin of these varieties has been the same in both cases. The late discoveries of palæontology have disclosed a general system of relations of the extinct species, entirely accordant with the process of solution from simple to more complex forms of life. The constant discovery of new forms of life and even of new populations of animals and plants, demonstrates the imperfection of the geological record, and holds out the promise that we will sometime have a completed genealogy of all existing animals, including man.

The speaker referred to the two great phenomena of constancy and variation, which meet the student of biology upon every hand, and dwelt at some length particularly upon the subject of variation. After giving some instances of variability as observed in certain birds and animals, he said:

The amount or degree of difference is a graduated quantity, and passes insensibly from the lesser to the greater; that is from the varietal to the specific. Besides we find related species constant in one part of the world, to be variable in another; also that individuals can be distinguished into species in two regions each taken separately, but, when all are compared together, the definitions of species vanish. These facts confirm us in the lawfulness of the general induction that all species, no matter how constant they may appear to us now, have been at some other time and place as variable as the most variable ones known to us. Moreover, to suppose that new elements of form, color, etc., can be introduced by the operation of laws of development in one set of organisms and not in another, is to violate the very foundation of all practical and instructive reasoning. It is also equally certain that the structural characters in which we have genera, families and orders are variable in some parts of the system. This, then, is the primary evidence of the descent of existing types from pre-existent ones. Taken by itself, this evidence is not conclusive, but in connection with that derived from the observation of living specimens, is cumulative to a degree which satisfies the mind as to the general fact of evolution, and already explains much of its mode and manner.

The speaker went on to show that although the geological record of the fossil mammalia is imperfect, it has become unsafe to assert that connecting forms have not been found, and still more unsafe to assert that they will not be found.

As to whether any intermediate form connecting man with the lower animals has yet been found we cannot speak with certainty. The earliest preserved human skeletons often represent well developed men, while others are less well eveloped, as, for instance, the jaw found at Nanlette, Belgium, which is very simian. Our greatest ignorance lies in the direction of the structure of higher extinct apes, whose teeth have been found, but of whose skulls we know nothing. But it is really of less than usual importance that such a form should be discovered (though I have no doubt it will be; for we have so often bridged wider gaps than that between homo and simia that the evidence may be regarded as sufficient. All that is necessary is to change the direction of the tendon which supports the first toe of the posterior foot, so that it shall become straight and not divergent from the other toes: to reduce a little the size of the canine teeth, and the space in front of the inferior canine, and the change from genus to genus is complete. The approximations already known render it probable that the change has already occurred.

The speaker here illustrated by a table upon the blackboard the characters which distinguish certain families of geological mammalia, together with the character and period of their changes. The changes were seen first in the limbs and feet, second in the teeth, third in the hair. The formations mentioned were all tertiary. The table showed that during this period the hoofed mammalia underwent general modifications of structure in many ways. The toes became less numerous and the feet larger; the ankle and wrist joints became more perfect; the teeth passed through a great number of stages from simple to complex, and the brain increased greatly in size and complexity. An examination of these changes, said the speaker, demonstrated that they were all of the nature of mechanical improvements for the accomplishment of work. Many evolutionists are content to leave the question at this point—the survival of the fittest. But this is not enough.

The Darwinians proper, he continued, have been willing to treat the variation of form, as a matter of course, and as taking place in all directions and ways. They have openly or tacitly avowed a doctrine of omnifarious variation. This mode of stating the case has met with adverse criticism within and without the ranks of the evolutionists. It is contrary to the so-called law of chances that such omnifarious variation should produce the exact adaptations so wonderfully displayed on every hand; and palœontology distinctly negatives any supposition. Evolution had proceeded along lines of profitable variation; it is even probable that most variations have been profitable in some direction, and that the extinction of so many of the lines has been due to the fact that they have not been permanently, but only temporarily beneficial. In a word, "the origin of the fittest" has been adaptive in its direction, and for this there is only one explanation—*i. e.*, the action of mind. And it is altogether probable that this mind is to be found in the animal itself, and has acted as the director of its movements. If the movements have produced the structures under the influence of impacts, strains, etc., as I believe to be the case, and expect to see proved, the relation of mind to the development of types becomes clear, and explains the origin of the fittest.

On Saturday the 18th an excursion to Lake Minnetonka was tendered by the local committee, and about three hundred of the members availed themselves of the opportunity to visit this most lovely of western resorts. On arriving at Lake Park Hotel an excellent dinner was served, after which the whole party was taken upon the magnificent steamer, City of St. Louis, for an excursion of some thirty miles around the lake and among the islands, bays, straits, etc. This excursion will long be remembered as one of the pleasant features of the Minneapolis meeting.

On Monday afternoon, August 20th, another excursion was tendered; this time to St. Paul *via* Minnehaha Falls and Ft. Snelling. This also was highly enjoyable and terminated in a formal reception by the municipal officers and citizens of St. Paul and a grand dinner at the Metropolitan and Merchants' Hotels.

On Wednesday, the 22d, the Association adjourned. The next meeting will be held in Philadelphia, and the British Association, which meets in Montreal at the same time, will join it. Over $100,000 has already been subscribed in Philadelphia to meet expenses.

The following are the officers for 1884: President, Prof. J. P. Leslie, of Philadelphia; General Secretary, Dr. Alfred Springer, of Cincinnati; Assistant Secretary, E. S. Holden, Madison, Wis.; Treasurer, Wm. Lilly, Mauch Chunck, Pa.; Permanent Secretary, Prof. F. W. Putnam.

ASTRONOMY.

ASTRONOMICAL NOTES FOR SEPTEMBER, 1883.

W. W. ALEXANDER, KANSAS CITY, MO.

The Sun's apparent right ascension will increase only one hour and forty-five minutes during this month; this is a very small amount, the average being two hours. Its diameter is also increasing; on the 1st it is 31′ 46″ and on the 30th 16″ more. Equation of time, or the angular distance between the true and equatorial fictitious Sun, usually called the "mean Sun," will be on the 1st 6.86 sec., on the 30th 10 min. 01.1 sec. The sidereal time of Kansas City mean noon on the 1st will be 10 h. 42 min. 15.8 sec., on the 15th 11 h. 37 min. 27.6 sec., and on the 30th 12 h. 36 min. 35.9 sec.; daily change from noon to noon 3 min. 56.556 sec.

MERCURY.—The most favorable time to see this planet will be on the 10th, at this time it will attain its greatest elongation east of the Sun and will be visible in the evening for one hour and thirty minutes after sunset. It will set about 6° south of west, at the time of its elongation. The difficulties in the way of seeing this planet are numerous; but few persons have ever seen it. The amount of light we receive at its maximum brilliancy equals that of a first magnitude star, but being always seen when near the horizon, it does not appear brighter than one of the second magnitude. During this month its south declination is rapidly increasing, also the apparent diameter. On the 24th it is moving in a direct line toward the earth.

VENUS.—This planet cannot be seen this month except by the aid of a good telescope. On the 20th at 5 o'clock P. M., she is in superior conjunction with the Sun and will pass very close to his northern limb; were it possible to measure the distance it would equal two-thirds of the apparent diameter of our Moon.

MARS.—This will be in right ascension 6 h. 23 min. to 7 h. 37 min., and will rise, in the morning about 1 o'clock, at a point 23° north of east. Its diameter is 6.2″ on the 1st and slowly increases. On the morning of the 20th it is in conjunction with Delta Geminorum and will pass 49′ north of the star. The Moon also pays him a visit on the 24th. He is too far from the earth for telescopic study; with the best instruments his satellites cannot be seen.

JUPITER.—The giant planet of our system is rapidly gaining a conspicuous position as morning star, rising about four hours before the Sun. On the 1st it is in the western edge of the constellation Cancer and will remain in this constellation during the entire month. Its apparent right ascension is 7 h. 50 min. to 8 h. 11 min., declination north 21° and slowly decreasing. This massive planet is about 13,000 times larger than the earth. His mean distance from the Sun is 480,000,000 of miles; length of his year, or time of revolution round the Sun, is fifty days less than twelve years. It can be easily recognized by his brilliant white light, with which he outshines every other planet or star in the eastern sky, except the Sun and Moon. There is no other object in our system that has been the subject of more careful examination than this same planet. There are no really permanent markings on his disk, therefore a map of Jupiter is impossible; but his surface always presents a very diversified appearance. The first telescopic observers described light and dark belts as extending across it; until quite recently, it has been customary to describe these belts as two in number, one north of the Equator, and one south of it; usually they are seen as dark bands on the bright disk of the planet. Huyghens represents them as brighter than the rest of the disk. As telescopic power increased, it was found that the so-called bands were of a far more complex structure than supposed, and presented more of a cloud-like form; these forms change so rapidly that the face of the planet hardly ever presents the same appearance on two successive nights. In addition to the ever-changing features of the disk, it is also attended by four moons, which as they course round the planet in their orbits, lend additional interest to the picturesque phenomena presented by this miniature representative of our system. As the plane of the orbits of the moons lie in the same direction with the Equator, they must, at every round they make in their orbits, get eclipsed by entering the shadow of Jupiter, occultated by passing behind the planet and appear as light and dark spots on its face when they are between the Earth and its disk, also the Sun when they make eclipses the same as our Moon does on the Earth. The most interesting days to watch the satellites will be the 3d, 10th, 11th, 15th, 19th and 27th.

SATURN.—On the 1st Saturn is in right ascension 4 h. 33 min., and only increases two minutes during the month. It will rise about 10 o'clock in the evening and after that time will be visible all night. The apparent diameter is increasing. The southern surface of its rings has opened out full to the view, the Earth having nearly attained its greatest elevation above the ring plane—25° 24′. This is the sixth planet, in order of distance, from the Sun, and the most remarkable; it is next in order to Jupiter and most remote from the Earth of any that are visible to the naked eye. It may easily be distinguished from the fixed stars by its pale, feeble and steady light. Situated 890,000,000 of miles from the Sun, it revolves round it in twenty-nine years one hundred and sixty-seven days, therefore its apparent motion among the stars is quite slow, being only 12° a year. Saturn, besides being attended by eight moons, is surrounded by two large co-eccentric rings which are separated from each other and also from the planet. The matter of which these rings are composed is, in all probability, fluid or even gaseous, and they are observed to cast a strong shadow upon the planet itself. Saturn is about 1,000 times larger than the Earth. The axis is inclined to that of its orbit 28°, and as the rings are in the plane of the Equator, the axis of the rings has the same inclination, hence they must present to the inhabitants of the planet a most magnificent spectacle. They appear like vast arches or semicircles of light, extending from the eastern to the western horizon. At the Equator the outer ring is not visible, being hidden from view by the inner ring; but in about 45° of latitude, both can be seen and present a magnificent appearance. During the day-time, they appear dim like a white cloud, but as the Sun goes down their brightness increases, while the shadow of the planet is seen to come up on the eastern limb of the ring and gradually rise to the zenith, when it passes down and disappears in the western horizon at the rising of the Sun. The rays of the Sun always fall obliquely upon the rings, as the Sun is never seen more than 30° above their horizon, while at other times their edge only is presented to the Sun. These rings appear rough and of unequal thickness and width, and it has been demonstrated that they could not maintain their stability of rotation if they were in all parts of equal thickness and density, as the smallest disturbance would destroy their equilibrium, which would continue to increase until at last they would be precipitated upon the planet. This planet has also eight moons, or satellites, but they are only seen with a very good telescope. Their orbits, with the exception of the seventh, are nearly in the plane of the rings.

URANUS—Will be in conjunction with the Sun on the 16th, hence it is impossible to see it this month.

NEPTUNE.—Planet Neptune is in right ascension 3 h. 16 min. on the 1st, and 1 min. less on the last of the month. About noon on the 20th it will be occultated by the Moon. It is not visible to the naked eye.

THE MOON.—On the evening of the 3d, the Moon will be seen 5° south of west for about one hour after sunset. On the 4th at 7 P. M. it will occultate 58

Virginis, a star of the sixth magnitude. On the 6th, Alpha 1 and Alpha 2, Librae, the first a star of the sixth, and the second, a star of the second magnitude; both stars will disappear behind the Moon before it is dark enough to see them; their reappearance can be seen 6 h. 32 min. and 6 h. 57 min. P. M. On the 13th a star of fourth magnitude, in the constellation Aquarii, is occultated at 11 h. 13 min. P. M. On the 16th, two stars 21 and 25 Piscium, both of the sixth magnitude; on the 17th, E Piscium of the fourth magnitude; on the 18th, 54 Ceti and B A. C. 609, both of the sixth magnitude; on the 19th, Gama Arietis, fifth magnitude; on the 21st, B. A. C. 1468 and 2 Tauri, sixth magnitude; on the 25th A. 1 and A. 2 Cancri, both of the sixth magnitude; on the 26th, W. Leonis, fifth magnitude. All of the above accultations are visible at Kansas City, besides these it will make ninety-one occultations visible in different parts of the earth. It will also pass Saturn on the 21st, Mars on the 24th, Jupiter on the 25th, Uranus on the 29th and Venus on 30th.

SUN AND PLANETS FOR SEPTEMBER, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's increase of right ascension, caused by the Earth's motion around the Sun, brings it to R. A. 10h. 42m. on September 1st, and 12h. 26m. on the 30th. The show of solar spots thus far (11th) has been very small compared with last month. But two or three good sized spots and considerable faculæ near the east edge, I think indicate an increase spot-producing activity.

Mercury is evening star this month. It arrives at greatest eastern elongation on the 10th. For a few evenings before and after this date Mercury may be seen with naked eye a little south of west in the waning twilight. Spica, the bright star in Virgo, will be a few degrees above, and southward, of the planet. Venus is near the Sun—coming to superior conjunction the 20th; after which it will be an evening star.

Mars is among the prominent stars in central Gemini—southerly from Castor and Pollux toward Procyon. Jupiter is morning star and very prominent considerably north of east. It rises about 2 A. M. on the 1st, and soon after midnight on the 30th. Its moons may be seen easily with a spy-glass one and a half inch diameter. Saturn is high up in the morning sky; souths a little before 6 A. M. on the 1st, and about 4 A. M. on the 30th. It is about 5° nearly north of Aldebaran, and changes place among the stars but *very little* during the month. Uranus will be in conjunction with the Sun on the 16th. Neptune is in a blank region in Taurus nearly 10° southwest of the Pleiades.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	July 20th to 30th.	Aug. 1st to 10th.	Aug. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	..	..	..	..
Max	..	..	..	..
Min. and Max	..	..	..	..
Range	..	..	..	..
TRI-DAILY OBSERVATIONS.				
7 a. m.	71 3	66.2	69.3	68.9
2 p. m.	83.5	81.2	88.0	84.2
9 p. m.	72.0	67.0	72.5	70.5
Mean	74.7	70.3	75.5	73.5
RELATIVE HUMIDITY.				
7 a. m.	.89	.90	.90	.90
2 p. m.	.68	.60	.59	.62
9 p. m.	.84	.88	.87	.86
Mean	.80	.79	.79	.79
PRESSURE AS OBSERVED.				
7 a. m.	29.095	29.175	29.075	29.115
2 p. m.	29.084	29.180	29.055	29.106
9 p. m.	29.085	29.160	29.060	29.102
Mean	29 088	29 171	29.065	29.108
MILES PER HOUR OF WIND.				
7 a. m.	9.5	4.2	6.3	6.7
2 p. m.	12.8	8.3	8.8	9.9
9 p. m.	7.1	4.3	5.7	5 7
Total miles.	2863	1282	1515	5660
CLOUDING BY TENTHS.				
7 a. m.	4 8	6.3	4.2	5.1
2 p. m.	5.2	5.7	4.0	4.9
9 p. m.	4.8	2.8	5.0	4.2
RAIN.				
Inches.	2.87	.97	3.20	7.04

There was a heavy wind the night of the 19th, 0:35 A. M., the wind reaching the velocity of 70 miles per hour.

The prevailing winds have been southwest, and have traveled a comparatively small number of miles.

Highest barometric pressure was July 28th, 29.310, reduced 30.245 inches; the lowest barometric pressure was on August 19th, 28.92, reduced 29.817 inches.

Highest temperature 95° on July 23d; the lowest temperature 57° on August 20th.

BOOK NOTICES.

A Visit to Ceylon: By Ernst Haeckel, translated by Clara Bell; 12mo. pp. 337. S. E. Cassino & Co., Boston, 1883. For sale by M. H. Dickinson & Co. $2.50.

To those persons who have only heard of Professor Haeckel as a biologist and an anthropologist, or as an evolutionist of the most pronounced type, or as a writer of huge volumes on microscopic objects, this book will prove a great surprise. It is written in an easy, sprightly manner, bordering upon the enthusiastic and contains little more of technical matter than if written by De Amicis or any other book-maker. At the same time his observations are fresh, critical, and accurate. Evidently he expected to achieve important results from his explorations in the tropical seas and forests of India for he took with him no less than sixteen trunks and cases of luggage. "Two of these were filled with books—none but the most necessary scientific works; two others contained a microscope and instruments for observations in physics and the study of anatomy. In two other cases I had apparatus for collecting materials and for preserving specimens; soldered tins, containing different kinds of spirit and other antiseptic fluids, carbolic acid, arsenic and the like. Then two cases contained nothing but glass vials—of these I had some thousands—and two more were packed with nets and appliances of every kind for snaring and catching the prey; trawls and dredging-nets for raking the bottom of the sea, sweeping and landing-nets for skimming the surface. A photographic apparatus had a chest to itself, and one was filled with materials for oil and water-color painting, drawing and writing. Another was packed with a nest of forty tin cases, one inside of another. Then another contained ammunition for my double-barreled gun—a thousand cartridges with different sizes of shot. Finally, in two tin trunks I had clothes and linen to last me during my six months' wanderings."

This gives an idea of what preparation is made nowadays for a scientific excursion of six months by a single observer. It does not appear, however, that his explorations were rewarded by any very remarkable discoveries. The field had been pretty fully explored by Hooker and Wallace in the Eastern Hemisphere and by Darwin and Humboldt in the Western, years before. However, his descriptions of places visited are admirably done and no more attractive work has been put forth. To Bombay alone thirty one pages are devoted, while to Columbo, "Whist Bungalo," Kaduwella, Peradenia, etc., are given from ten to twenty each. No place is slighted and all are faithfully portrayed. The scientific spirit peeps out in all directions, botany, zoölogy, chemistry, anatomy, meteorology, all appear by turns, not technically, however, but naturally, as the necessary concomitants of a scholar's observation, *en passant*. Not a trace of the dogmatism which appertains to Haeckel's character as an upholder of his biological theories appear anywhere in the volume, and we can recommend it to any reader who desires simply facts set forth in a glowing and attractive style.

The details of printing, binding, etc., have been carefully attended to by the publishers with the result of producing a very handsome book.

RECOLLECTIONS OF MY YOUTH: By Ernest Renan; translated by C. B. Pitman. 12mo. pp. 355. G. P. Putnam's Sons, 1883. For sale by M. H. Dickinson, $1.00.

This is another book on common things by a distinguished author whose name is usually connected with philosophical and religious subjects. It is intended somewhat as a memoir of M. Renan's earlier life, though by no means as an autobiography. At the same time it is made a convenient and, perhaps rather unofficial, means of expressing certain opinions and shades of thought not conveyed in his more pretentious works. It may also be regarded as an index or indicator of his mental growth and development under different environments.

The titles of the chapters are as follows: The Flax-Crusher, Prayer on the Acropolis, St. Renan, My Uncle Pierre, Good Master Systeme, Little Noemi, The Petty Seminary of St. Nicholas Du Chardonnet, The Issy Seminary, The St. Sulpice Seminary, First Steps outside St. Sulpice, Appendix.

OTHER PUBLICATIONS RECEIVED.

Work of the U. S. Signal Service. Report of Mr. W. M. Beebe, Relief Expedition to Lady Franklin Bay, Grinnell Land. Lieutenant Joseph S. Powell. Relief Expedition to Point Barrow, Alaska. Lieutenant O. Henry Ray, Work at Point Barrow, Alaska, from September 16, 1881, to August 25, 1882. Miscellaneous Papers on Anthropology, prepared under direction of Prof. Otis T. Mason, from Smithsonian Report of 1881. Norman Constables in America, by Herbert B. Adams, Ph. D., June, 1883. Paper read before Loyal Legion on Gen'l Wm. Haines Lytle, by Dr. And. C. Kemper, June 16, 1883. The Pulpit —The Treasury, J. Sanderson, D. D. Observations on Rocky Mountain Locust and Chinch Bug, 1883, Prof. C. V. Riley. Inaugural Address of President C. O. Thompson, delivered at opening of Rose Polytechnic Institute, March 7, 1880. Special Report on Industrial Education, prepared by the U. S. Bureau of Education, 1883. Four Years Term in Rotation in Office, by Frederic W. Whitridge, June, 1883. Gunnison, Colorado's Bonanza County, by John K. Hallowell, 1883. *The Western Jurist*, a monthly Law Magazine, June, 1883. Crop Report of Kansas State Board of Agriculture, June 30, 1883. Proceedings Boston Society of Natural Science, 1882. Bulletin of Torrey's Botanical Club,

1883. Seventh Annual Report of Railroad Commissioners for State of Missouri, 1881 and Bulletin of Geographical Society, 1882. Notes on Literature of Explosives by Prof. Chas. E. Monroe, U. S. N. A., 1883. Proceedings Royal Geographical Society, 1883. Scholar and Man, by M. F. Force, address before Literary Societies of Marietta College. Catalogue of Missouri State University, 1882–3. *Psyche*—Entomological Society—1883. Fuel for the Army, 1882, Gen'l M. C. Meigs. Notes on Value of Carbo-Hydrates as Food and Physiology of Starch-Digestion, address by Lloyd Tevis, of California, 1881. A History of the People of the U. S., by John B. McMaster. *Railway Review*, June 30, 1883. Tours in England, Ireland and Scotland, Where to Go and What to See in the British Isles. Fourth Report of Executive Committee, and Second Report of Committee on American School of Classical Studies, at Athens, 1883. Ninety-Fifth Anniversary of Settlement at Marietta, Ohio, address by Hon. Geo. B. Loring, 1883. Bureau of Education Circular on Co-Education of Sexes in Public Schools of U. S., 1883. Kansas—The Golden Belt Lands, 1883, B. Mac Allister. Political Economy, a Science Based on Assumptions, by William D. Kelly, 1882. How Protection Affects the Farmer, by Thomas D. Hudley, 1882. *Magazine of American History*, edited by Mrs. M. J. Lamb, 1883. Proceedings of Fifth Grand Annual Communication of Grand Lodge of New Mexico, 1882. *Christian Quarterly Review*, edited by E. W. Herndon, A. M., M. D., 1883. Bulletin Philosophical Society of Washington, Containing Minutes from 203 to 226 Meeting, 1883. Catalogue of Marietta College, 1835 to 1882, and Annual Catalogue 1882–3. Alumni Memorial of Marietta College. Memorial of John Cotton, Caleb Emerson, John Mills, A. T. Nye, Wm. R. Putnam, Samuel Shipman, B. B. Gaylord, E. B. Andrews, B. D. Fearing, D. W. Washburn. Report on Agricultural College Lands Lately Sold, by G. C. Swallow, LL.D., 1880–1. The Hog, address before American Agricultural Association at Chicago, 1882, by F. D. Coburn. Footprints of British Lion, 1882.

SCIENTIFIC MISCELLANY.

SCIENTIFIC NOTES.

S. A. MAXWELL.

I. On May 5, 1880, Mrs. F. M. Harrison, of Union Grove, Whiteside Co., Illinois, found a specimen of smooth lung-wort, *Mertensia Virginica*, the corolla of which was of pure white. In all other respects the plant was just like the one improperly called the "blue-bell," except that the leaves and stem seemed to be a little lighter colored. It was probably a freak of nature—an albino of its species.

II. On a certain occasion, having successfully performed the well-known experiment of producing jets of flame in the bottom of a tube of water containing bits of phosphorus and potash chlorate, I concluded out of curiosity to add to the mixture a few scales of iodine. Having done this I placed the tube over the spirit lamp, when there occurred quite a violent explosion—a part of the water in the tube being thrown out, and at the bottom of the tube there remained a spongy mass, brown in color, and several times greater in bulk than the aggregate of the three solids originally put into the tube. The query is: what was the chemical reaction in this experiment? And again, since iodine and phosphorus readily burn in air if in contact, did the presence of a small quantity of sulphuric acid help to produce the result?

I would like very much to have answers to these queries through the REVIEW or otherwise.

III. A barometer, much more reliable than the "storm-glass" which has had such extensive sale during the past few years, may be made as follows: Let one end of a glass tube, one half inch in diameter and about twenty-eight inches long, be corked air-tight, then fill the tube about four-fifths full of water, insert the open end in a large mouthed bottle or a glass fruit-jar. On a piece of paper mark a scale in inches and tenths and attach it to the outside of the tube, having the middle of the scale even with the top of the water in the tube. The scale need not be over four inches in length as that will more than cover the rise and fall that will be observed. The instrument is now complete, but correction for temperature must be made for each observation, as the height of the column of water varies much more from changes in temperature than from atmospheric pressure. With the instrument which I have constructed on this plan the depression of the column for each degree of increase of temperature is .036 inches. Let the following, taken from two observations on the 20th of last July, serve to show correction for temperature:

Thermometer 2 P. M.	78°
Thermometer 9 P. M.	72°
Water Barometer 2 P. M	12.45 inches.
Water Barometer 9 P. M	12.55 inches.

$78°-72°=6°$. $.036\times6=.216$, say .22.
$12.45+.22=12.67$. $12.67-12.55=.12$.

It may be understood from this that had there been no change in the atmospheric pressure the barometer reading for the latter observation would have been 12.67, but since it stood 12.55 it indicated a depression of .12 inches on the column of water.

Having compared the workings of this simple instrument with a number of standard ones, I am satisfied that it is worth the trouble of construction. The material would cost but twenty-five cents, and the making would require less than as many minutes. The tube should pass through the cork but of course the bottle should not be corked air-tight. After the water has remained in the bottle several days it may be changed without removing the tube, by turning several pints of water into or upon the bottle so as to cause an overflow of most of that first contained. Repeating this operation weekly will keep the water quite pure. The more nearly filled the tube is with water the less will be the variation due to temperature, for it is mainly the expansion of the air in the upper part of the tube that depresses the column of water beneath. The change due to atmospheric pressure is also more marked when the tube is nearly full, since the length of the water-column is increased.

Captain Geo. H. Fay, of Morrison, Ill., uses one of these instruments, and by having the tube very nearly filled with water thereby dispenses with the trouble of making corrections for temperature.

Morrison, Ill., July 21, 1883.

PROFESSOR ESPY.

Few are aware of the origin of the present efficient Signal Service, nor of the debt of gratitude the whole country owes to the late Prof. James P. Espy. His rise to prominence in the scientific world, as related by Capt. Samuel Erseyis, of Philadelphia, who was one of his earliest friends, is one of remarkable interest.

When about ten years of age, Espy's father died, and mother and son tramped from their home near Harrisburg out to Ohio. The boy was put at farm labor, at which he served until seventeen years of age, for the meager pay of fifty bushels of corn a year. A signal incident marks the commencement of his career. Henry Clay was just then rising to fame, and young Espy found himself one afternoon within sound of the silvery voice which was yet to captivate its tens of thousands.

Espy was entranced by its witchery and followed the American Cicero as a needle the lodestone. He got near enough to Mr. Clay to have some one mortify him by pointing him out with, "Here, Mr. Clay, here's one of your admirers He's seventeen years of age, and can't read." Mr. Clay laid his hand affectionately upon the lad's head and said: "Come, my lad, let us see if we can find a book store hereabout." A book store was found. Mr. Clay purchased a copy of Noah Webster's spelling book; opened the book at the alphabet, and, pointing to the first letter with a long index finger, said: "This is the letter A. Do you understand? Yes! Well, there are twenty-five more of them. You must learn the rest, and when you have learned them it will not take you long to learn to read."

Ten years after this time Espy was here in Philadelphia, engaged in teaching school. John Troutwine, well known to many citizens, was one of Espy's pupils. At that time the Franklin Istitute had a high school connected with the institution. Walter R. Johnston was the first professor; his specialty was chemistry. Espy was the second, and taught mathematics. He was hungry for knowledge, and the motto prefixed to his first work, "The Philosophy of Storms," published in 1841, indicates the man: *Felix qui potuit rerum cognoscere causas*. There was no great "Unabridged" at that time, and Espy was always unhappy until he found out the meaning of things. He therefore applied himself to the study of Greek, and soon became master of that language. Says Capt. Erseyis: "Espy could not write a ten-line advertisement in good and graceful English; but he was accustomed to note down his thoughts in Greek and afterwards would translate them into his vernacular. He corresponded with the great Arago, in Greek, as he did with other learned men in Europe."

He was also a student of nature. Long before he knew why, young Espy began to study the mystery of the slowly moving clouds as they gathered their forces together in elemental warfare; but he found he could come no nearer to a true answer to his question than did the prophet from the storm that roared around the cave in Horeb. Failure, however, did not deter him. If the storm would not call back in answer to him from the clouds, he could reach up to them by means of Franklin's messenger, the kite; and when the strongest cords were broken in his adventurous attempts, leaving only blistered and lacerated hands, he bound his emissary by means of strong wire reeled on a windlass.

Espy was a most patient collector of data, and facts were the basis and support of all his theories. He was patiently industrious in acquiring facts by observation and comparative experiment. In hundreds of fields, then vacant, now covered with houses, in and around Philadelphia, he studied the laws which govern the winds, the causes of the storms, and determined upon those artificial means by which rain may be produced. But the time was not yet ready for him. When he went to Washington, asking of Congress a paltry $5,000 a year for five years, that he might be enabled to extend his experiments and enlist the aid of others over a larger area than Philadelphia's back lots, he was met with jibes and ridicule. Senator Preston, of South Carolina, said Espy was a madman, too dangerous to be at large, and the Senator would vote a special appropriation for a prison in which to confine him. Espy was in the Senate gallery at the time. Wounded to the quick, he came down and found his way back to Philadelphia.

Gathering heart once more, he went to New York and put a small advertisement in the *Evening Post* announcing a lecture at Clinton Hall, in which he would show how rain could be produced. Espy expected to meet a crowd of 1,000 people. The audience was a Miltonic one, "fit though few," for hardly a score of persons were present. Among them were William Cullen Bryant, and, as Espy afterwards found, his life-long friend, adviser, pupil and lover, Capt. Samuel Erseyis. Espy went through his lecture; then submitted to a running fire of question, and, these answered, frankly confessed his disappointment. Clinton Hall had cost him $18. There was a hotel bill to be paid, and he had but $5 in the world with which to pay this vast and impossible sum. He had in stock five sets of lectures, price, $5 a set, that was all.

There was a pause of a moment or two after which Capt. Erseyis promptly subscribed $25 for the course, put the money into Espy's hands, and was immediately followed by Bryant and nearly all of those present, until his pockets were filled and Espy himself was as overcome as a child. Before New York would let him go he delivered nine courses of lectures; went thence to Boston, where he gave six, and then made the tour of the Union and $25,000 besides.

Soon afterwards he sailed for Europe. Not long after reaching Liverpool, January 6, 1839, a great storm occurred. He went to Lloyds, consulted the newspapers as they arrived noted the direction of the wind as given at the different places, and from these data constructed the first great storm-map ever prepared, with the hour-points marked. Every line and curve and point exemplified his theory. He was at no loss now for audiences. He appeared before the British Association of Scientists, at London, at which Sir John Herschel was present, an interested auditor. He crossed the Channel to Paris, and the Academy of Sciences appointed a committee, composed of the illustrious Arago, with whom were joined Messrs. Pouillet and Babinet, "to report upon the observations and theory of Mr. Espy, which have for their object the aerial meteors, known by the names of storms, water-spouts, and tornadoes, which occur in the vicinity of the Gulf of Mexico; storms, however, which are produced in every part of the globe when a few given conditions concur in one place."

The length of the Arago report indicates the strong hold which Espy's startling and conclusive array of facts had made upon the minds of the members of the Academy, and also evinces the care with which the committee studied the subject from its scientific standpoint. The effect of the report, when it reached Washington, was not much different from that which followed, afterwards, the announcement of Morse's first transmitted message over the wire from Washington to Baltimore.

In due time Prof. Espy returned to the capital of his own country, and one of the first public men he encountered was Senator Preston. They met on Pennsylvania Avenue. Towards the conclusion of their report, M. Arago's committee had expressed the hope that the Government of the United States would place Mr. Espy in a position to continue his important investigations and complete his remarkable theory by means of all the observations and all the experiments which even the deductions of this theory may suggest in a vast country, the home, as it were, of the aerial meteors, storms, water-spouts and tornadoes. Senator Preston was prompt to apologize for she mistake he had made when his language drove Espy from the Senate gallery, and he was as profuse in his promise to help the storm-king onward in the spirit of the French report. It is a matter of history that he did so; that Espy got his $25,000, and that to him we owe the first step in the formation of the present Signal Service.—*Philadelphia Press.*

BOTTLED SUNSHINE.

T. BERRY SMITH.

The coal we burn, formed in the ages distant,
Is bottled sunshine, and to prove it so,
We'll hire Fancy and with her as assistant
Back up the geologic stream we'll row.

That creature there amid the dark old forest,
Nipping the twigs and breaking down the trees
Is nothing but a huge old Deinosaurus
Feeding himself and doing as he please.

Along yon beach you see a creature striding,
Leaving his tracks three feet apart or more—
Well, that's a bird: (we follow Marsh deciding),
Lestornis counts his dentals by the score.

Still on we go, the vista ever changing;
Lo! Pterodactyls wing their heavy flight,
While all around us in the waters ranging
The Ichthyosaurs the Plesiosaurians bite.

And now we've passed the wondrous line dividing
The Mesozoic from the Palæozoic time—
Have come to where Amphibians huge are sliding,
And crawling round in marshes full of grime.

And now, my friend, we cannot go much longer:
Carbonic acid gas so fills the air,
It chokes a man; the sun's heat too is stronger;
Aquatic life alone is everywhere.

Plants Cryptogamic flourish all around us—
Unnumbered fronds of Arboraceous ferns,
And Lycopods whose hugeness does astound us—
Catching the sunshine which so fiercely burns.

These plants receive the sunshine like an awning
And drink it in with much carbonic gas,
And then store up——— Aha! the truth is dawning,
And I can see you're "catching" on at last.

And so 'tis true that coal is sunshine bottled
    And stored away the earth's old crust below;
Man burns the coal—the sunshine is unthrottled
    And fills the world with all its ancient glow.

GLASGOW, MO.

THE WORK OF THE KANSAS FISH COMMISSION.

W. S. GILE.

VENANGO, KAS., July, 30, 1883.

For the information of your readers in reply to queries as to what my department is doing, I will say that since assuming the office of State Fish Commissioner, last spring, I have planted 30,000 speckled trout in spring creeks that have gravelly beds and an uniform flow of water, and where I have substantial reasons for believing that the temperature of the water will not rise above 55° F. I have also planted at Junction City in the Smoky Hill River 350,000 shad, received from Prof. Baird of the U. S. Fish Commission. My other work has been in making examination of the streams of the State for a two-fold purpose—first, to determine from a personal examination what varieties I had better select in order to have them adapted to the stream and climate; secondly, to see what obstructions had been placed in them that would prevent the passage of fish. These objects I have accomplished. Owners of dams have promised me that during the season they will construct fish-ways, and I have given them assurance that on this promise I will stock the streams with such food-fish as I believe will stay, and if the people will not destroy them it will only be a few years before the streams of the State will be *alive* with black bass, crappie, channel catfish, pike and wall-eyed pike.

As soon as the Mississippi is low enough I shall commence the catch. My arrangements for boats, cages, tanks, seins, nets, and all the apparatus necessary to work the whole matter fully and thoroughly are made, and nothing will defeat them but the elements. I may add one or two other varieties to the list. In this, however, I shall be governed by my judgment after we commence the catch. When the river gets low enough at Quincy to begin the catch, I shall want from among your fishermen who are used to caring for live fish two or three *good, trusty* men to act as messengers and take care of the fish while in transit, and plant them in accordance with my *written directions.* I shall probably begin the distribution of carp in October, and deliver from Kansas City.—*Live Stock Indicator.*

SPIRITUS MUNDI.

E. R. KNOWLES.

Stat Ætherium infinitum
Tempore et spatio,
Et æterno per naturam
Mundi instiratio.

Totum in uno alligantem,
Vim invictam mysticam,
Et materiam regentem,
Sentimus perpetuam,

MONEY: ITS ORIGIN AND HISTORY.

H. A. HAGEN.

All nations, on emerging from a state of barbarism, have adopted, without any mutual agreement, the precious metals, gold and silver, as a medium of exchange and standard of value. Certain pieces or coins, the definite fineness and weight of which are denoted by a familiar stamp, thereby became money. As a fixed measure of exchangeable value lies beyond the bounds of possibility, so that of the precious metals is subjected to variation. To ascertain the proportion in which the exchangeable value of money may have been altered is an inquiry of very difficult nature, demanding great sagacity, diligence and information.

The changes of the value of gold and silver during five centuries from 1320 to 1820 are the subject of the memoirs of two students of the late Prof. Carl Hagen. Both memoirs are still unpublished. As I am not able to find investigations of a similar extent, I have used the results. A large number of other details is taken from papers of my father.

Two capitals of exactly the same amount—one in gold, the other in silver—are supposed to have been invested in 1400. The change of the value of the capitals was as follows: During the fifteenth century the gold rose at first quicker, later the silver followed, so that after seventy-five years both capitals had again an equal value. But against 100 per cent in 1400 they represented 166 per cent in 1475. Both rose farther, and the capital in gold reached the highest point ever seen, viz: 175 per cent, shortly before the end of the century.

During the sixteenth century, in consequence of precious metals imported to Europe after the discovery of America, the gold and the silver—the latter had reached its highest points in 1510 with 215 per cent—were declining in such a measure that both capitals in 1548 were again of equal value, but both only worth 85 per cent of their value in 1400. From this time, and during the seventeenth century, gold and silver were both declining at a nearly equal rate, the silver somewhat faster. Both reached in 1660, in the same year, what is very remarkably the lowest point. The capital in gold had then only 44 per cent, the capital in silver 37 per cent of its original value.

During the eighteenth century both rose again slowly, and were again of equal value in 1750. Again declining, they reached the formerly quoted lowest point in the beginning of the nineteenth century.

During those 400 years both metals rose and fell about in the same proportion, except after the discovery of America. During those 400 years the value of gold was changed to four times less and of silver to six times less than at the time of their value in 1500. The remarkable fact that both capitals were only once in each century of equal value is the best proof against the admissibility of bi-metalism.

The continuous rise of the value of gold and silver during the fifteenth century was apparently not the consequence of a declining production of the mines in Europe and Asia—which certainly is nowhere proved by facts—but only the consequence of the progress of trade and manufacture and the accumulation of wealth of the nations. There were relatively few wars during this time, and the advancing abolition of old feudal prerogatives kept pace with the consolidation of more natural and healthier forms of government. Agriculture, industry and trade were flourishing, and the increasing wealth was followed by a larger demand for costly ornaments and vessels of precious metals.

The news of immense treasures of gold brought over to Europe by the Spaniards from the newly discovered America checked suddenly the advance of the value of gold to a remarkable degree. The news spread through the world in the quickest possible manner, and was of course largely exaggerated. According to Humboldt's statement, the gold imported from America from 1494 to 1540 did not exceed $25,000,000, or only about $500,000 for every year.

Therefore the supposition of the inexhaustible wealth of America caused the sinking of its value rather than the really imported amount of gold. The subsequent religious troubles, the change of the old tradeway to India by the discovery of a more convenient one around the Cape of Good Hope, and the unsafe condition of the governments combined, together with disastrous wars, made the nations at first less rich, later poorer, and diminished the demand for the precious metals. The value of gold, which was twelve and a third times higher than that of silver in 1400, declined directly after the discovery of America to ten times, and in the beginning of the sixteenth century to less than eight times. When the Spaniards found no more gold to appropriate in America, silver was brought over, and the discovery of the rich Mexican mines was sufficient to bring down also the silver value, and to enable in this manner the precious metals to reach again the same standard of value. The amount of silver imported from America has been as much exaggerated as formerly that of gold. The silver imported did not exceed for twenty years about $12,000,000. Therefore the unexampled decline of silver—a rent worth $1,000 in 1500, was worth only $305 in 1568—could not have been alone the consequence of the increased amount of silver, but probably more the diminished demand. The heretofore flourishing trade of Venice and of the Hansa was rapidly declining.

The growing disturbances culminated in long and disastrous wars and destroyed the former wealth of the nations.

At the end of the seventeenth century the returns of the rich mines in Brazil began to come to Europe. Humboldt has calculated that all the silver brought from America to Europe during the 300 years followed its discovery, joined together, would form a solid ball of sixty-three feet in diameter, and would represent together with the gold somewhat more than $2,133,000,000.

By degrees the mines of the old world gave also more important returns. Konigsberg, in Norway, which was believed to be exhausted, and was very near being sold for a small sum, produced large amounts of silver, among them nuggets of pure silver of 560 ounces weight, and continued to be productive. I can not omit to state here that the shores of New England are very similar to those of Sweden and Norway. Going from Boston to Salem you are reminded strongly of the shore of North Sweden, and the shores of Maine remind you also of those of Norway and its fiords. The rocks are similar, and the presumption of similar veins of pure silver, just as in Konigsberg, at a depth of 1,200 feet, is by no means improbable.

The mines in Russia, in the Ural and in Siberia, did not return much gold to 1814. In that year large quantities of gold were discovereed in the alluvium, similar to the formation in California, and in the Ural; in 1839 in the Kolywan district, and in 1836 near the Lake Baikal. Those layers produced, in twenty-nine years ending with 1847, more than $160,000,000.

It was to be supposed, after the precedent in the sixteenth century, that so sudden and large an increase of the amount of gold should be followed by a sudden decline of its value and in its relation to silver. Neither advanced; on the contrary, the proportion of gold to silver rose from 15.2 to 15.6 in 1823. The suggestion that this may have been the consequence of the decline of silver is refuted by the price of grain varying during this time only a very small fraction of a mark. The discovery of gold in California and silver in Nevada, and the immense return of all mines in the United States, are so well known that it would be bringing coals to Newcastle to speak about them here.

I may only remark that the first quotation of the gold returns to Congress, to July, 1849, amounted to $5,500,000, which is only one-third of the amount produced in Russia in 1847. The fact that gold had not declined in consequence of this immense production justified the presumption that even the new discovery would not seriously affect its value. Before the discovery of California Humboldt had stated that all known mines produced, of precious metals, every year, about $67,000,000. According to the last United States census, now $182,000,000 are produced. I may add only, that the statement of the Director of th

United States Mint gives the total yield to the close of June 30, 1882, of all mines of the different States and Territories as 1,109,000,000 of gold, the half of it from California, and 197,000,000 silver, one-half of it from Nevada.
from Nevada.

The production of the year 1880 represents five ordinary car-loads of gold, and a train of 109 freight cars of the usual capacity to transport the silver would be needed.

The question, How much of the precious metals is now in existence? has been answered by various quotations, without warranted proofs. They may be right or not.

Much more confidence is to be given to the statement that on November 6, 1882, the banks of England, France, Germany, and the United States Treasury alone contained $487,000,000 in gold; and it is obvious that this enormous amount is only a fraction—probably a large one—of the gold actually possessed by all the banks of the world. To this we have to add the enormous amount in circulation, and all the silver. But this is by no means all. In a large part of the world, small capitals earned by farmers, workmen and citizens are laid aside for emergency, often hidden somewhere, and represent by their number, doubtless an enormous large sum of money; the more so as it is the custom to keep such small capitals in specie. It probably will not happen again, as Archenholz tells us in his description of England in the last century, that a farmer presented to the Bank of England a £10,000 note, asking for an advance on it. Refusing to have the note paid, and when asked why he refused it, he answered candidly that he possessed for years this and a twin note of the same amount, and that he did not like to part with them.

The unexpected quick payment of the enormous war indemnity by France to Germany has generally been explained by the unusually large number of small capitals which were freely offered by the patriotic and noble feeling of the inhabitants. The amount of gold and silver contained in objects of luxury is commonly much exaggerated. During the French revolution, when the delivery of all gold and silver was ordered, and the order rigorously executed, the whole amount proved to be surprisingly small. When, in Prussia, during the Napoleonic wars in 1809, a tax was laid upon all precious metals in private possession, the whole amount did not reach $100,000. This statement is far more interesting, as everybody was so eager to help the country that a new order had to be issued, stating that it had not been intended that overconscientious citizens should tax their family souvenirs to an unusual value. Therefore the suspicion that the small amount may have been the consequence of many hidden treasures can not be thought of. The same tax gave similar small returns in the unlucky year of 1848.

The newspaper tales of the treasures of Oriental princes contain sometimes enormous accounts of precious metals and jewelry. Perhaps it may be there similar to what happens to be in the treasury of some European princes, where the treasures are still shown to the public, but, in fact, imitations for a large part of the old real treasures. But even the highest number given to-day reach scarcely the treasure mentioned by ancient authorities. King Crœsus presented to the temple in Delphi 214 talents, nearly $2,000,000 of gold; Phidias used for the statue of Minerva in the Parthenon forty talents; and in the treasury of Ptolemaius Philadelphus was 740,000 talents of gold, about $13,000,000,000. Verres, during his short prætorship in Sicily, appropriated more than $6,000,000 of costly objects simply by what he called confiscation. About the mines of precious metals and their production before Christ, nothing is sufficiently known. But the immense amount of money coined in those times, the costly treasures and implements reported to have in existence warrant the supposition of their wealth. The first gold coins, stamped only on one side, belong to Asia Minor, and the stater from Phoxaia, with the seal, the emblem of the State, dated 600 years before Christ. It was followed by the Persian gold coins of Darius. Both seem to have been made of gold washed out of the alluvial layers of the Pactolus River. The money of Greece was originally of silver. The money of the Romans was at first copper, later silver; gold coins appear not before Sylla, Pompeius and Cæsar, mostly coined for the triumphal honors of those men. Later, in the time of the emperors, large numbers of gold coins appear.

By far the largest amount of precious metals has undoubtedly been used to coin money. The amount of coined money has always been very large, and followed, from 1400 to 1800, if graphically expressed by a curve, the standard of the value of both metals even nearer than the curve of the production of the mines. The advance of trade and industry demands always a larger amount of money. The lack of it has been many times seriously felt and complained of when the supply of money did not follow at an equal rate the advance of trade. The beginning of this century was marked by such a serious lack of coined money, probably by the development of trade and industry in England and North America. Perhaps the trade with China, which had to be paid in cash, with silver which never returned, may have had also some influence. The trade in tea and silk alone required to be paid by England and Russia with nearly $50,000,000 each year. Smaller sums of silver, also never returning, were absorbed by the trade with the interior of Africa. As the merchants there had nothing but the so-called Maria Theresa thaler, this coin—long ago out of use in Europe—is still made to-day expressly for this trade. The experiment to give at least a temporary help for the lack of money with notes or paper money prove to be a failure, even in states with such a firmly established credit as England. The bank notes lost in London itself, in 1814, about 26 per cent. Therefore, the coinage of large sums was decided upon, and in England alone, during the ten years from 1821 to 1832, £48,000,000 of sovereigns and £32,000,000 sterling of silver were coined. The same was done in Russia, and every miner was obliged to sell the whole product of precious metals to the imperial mint for a fixed price.

We do not know how much gold or silver coin is in existence. The numbers given by the mints, even for comparatively recent times, allow us by no means to conclude that an average number of the coined pieces is still in existence. As gold and silver are both merchandise, they are used as merchandise when their intrinsic value is worth more than the accepted value of the coined pieces. Therefore, the value of coined money accepted by the Government is mostly a little higher than the value of the piece of metal used and the cost of coinage, which is, indeed, nothing else than a credit asked by the Government for the additional value. Nevertheless, even this method does not prevent that, suddenly, somewhere in the world, the price of precious metals makes it profitable to melt down and sell coins in bars. From 6,500,000 of guineas coined during 1817 in England, very few are in existence, as directly after the emission, and in spite of strong laws, they were melted down and sold, because the gold in bars was worth more than in guineas. From 14,000,000 of Fredericsdor coined in Prussia from 1764 to 1837, the coinage of several years has, for the same reason, entirely disappeared, and the others were only kept in existence because the Government's treasury accepted them for five and two-thirds thalers, though they were worth only five and a third. The total coinage of the United States from 1793 to 1880 is $1,438,000,000.

The deterioration of coins in circulation is considerably larger than it is commonly supposed to be. Everybody will remember having seen the older English half-crowns, shillings and sixpence, coined from standard silver (14.8), with scarcely a trace of the stamping. A careful investigation of those pieces showed that the half-crowns had lost nearly 15 per cent, the shillings 20 per cent, and the sixpences often 45 per cent of their original value. The 50,000,000 livres coined in 24, 12 and 6 sous pieces in France from 1726 to 1794 had lost, when withdrawn, according to Say's statement, one fourth of their weight. Therefore, by friction in circulation twelve million livres' worth were lost entirely in sixty-eight years. Well alloyed coins, as the Prussian thalers, show, for pieces fifty years in circulation, an average loss of 1.1 per cent. Therefore out of one hundred and five millions supposed to be in circulation each year, the value of 21,000 has been lost in the pockets or money-bags. The loss by smaller coins is, of course, larger. The chemical examination of old money-bags used in the Government treasury was made for my father, and proved that those bags contained more silver than it had been thought before. I remember the following fact which happened to occur fifty years ago in Koenigsberg, Prussia. A part of loans contracted by the Russian Empire with Hope in Amsterdam, two millions in gold, was transported in a mail coach. The gold, wrapped in paper, having become loose, had to be unpacked in Koenigsberg. The janitor of the banker, who superintended the packing, had received the old wrappings, and by burning them a jeweler found them to contain $18 gold.

The invention of photography has consumed since 1840 an enormous amount of silver, which is lost forever, as far as contained in the pictures. The production of nitrate of silver consumes year by year a large number of coins. From the smaller Hanoverian thalers before 1840, which contain a large percentage of pure silver, it will be difficult to find a specimen. The rapid disappearance of them induced the Government to alloy the next series with iron, which is decidedly obnoxious to the photographic process, and more difficult and expensive to extract. But new chemical operations were soon equal to the emergency, and allowed some profit to the manufacturer. I am told that it is of some profit to buy old pocket-books and to extract the silver left by use on the leather lining.

The use of gold and silver for plated ware, for gold lockets, gold leaf and similar things is very large. It is difficult to get at the average loss of metal in consequence of this industry. France exported in one year about $1,000,000 of different fabrics for which gold and silver were used, and this represents probably less than one-half of this industry. If the yearly loss be accepted as 30 per cent every year about $600,000 would be lost. The United States census puts the consumption of precious metals in arts to $15,000,000 for 1880, of which $4,500,000 would be lost. Every old family knows how much lighter silver spoons, forks and similar objects grow by use, and the widely spread fashion of such objects makes it plausible that a large amount of silver is forever lost by polishing and cleaning. There are comparatively few watches without a gold or silver case, and rings and jewelry worn lose almost daily somewhat of their value. The more precious metals exist the more they are used, and the loss keeps an equal pace with their use.

Further, a very large amount of precious metals has been lost from time immemorial by ships foundered at sea, sometimes even very large in single ships, as in the so called silver fleet of the Spaniards, or in war times.

A greater amount of gold and silver in coins or ware is hidden in the ground in uncertain war times, and afterwards forgotten or not found. In Germany, the construction of roads and railways brought many such treasures to the light, which, according to the date of the coins, had been several hundred years in the ground. In Eastern Prussia alone, during the first half of this century, were found about 100 pounds of golden Arabic or Kufic coins, which must have been hidden 1,200 years or more, which proves that the tradeway in those times passed through Prussia. The well-known Hildeshelm silver found in 1867 near the battlefield of Arminius and Varus, has brought to light extremely tasteful silver vessels after twelve centuries.

Iron or earthen pots, filled with coins during the Thirty Years' War, are by no means rare. The discoveries by Schliemann in Troy and Mycenæ, and similar findings in Italy, are many centuries older. In Italy, such findings contained sometimes 30,000 coins; but, curiously enough, till now no hidden treasure is discovered which antedates the time of Sylla. More than 50,000 denares are quoted by Momsen in about a dozen different findings. The treasure hidden during the first and second century after Christ contains very large numbers of gold coins, and contrasts obviously with the small amounts during the next century. The visitor at the Copenhagen Museum will remember the heavy, solid Roman gold pieces found in the northern peat swamps.

[*To be Continued.*]

EDITORIAL NOTES.

OWING to the absence of the editor at the meeting of the American Association for the Advancement of Science, at Minneapolis, during the latter portion of August, the publication of this number of the REVIEW has been somewhat delayed. Besides this, we have only been able to give a few of the papers read at that meeting, the greater part of the issue having been in print before we left home. Those that we give are among the best, however, and others will be published hereafter.

The citizens of Minneapolis are deserving of great credit for the success of their efforts to make the meeting agreeable and profitable to the members of the Association, and this was fully appreciated by all in attendance. Such meetings are of great benefit directly and indirectly to any city where they are held. and it would be of service to Kansas City to have such an one held here. The only obstacle in the way of our holding one that would be fully as satisfactory as that at Minneapolis, is the absence of a suitable building, like the University of Minnesota, in which to hold the sessions of the various Sections, nine in number.

A REPORT entitled "The Mineral Resources of the United States" is now in press, and will shortly be published, by Mr. Albert Williams, Jr., chief of the Division of Mining Statistics and Technology, United States Geological Survey, Hon. J. W. Powell, Director. This report is for the calendar year 1882 and the first six months of 1883. It contains detailed statistics for these periods and also for preceding years, together with much technical and descriptive matter. The compilation of special statistics has been placed by Mr. Williams in the charge of leading authorities in the several branches, and the results will therefore be accepted with confidence.

NOT the least pleasant feature of the Minneapolis meeting, personally, was the expression of hearty approbation of the course and management of the REVIEW, voluntarily spoken by some of the most distinguished men present, and the surprise manifested by them that such a place as Kansas City, known to the country only as a busy commercial center, should have the taste and the disposition to support it.

WE are indebted to J. D. Carson, General Superintendent of the Union Depot of this city for a copy of an address upon "Technical Training" delivered before the Alumni Association of Lehigh University, of which Mr. Carson is a graduate.

WE have received from the Secretary a copy of the Transactions of the Kansas Academy of Science, Volume VIII, 1882–3, which will be fully noticed next month.

ALDERMAN HADLEY, of London, to whose successful efforts to establish a new American British and Canadian Cable Company we referred last month, gave a reporter of the *N. Y. World* this important item, August 1st, 1883: "We intend upon my return to England to make immediate arrangements for the full completion of the entire system, and shall proceed by laying a cable from Penzance to Sable Island, and from that point to Halifax. At the latter place we shall be connected with the entire telegraphic system of the Dominion of Canada, and by a favorable arrangement just completed with the American Postal Telegraph Company we shall have direct communication throughout the United States."

PROF. T. BERRY SMITH is again in the chair of Natural Sciences at Pritchett Institute, Glasgow, Mo., which opens September 3d.

LAST year the aggregate copper yield of Arizona Territory was 17,000,000 pounds, worth at New York rates 14½ cents per pound, $1,465,000, and it is estimated at 23,000,000 pounds for 1883, worth $3,335,000.

PROFESSOR BROADHEAD, former State Geologist of Missouri, endorses all the reports of great coal discoveries in Bates County, but says that the money expended in boring for oil there will all be wasted.

PROF. J. W. SANBORN, Dean of the Agricultural College of Missouri, is conducting a series of experiments upon the yield of different varieties of wheat and corn, the results of which he proposes to publish in a series of Bulletins, for general distribution among farmers and others.

AUGUST, 1883, will long be remembered for its earthquakes, tidal waves, cyclones, railroad and marine disasters, pestilences, etc.

THE Durango Smelting Works are receiving twenty tons of ore per day from Silverton.

PROF. WM. H. WILLIAMS, for seven years principal of the public schools, of Brownsville, Mo., has been selected as principal of the Lathrop public schools and will remove to that place very shortly.

THE sixth annual meeting of the American Society of Microscopists was held in Chicago, August 7th to 10th inclusive; Albert McCalla, A. M., of Fairfield, Iowa, President, and D. S. Kellicott, Ph.D., of Buffalo, N. Y., Sec'y.

THE predictions of the U. S. Signal Service for August 21st, included this: "For the Upper Mississippi Valley, generally fair weather, winds mostly westerly, falling barometer, stationary or rising temperature." At 6 P. M. the most severe tornado of the season swept across Minnesota, destroying the town of Rochester and killing or wounding some sixty persons.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Scientific American Supplement* for August 25th has a very interesting illustrated article upon glass-blowing by means of compressed air. The idea is not new, but its practical application on a large scale is confined to the establishment of the Appert Bros., of France.

IN the *Electrical Review* for August 30th we find an illustrated description of a Multiple Switch-board with a capacity of 2,400 lines, made for the Kansas City Telephone Exchange. The claim is made for the exchanges using this Multiple system, that they give the most prompt and reliable service of any their equal in size, the average time in making connections being only ten seconds. It is a little remarkable that a similar switch-board made for use in London, England, is only equipped for 1,000 wires.

THE *Humboldt Library*, No. 47, presents a most valuable and interesting work, viz: The Childhood of Religions, by Edward Clodd, F. R. A. S., author of The Childhood of the World; octavo, paper, pp. 51. Price 15c.

The Popular Science Monlhly for September begins with a clear exposition of "The Germ-Theory of Disease," by Dr. H. Gradle, who explains the theory, defines the extent to which it has so far been found surely applicable, and sums up the evidences on which it rests. Dr. Felix L. Oswald continues his pungent descriptions and recommendations of "The Remedies of Nature" with a paper on "Asthma" and its treatment. In "Fire-proof Building Construction" Mr. William E. Ward describes and recommends a system of building with iron and *beton* without wood which he has tried and found practicable and effective.

Dr. A. L. Chapman, editor of the *Medical Era and Sanitarian*, in his September number, affirms that "there is no fact in geology or science which contradicts anything that Moses said" and declares himself ready to discuss the question "with any responsible antagonist who will pay a decent regard to the rules of logic and the facts of science."

Harper's Magazine for September is an exceedingly attractive number, varied in its contents, and richly illustrated. One of the most timely of its articles is that on "Recent Building in New York"—an intelligent, critical estimate of the "New Departure" in architecture—illustrated by eighteen characteristic pictures.

The *London Journal of Science* for August contains, among other interesting matter, an account of Dr. Edwin R. Heath's explorations in Bolivia, written by Prof. J. D. Parker. As both explorer and writer are citizens of this immediate locality and well known to most of our readers, it is gratifying to note their recognition in a magazine of so high repute in scientific circles abroad.

One of the most meritorious weekly publications is the "*Ausland*," of Munich, a German periodical which for the last sixty years has been succesful in popularizing the results of natural and historic science, of ethnology and anthropology; has given lucid sketches on fine arts, on new inventions, and the march of exploration and foreign travel. The present volume of the "*Ausland*" gives interesting descriptions of past and present polar expeditions, of the pastoral pursuits of the Southern African natives, of the geography of China, and the interior of South America, etc. The editor of the magazine, Prof. Ratzel, recently began to add illustrations to the instructive contents of this widely circulated sheet.

The *Atlantic Monthly* for September, 1883, has the following table of contents: A Roman Singer, V., VI., F. Marion Crawford. En Province, III, Henry James. King's Chapel, Oliver Wendell Holmes. Our Nominating Machines, George Walton Green. Poets and Birds: A Criticism, Harriet C. W. Stanton. Newport, VI., VII., George Parsons Lathrop. Glints in Auld Reekie, H. H. Chrysalides, A. F. Annexed by the Tsar, William O. Stoddard. Along an Inland Beach, Edith M. Thomas. Merimee in his Letters, Maria Louise Henry. Character in Feathers, Bradford Torrey. Lily of Strath-Farrar, Thomas William Parsons. The Civil War in America. Mark Twain's Life on the Mississippi. The Spanish Peninsula in Travel. Two Journalists. The Contributors' Club. Books of the Month.

We have received, too late for proper mention, the first and second numbers of the *Pattern Book of Old Italian Embroidery*, edited by Madam Frieda Lipperheide, at Berlin, Germany. They are admirably printed and superbly illustrated, and will be fully noticed next month.

KANSAS CITY

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GEOLOGY AND MINERALOGY.

EXPLORATIONS IN THE JUDITH RIVER GROUP.

CHAS. H. STERNBERG.

I have thought that a more detailed account of our expedition to the Judith River than the one given in the April number of 1881, might be of interest, as all we can learn of that strange country with its buried remains of an earlier world, ought to be of interest to the readers of this interesting monthly. In August of 1876, I received instructions from Prof. E. D. Cope to join him at Omaha, for an expedition into a new country. We were soon on our way across the prairies of Nebraska, through the grand and impressive scenery of the Rocky Mountains and through the great high prairies that lay on top of the Rocky Mountains, through long stretches of sage brush, and grease wood. Down the beautiful Wiou and Echo cañons, holding our breath for very wonder, as new scenery presented itself to our astonished vision. Who can ever forget a journey through these magnificent cañons, where beetling crags line and shut us in and lilliputian forests have sprung up on either side in singular contrast to the mighty mountains that tower above. It is a scene long to be remembered: the hand of nature through her forces has cut and fashioned these mighty gulches, providing drainage channels for the rains that fall on the high prairies to the east. At Ogden we took the narrow gauge railroad for northern Utah and left the train at Franklin, Idaho. Here a journey of 600 miles awaited us. Who can tell of the discomforts of this journey, but those who have made it? For 200 miles we traveled at the rate of ten miles an hour through the barren alkali desert of Idaho, great clouds of dust enveloped us and penetrated our clothing, giving us all a death like appearance; three times a day we stopped an hour at dirty stage stations, where for the small sum of one dollar we ate hot bread and bacon, and drank strong, clear coffee; the proprietors had evidently not settled here for their health but for dollars. One very unhappy accident occurred on the stage that preceded us. The driver fell from his seat, and the horses ran, tipped over and dragged the stage for some distance. One large man was severely injured and was taken into a stage station. Three months later he was still lying there helpless, I never learned whether he recovered but think it doubtful. Well, we passed safely through the Port Neuf Cañon, where road-agents usually called on the passengers to stand and deliver. The mountains were hailed with delight, and we were soon amid the pines, and at Pleasant Valley we feasted on trout, and thereafter our fare was much better. At Helena we rested a couple of days and then proceeded to our outfitting post, Fort Benton, at the head of navigation on the Missouri River, a rough, frontier town where gambling seemed to be the chief business, in connection with drinking whisky.

Here we procured our outfit, consisting of four work horses, a large wagon, and three saddle horses, tent, rations, etc. We traveled down the Missouri River, and went into camp at Dog Creek, sixty miles below. This creek is a few miles from the mouth of the Judith River. I will try and give my readers some idea of the hardships and sufferings that fall to the lot of the explorer. We were in an unknown country with neither trail or wagon road, and we were in a dangerous country. Our fossil fields lay in the neutral grounds of the Sioux and Crow Indians. Here, though they had always been deadly enemies, they buried the hatchet while they hunted buffaloes, in the great Judith River Basin, for the sustenance of their squaws and little ones. In this country were countless herds of mule-deer and antelope, and the high prairies were dug up by grizzly bears for wild artichokes. The rich prairies and along the mountain sides were covered with luxuriant bunch grass, providing an endless food supply; it cures early in fall, and is superior to hay during winter. The Bad Lands along all the water courses are full of mountain sheep. It is indeed a veritable hunter's paradise, and is the great store-house from which the Indians for many years have drawn their supplies. The soil is rich from the accumulated mold of centuries. The basin is miles and miles in extent, and is bounded by the Judith River and Medicine Bow Mountains: countless streams of pure water flow through it. After the buffalo and Indians have disappeared it will make one of the grandest farming lands in America. When our party visited this beautiful country it was entirely under the sway of the red man. No cattle grazed on the rich grasses. The bosom of mother earth had never felt the sharp plow-share. No adventurous frontiersman had built his cabin along the clear stream. From these facts you will understand the dangerous land we were in.

Prof. Cope's first work on reaching Fort Clagget was to make friends of the Crow Indians: a couple of thousand were camped here when we arrived, preparing to go on their annual buffalo hunt. An amusing incident occurred here. The Professor had taken out some false teeth and was washing them; some Indians saw him, and when he replaced them in his mouth their astonishment was unbounded. When they found their voices they called out, "do it again, do it again"; and the next day they brought over a number of others to see the wonderful feat. After that the Professor was a great man in their estimation, if he had had a cork leg and glass eye they would doubtless have fallen down and worshipped him. The Professor so won the respect of the Crows that none of us were molested. We saw a few days afterwards the profligacy with which they destroyed their choicest fruit. We were following their trail up the Judith River and found on either side great quantities of the branches of berry-bushes scattered along: the Indians had rode up to the bushes and cut off branches, after eatitg the berries they had thrown them down. They call them the bull-berries and it is a nice acid fruit.

We also saw where the squaws had cut down a great many large cottonwoods with their chisel-shaped axes, the only use they made of them was to cut off the dead branches from the top of the trees, choosing only those that were dry and hard and without bark; they burn them in their wigwams, as they make good coals and but little smoke. I never saw so many well formed men in my life among the same number, as I saw among these River Crows, and was told that the Mountain Crows were still larger. They will prove a formidable enemy should they ever take the war path.

We were camped in August, 1876, on Dog Creek under some large cottonwoods. The Bad Lands presented their bold escarpments, or steep hill-sides on either side. They assumed all the characteristics of Bad Land scenery, rugged hills, rounded mounds, sharp pinnacles, long narrow ridges, etc. Some of the hills reached a height of 1,200 feet above the creek level. They were composed largely of the black shales of the Fort Pierre Group, through which were scattered beds of soft coal, or lignite, from a few inches to six feet in thickness. These Bad Lands will be the great fuel producers for the farmers of the great treeless plains, that extend far north into the domains of England. The Bad Lands of the upper Missouri present a scene of singular barrenness, and desolation: the blackness of the hills is covered up in places by sage brush, greasewood and cactus.

The shale disintegrates readily and produces a loose dirt into which one sinks a foot, this prevents one from sliding down the hill, as the accumulated dirt stops his downward progress. This dirt is carried down by every rain and helps augment the number of mud banks in the Missouri. At this point, except during high water, the river is clear; it receives its characteristic color from the Yellowstone. On top of the Fort Pierre shales are the buff-colored sandstone of the Fox Hills Group, then the yellowish clays of the Judith Group. It is a fresh and brackish water deposit, and has three beds of rusty sandstone, and a few beds of lignite. On top of the whole is a large bed of oyster shells, showing that at the close of the cretaceous and for the last time the sea again gained access: these are the transition beds between the cretaceous and tertiary, or the age of reptiles and mammals. They are usually barren of vegetation and are covered with angular cherty fragments, that roll under the feet, making travel dangerous and difficult. I forgot to mention beds of unios that are found in this formation, I discovered in one place where a bed of lignite had burned out, baking and coloring the under and overlying clays: the rock resembled the red stone from the pipestone quarries of Minnesota. The beds of the Judith River have been studied and their stratigraphy made out by the famous U. S. Geologist, Prof. F. V. Hayden. While collecting here a great many years ago, he was chased by some Blackfeet Indians, his collections turned out, and he was ordered to leave the country, which he did. He fortunately had a few teeth and turtle shells in his pocket which the Indians had not destroyed: they were studied by Dr. Joseph Leidy, the father of American palæontology, and were prophetic of the rich store that lay in wait for the successful explorer who braving the dangers from Indians, should explore and collect in this *terra incognita:* the accomplishment of this feat is due to Prof. E. D. Cope. He reasoned when the country was astonished by the news of the fearful slaughter of Custer and his brave 7th Calvary, that all the able-bodied warriors would be south fighting the soldiers, and their squaws and little ones would be secreted in the mountains. He thought we would be able to explore the country and return when the Indians, under Sitting Bull, were driven north by the troops. His reasons were good and in proof we were so fortunate as to add forty new species of strange animal life to science. They belonged to the extinct Dinosaurians, great land animals that partake of the characteristics of birds, reptiles and mammals. In fact some comparative anatomists claim that these three great families owe their descent to the Dinosaurians. Their bones were hollow and bird-like. The species we discovered walked on their hind limbs, which were large and pillar-like; a heavy tail helped support their ponderous weight while feeding from the branches of trees; their front limbs were arm-like and were provided with claws.

The plant eaters were provided with three rows of teeth in each jaw, thus giving a large grinding surface: under each old tooth was a hollow cylinder containing five young teeth, which were pushed upwards: as fast as a tooth was worn out another took its place. These huge animals reached a height of over twenty feet, their enemies, the flesh-eaters, were smaller and provided with powerful claws, and long recurved teeth with serrated edges: there was a single row in each jaw, they were elegantly built, and well adapted for springing on the clumsy plant-eaters. The waters abounded in sharks, gars, etc., among fishes; also batrachians and turtles: these last had elegantly sculptured shells composed of ridges, grooves, punctures, and elevations, made with mathematical precision. Great numbers of unios and other fresh water shells abounded.

I discovered a new species of the shark family: the teeth were six-sided with a line down the long axis of the grinding surface, on one side of which was black enamel with white 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 food.

We were early in the saddle, and taking a lunch of hard-tack and bacon, we started for our fossil fields, returning at sundown. We suffered a great deal from clouds of minute black gnats, that got under our hat-rims, inflicting severe wounds causing the forehead to swell and giving much pain. We also suffered from thirst in the hot arid beds. One day, I remember while very thirsty, I saw a stream of water in a deep cañon: after much labor I reached it only to find that it was so strongly impregnated with glauber salts as to unfit it for drinking. I never after that tried to find a drink in the Bad Lands. Prof. Marsh in writing about the fossil fields of the northwest, has likened them to veritable battle-fields, where the remains of the slain lay scattered about, and it requires much work and exposure to wrest them from dame Nature. She never gives up her choicest treasure without a severe struggle.

I was so unfortunate as to have for a saddle pony a half wild mustang. He was a black, vicious little fellow, and more than once attempted to kill me. One day, near Cow Island, I had picketed him on a high table-land of about two acres in extent and surrounded by deep cañons, with a difficult trail leading over it. I noticed that he stood very still while I climbed into the saddle; he was usually restive and ready to start the moment I put my foot in the stirrup. The moment I gained my seat he started on a full run across the level space that separated us from a deep cañon, the curb was broken and the reins were as worthless in my hand as a bit of straw. I feared that he meant to hurl himself over the precipice, but when he reached the edge he stopped suddenly, expecting me to go over his head into the deep gorge below. Fortunately I kept my seat; turning as quick as a flash he rushed at full speed to the other side stopping suddenly with his feet planted within a few inches of the brink. Once more he made an attempt to dismount me, and again failed; he then gave up and allowed me to dismount. After fixing the curb I made him pay for his murderous attempt by riding him at full speed over hills and valleys for several miles.

I had another experience that nearly cost me my life and that I can never forget. I was following along a steep slope between two ledges of sandstone, the surface was covered with loose dirt into which I slipped until stopped by the accumulated dirt. I came to a place where the upper sandstone ledge had broken loose, and carried with it all the dirt, laying bare and polishing the underlying rock. Below, the second sandstone ledge had broken off and there was a sheer descent of several hundred feet. On my hands and knees I started to cross, and midway began to slip. I struck my hand-pick on the rock expecting to thus stop, but the sharp pick rebounded as if I had struck granite with it. My case now appeared hopeless, as I was fast approaching the brink of the fearful precipice; by some means I never knew how, I succeeded in reaching the loose earth at a point within a few inches of the descent. I suppose that when I first started over, my clothes, being very dusty, were the means of preventing my slipping, and in my frantic efforts for life I got other parts of my clothes next to the smooth surface; that helped stop my downward motion, and thus enabled me to reach a place of safety. We found a number of nearly perfect skeletons of Dinosaurs near Cow Island. The Professor left us to take the last boat down the Missouri. The night before he went on board we had gone out to some beds on an open prairie twelve miles south of the river, and delaying too long, night overtook us just as we reached the breaks of the Missouri. I advised the Professor to stop where we were until morning, as I would much prefer to sleep in the open air and go without supper, than to make such a dangerous attempt as to try to reach the river at night, with no trail and deep cañons on either side, but he thought he saw the lights of the steamer that he must take, and fearful of missing it, he determined to reach the river if it took all night. After four or five hours of the most dangerous and difficult traveling I ever engaged in, we reached our destination. When night overtook us we were 1,200 feet above the Missouri, the cañons that surrounded us looked so black that the darkness could almost have been cut. We would follow an old buffalo trail to find it washed out. Would get nearly to the river and find a yawning gulf of inky darkness beneath our feet and have to retrace our way to the top of the Bad Lands. We, of course had to lead our horses and feel our way with the greatest caution, as one misstep would hurl us into eternity. I would gladly have stopped, but the indomitable energy of Professor Cope that knew of no defeat, won us victory, and we accomplished what no one else had ever done, namely, to reach the river after night from the high prairies south of it. The boat had indeed arrived, and we had just enough time the next day to get the Professor's things up to the landing.

Mr. Isaac and myself remained at Cow Island until the first of November, when severe cold weather forced us to retreat to Fort Benton, which we reached in safety. From this point I took the stage for another journey of 600 miles and suffered very much through the mountains, where the mercury fell to 20° below zero. But the Union Pacific train was at last reached and I was speeding eastward, and before many days was walking the streets of Philadelphia in time to see some of the wonders of the Centennial buildings.

The results of our three months expedition have been published by the Government and a new chapter added to the palæontology of North America.

THE LEAD AND ZINC REGION OF MISSOURI AND KANSAS.[1]

F. L. CLERK.

The lead and zinc region of Southwest Missouri is known to embrace the greater portion of Green, Dade, Lawrence, Jasper, Newton, and McDonald Counties, and to it adjoins the mineral region of the eastern part of Cherokee County, Kansas. Throughout the whole of this region, both lead and zinc have been found; but the most productive district, and the only one at present worked, is confined to the northern half of Newton County, the southern half of Jasper

1 From advance-sheets of *The Mineral Resources of the United States*, published by the United States Geological Survey, Department of Industrial Statistics. Albert Williams, Jr., Chief of Department.

County, and the eastern end of Cherokee County, Kansas, and to the area drained by the three streams, Center Creek, Turkey Creek, and Shoal Creek, which flow west and north and empty into Spring River within six miles of each other. In this region, the towns of Granby, on the south, and Joplin, on the north, are the centers of the principal mining activity. A very careful and intelligent account of this region, so far as it had then been developed, is to be found in the report of Dr. Adolf Schmidt and Mr. Alexander Leonhard, published in the Geological Report of the State of Missouri for the year 1873–74, to which the reader is referred. Work on the survey was interrupted in 1876, and has not since been resumed, for which reason few reliable statistics have since been published. The importance of this region as a source of zinc ore dates from the year 1871. In this year, the first regular shipments of ore were made from Granby to the zinc-furnaces at Carondelet. The discoveries of rich deposits of lead ore at Joplin in the same year, and their wonderfully rapid development, had also an immediate effect on the prosperity of this region. Here, as in Wisconsin, the discovery of zinc ore is proportional to the activity in prospecting for lead ore. The production of zinc ore for the year 1874 is given as 19,000 tons, and the present output is variously estimated at from 1,000 to 1,500 tons a week. There is no doubt that the latter figure is often reached, and could be maintained from present developments, except when mining is extensively interrupted either by wet weather or excessively low prices for lead or zinc ore; or that more than two-thirds of the spelter made in this country comes from ore mined in this region. The ore is found in the sub-carboniferous formation, and there is an evident connection between the known deposits of ore and the present system of surface drainage. Dr. Schmidt observed, as a remarkable fact, that the largest deposits do not lie along the principal streams, but at the heads of the smaller tributaries. The deposits of Webb City, Carterville, Empire, Galena, Sherwood, Belleville, and Blende, discovered since his examination, and now the principal sources of zinc ore, fall under the same rule. These throw new light upon the character of the mineral formations, and seem to warrant increased confidence in their extent and depth. The most important zinc mines of this region are those at Carterville and Webb City, which are really parts of the same deposit. They produce more than half of the zinc ore raised, and are worked principally for zinc ore.

As these deposits are very regular in their formation, and in a measure rule the ore market, and as the method of mining them is essentially the same as prevails throughout the entire district, a general description of them and the method of mining them will here be given. These mines lie in the open prairie, which was once cultivated in farms, about five miles northeast of Joplin, near the head of a small branch of Center Creek. They were discovered about the year 1877. Here, at a depth of from 40 to 100 feet, and often under a cap of limestone and flint 60 feet in thickness, has been found an immense deposit of zinc blende, which has been worked continuously for over half a mile. The deposit is in the form of a bed of flint, traversed in various directions by solid bars of barren flint but in general resembling a breccia of sharp, angular pieces of flint, closely cemented by crystallized blende with occasional masses of bright, crystallized galena. With the exception of these bars and occasional pillars to support the roof, the whole body is blasted out. Draining is difficult, and rock drifts are sometimes necessary to unwater the ore. Dr. Schmidt considers a secondarily deposited quartzite to be the cementing material between the chert and the zinc-blende in the very similar deposits found at Oronogo; but this is certainly not the case in the best mines at Webb City nor at Sherwood, and zinc-buyers soon learn to detect the difference. Where the cementing material is pure blende, the blende breaks freely from the chert, and can be almost entirely cleaned by crushing and jigging; where the cementing material is quartzite, or black sand, as the miners call it, crushing is difficult, and a satisfactory separation is impossible. The mines spread over about a section of land, 640 acres. Their weekly output is about 700 tons. The method of working them is as follows: When a good prospect is discovered in new ground, the land around it is leased from its original owners, on royalties ranging from 10 to 25 per cent, by a number of individuals, who organize various mining, or as they would more properly be called, land companies. These companies have the land divided up into lots 200 feet square, and a plat of it made; select certain lots for themselves, and throw the others open to miners. They usually start a shaft on one of their own lots, and put in a pump. If the indications continue good, many of the lots, particularly those near the pump-shaft, are quickly taken up by parties of miners, who sink shafts upon them, timber the ground, put up hoisting contrivances, furnish all supplies, and bear all expenses.

When ore is struck, it is drifted on and followed in all directions up to the boundaries of the lot in question. The ore is raised to the surface and crushed and washed by the miners, and is sold to one of the zinc or mineral buyers. It is weighed over the company's scales, and paid for to the company, which deducts a royalty of 25 per cent on zinc-blende and 50 per cent on "mineral" (galena); and if it has pumps running, a pump rent of $1 a ton on zinc ore and $2 on 1,000 pounds of galena; and pays over the balance to the miner. The royalties, of course, vary with circumstances, but the above are general. The holders of lots hire other labor to do the mining at from $1 to $1.50 a day; and usually put up crushing and washing machinery on their lots. Very often the same parties control two or three adjoining lots or fractions of lots, and sometimes neighbors go into partnership. Most companies do not allow ores to be taken from the lots on which they are mined until they have been cleaned and have paid royalty. The machinery is usually of the simplest description—a farm or small stationary engine, covered by a shed of rough boards, a small-sized Blake's breaker, set over a pair of rolls, and a horse whim or whip. The jigs are ordinary hand-jigs, with an overhead breakstaff, working a sieve 2x3½ feet up and down in a box of water. The jigging is usually done by contract, and is paid for by the ton of cleaned ore. It is common to see from ten to twenty jigs grouped together under a shed of poles, covered with branches of trees or rough boards. The ore as crushed yields from 10 to 50 per cent of cleaned ore, and the No. 1 grade assays about 60 to 62 per cent of metallic zinc. The tailings must in most cases be piled up on the lot from which they have come; they are drawn up into a mound with two-horse scrapers or belt elevators, and it is not an unusual sight to see jigs and crushing machinery perched on top of these mounds fifteen or twenty feet above the surface level, the shafts being timbered up to a corresponding height. Several land companies have put in fairly effective pumping machinery. Plunger-pumps working in pairs, with wooden walking-beams or bob cranks, and driven by gearing and a crank-shaft, are the most common; but direct-acting steam-pumps, like the Worthington or Blake, have been largely introduced of late, notwithstanding the disadvantages they labor under from the gritty water of the mines. From a distance, these mines, with their swarms of busy men and heaps of tailings piled around the shafts, remind one strongly of gigantic ant-hills, and present a sight not soon to be forgotten. No one can fail to be struck with the glaring defects of such a method of mining, the absence of system, the useless duplication of machinery, the cheap yet expensive expedients, and the crowding together of conflicting operations. Below ground, the effects are, if possible, worse. Each lot is affected by the policy of its neighbors; pillars are left only when they are thought to be absolutely necessary; each miner tries to get as much as possible out of his own lot, is only interested in it as long as he expects to work it, and is not disposed to improve the value of adjoining lots by unwatering them or proving their ore. The roof and pillars are badly trimmed, and in many cases dangerous, fatal accidents being distressingly common. The officers of the land companies are generally individually interested in one or more lots, and all sorts of questions are continually arising from the conflicting interests of the company and miners.

Looked at altogether, as the main dependence of the zinc industries of this country, such a condition of affairs is far from satisfactory, and yet it is not easy to suggest a practicable remedy. If a single company with sufficient capital could control all the lots and work them in connection with each other, the output could be largely increased, the cost of mining and dressing the ore greatly reduced, and the value of the mines kept up for a longer period, and the ore could be sold to better advantage than can be hoped for under the existing method. But this is seldom possible after the present system is once in operation; too many individuals have acquired rights in the mines, which they value at what they hope to get out of them. Nor is the present arrangement without obvious advantages in a new country, and it is seriously questioned whether any other could be as effective or as economical. When mineral is once discovered, it requires but little capital to open mines, and conseequently the individual risks are small. The miners, working on their own account, with hopes of large ultimate gains, have every inducement to work hard and cheaply, and to follow every clew that may lean to the discovery of ore. There is a large body of keen, hard-working prospectors, who during the season wander from place to place, live in wagons, under tents, or in open air, and carefully observe and follow every real or sup posed indication of ore. How else, it may be asked, could prospecting be so well or so cheaply done? And there is a class of enterprising, skillful, well-to-do miners, naturally associated as partners, who have made one or more good strikes, and are always ready to take hold of any new venture that promises well, either in working a lot or in forming a land company to open new mines. Where else could be found capitalists so willing to risk their money in a speculative venture? Men of this sort are always ready and able to work themselves, or to direct the work above or below ground. How else could be obtained as willing and watchful superintendents, foremen, and clerks? New towns are started every year, and the mining district is rapidly extending. No uniform development seems to lead to this extension; chance and the policy of the land-owners appear to be the only determining causes.

The towns of Galena and Empire, on Short Creek, in Kansas, were brought into sudden prominence in 1878, and restored the waning fortunes of the Joplin region, by the exertions of two land companies, which, on the strength of two or three rich but undeveloped prospects, laid out two rival towns, and sold town-lots without reserving mineral rights; and by extensive advertising throughout Missouri and neighboring States, created an excitement which had a purely speculative basis, but led to the collection of a large number of miners and a considerable aggregate of money. Fortunately, the results very nearly justified their most sanguine representations. The land companies then withdrew all of their remaining lots from the market, and the success of the mines was secured. They are now the principal mines for lead ore in the region, and their output of zinc is increasing.

For the discovery and working of shallow deposits, the present system seems the best that can be devised; but it is clearly not adapted to solve the problems of discovering deeper deposits or working them to advantage. No system can be defended which involves extravagant expense in mining and preparing the ore for market, forces the sale of it without regard to its value, and renders worthless large bodies of ore that might be profitably worked by a better system; and no basis for a great industry, like the zinc industry, which makes it depend on a hundred chances independent of the price of metal, the cost of smelting, or the known deposits of ore, can be considered very safe to build upon. The caving in of a single mine, the breaking down of a pump, less activity in lead mining, or the scattering of the miners to richer camps may cause a falling off in the output of ore from which it would be very difficult to recover. That mining has on the whole been very profitable in this region, is established from the fact that the country around has steadly and rapidly increased in wealth and population. Within the last few years, three railroads, the St. Louis & San Francisco, the Missouri Pacific, and the Kansas City, Fort Scott & Gulf, have built branches through the ore-fields to each of the three towns, Joplin, Webb City, and Galena. Joplin, with its good streets, gas and water-works, machine-shops and foundries, flour and woolen mills, lead and zinc furnaces, street-cars, and extensive jobbing and retail houses has been built almost entirely from the profits of mining.

Granby, twenty miles southeast of Joplin, presents a striking contrast. It is dependent on a single railroad, which owns much of the mining land; and the land is all leased or owned by the Granby Mining and Smelting Company. Lead ore has been extensively mined since 1856, and during the war the mines were worked for both armies. The zinc ore obtained is mainly calamine, but blende is also found. The mines are in general shallow and less troubled with water, the ores usually require less mechanical dressing than at other points in the lead region. The company receives from the men all of the lead and zinc ore, deducts the royalties paid to the railroad and its own royalties, and pays the miner on a sliding-scale, based on the price of the metallic lead and the selling price of zinc ore, for the reason that it smelts the lead ore, and at present sells the zinc ore.

This mining point is noteworthy, as it is the only one producing large amounts of calamine. The calamine is naturally rich, not much contaminated with other materials, and occurs with the lead ore in shallow horizontal openings. It was first utilized in 1871, prior to which time large amounts of it had been discovered and left in the ground or thrown aside. Since that time, it has been extensively mined, and has added greatly to the prosperity of the mines. Calamine is by nature less rich than blende in the proportion of 53 to 67 per cent; it is also much more difficult to clean when mixed with rock, on account of its lower specific gravity; but in proportion to the metal it contains, it is more valuable than blende, because it can be smelted more cheaply and the metal more perfectly extracted from it, and when mixed with blende in the furnace charge, it makes it possible to get more metal out of the blende. It is also valuable on account of the superior softness and toughness of the metal obtained from it; but it will not bear transportation to a distance as well as blende, on account of its lower percentage of metal. This ore has been at times the principal supply of the Carondelet Zinc Works; large amounts of it have been shipped to La Salle and Peru; and in 1874, 4,000 tons were shipped to Bethlehem, Pennsylvania, which yielded a little over 32 per cent of metal on the weight of the raw ore. It is less favored by the zinc works in the neighborhood, because the freight upon it is heavier than the freight on ore from other points, and because furnaces working it can not turn out as many pounds of metal a day as when working on blende, and the output of the works is reduced.

NOTES ON KANSAS MINERALS.

ERASMUS HAWORTH, EMPIRE CITY, KANSAS.

The following minerals, *new to Kansas*, have been found in Cherokee County:

1. Native sulphur. 2. Chalcopyrite (copper pyrites). 3. Greenockite (cadmium sulphide). 4. Anglesite (lead sulphate).

1. Native sulphur occurs at Weir City, and in other coal-mining districts.

The "dumps" at the coal shafts take fire spontaneously, and the heat decomposes a portion of the iron pyrites, the sulphur from which it is volatilized, and condenses at or near the surface of the dump-pile. Needle-shaped crystals, fully ⅔ c. m. in length, have been seen.

2. Chalcopyrite (copper pyrites) occurs in perfect tetrahedral crystals, which are generally—though not always—adhering to zinc blende. They vary in size from 1 mm. to ⅔ c. m. in thickness. It is quite common in three or four shafts in the Short Creek lead mines, and a few specimens of it have been obtained from Joplin, Missouri, although its occurrence at Joplin is not mentioned by Prof. Leonhard in his "Notes on the Minerals of Missouri."

3. Greenockite (cadmium sulphide) has been found in a number of different shafts in the Short Creek mines, occurring as a yellow, or yellowish green, incrustation. It gives to some brilliant sphalerite crystals a most beautiful appearance. No crystals have yet been found.

4. Anglesite (lead sulphate) is found adhering to galena. (Rare.)—*Proceedings Kansas Academy of Science.*

ANTHROPOLOGY.

THE TOOLS OF THE PYRAMID BUILDERS.

The arts and civilizations of the early Egyptians have furnished a theme to writers and travelers from the time of Moses downward, and scores of books have been written giving minute descriptions of the pyramids, the temples, the tombs, and the ruined cities that attest the wonderful progress of a people who, situated in a land of overflowing fertility, where the burden of procuring a livelihood was exceedingly light, were able to turn their energy into other channels, and more than 4000 years ago produced acievements that have never been rivaled. All this has been told and retold, but when we inquire how these architectural feats were performed, how the stone was quarried, transported, carved, and raised into its place, authors are silent, or else talk mysteriously about mechanical powers that have been lost, and the superiority of the ancients over us even in the matter in which we pride ourselves the most. The fact is that but few men who have studied Egyptology have been fitted by their previous training to investigate mechanical processes, or from a number of scattered fragments to arrive at the nature and the construction of the tools employed; and Egyptologists in general have been too fully occupied by the more seductive study of the language and social customs of the people to give any attention to these matters. Hence it is that, until quite recently, we have had but very vague ideas upon the means employed by the builders and masons of the pyramids. A recent investigator, however,—W. M. Flinders Petrie,—has brought a sudden accession to our stock of knowledge, and by careful observation, and the collection of a number of samples, mostly half-finished articles damaged and rejected in manufacture, he has arrived at the most unexpected and startling conclusions that the hard stones employed by the Egyptians—the diorite, basalt and granite—were cut with jewel-pointed tools, used in the forms of straight and circular saws, solid and tubular drills, and graving tools, while the softer stones were picked, and brought to the true plane by the aid of trial or face plates.

Mr. Petrie has embodied the results of his novel and most interesting researches in a paper read before the Anthropological Institute; and on this we have drawn for the following account of the specimens and results, which will also be described in Mr. Petrie's forthcoming volume on "The Pyramids and Temples of Gizeh."

The first and most important point is that the principle of action of the tools was by plowing out the stone by fixed cutters, as in a planing machine, and not by grinding, as with a lapidary's wheel. The proofs of this are that the cut surfaces do not show a smooth ground surface as a stone sliced with diamond dust does, but a grooved surface, like free-stone cut by a toothed saw, or like rough-sawn timber; and that this grooving is not due to the action of any loose powder, is proved by the grooves being just as deep in hard stone (like quartz) as they are in softer stone, (like feldspar), when both occur side by side in the same specimen. Two examples of this grooving we illustrate here. The first (Fig. 1, one-

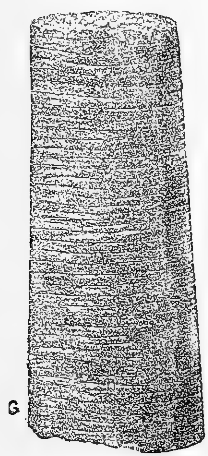

FIG. 1.

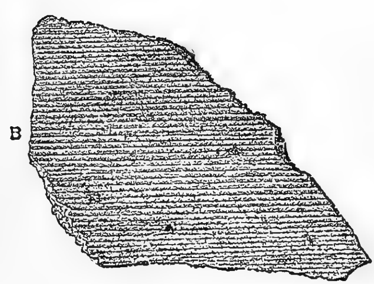

FIG. 2.

half actual size, as are all the illustrations of this article) is a core from a tube-drill hole in granite; on this, in one part, a continuous spiral of the lines of cutting may be traced for a length of three feet, passing five times around the core; and though, owing to rocking of the drill, it cannot be traced from end to end, yet no shallowing or widening of the grooves, indicating wear of the cutting point, can be seen in the course of the continous spiral. The second (Fig. 2) shows the lines on basalt produced by the successive strokes of the saw; their regularity, both in depth and in distance apart, shows unmistakably that they are due to successive strokes of the cutting point, and not to any accidental or irregular causes. On other pieces of granite, diorite, basalt and limestone, similar marks may be found. A piece of diorite shows grooves $\frac{1}{100}$ inch deep, cut without any irregularity or starting of the tool; and a piece of the drill-hole in diorite shows seventeen equidistant grooves, probably equal to a cut twenty feet in length, without any appreciable difference in the groove from one end to the other. The fragments of diorite bowls with incised superscriptions which were picked up by Mr. Petrie at Gizeh show also the use of a graving point far harder than quartz, since the hieroglyphics are made by a cut with jagged edges, and not either scraped or ground. These are of the earliest period, as they bear the names of Semaferu and Khufu, the two oldest kings of whom any contemporary remains are known.

Considering these examples of work,—the definite grooves produced, their depths, continuity and equality throughout, the capacity of the cutting point for dealing with the hardest materials, and the rapidity with which the cutting was done, the tube-drills sinking $\frac{1}{10}$ inch in granite at every revolution,—it seems certain that no instrument but a metallic tool set with fixed jewel points could produce such results. The passage of the grooves without any interruption through the quartz, feldspar, hornblende, and mica of the red granite (as seen on the specimen in Fig. 1) is also a feature which shows brilliantly the capabilities of the tools, and the skill with which they were constructed. The strain on the cutting points in thus passing from a softer material into a patch of quartz would be enormous, far greater than if working continuously in quartz; and yet there is no starting, no burring, and no failure of the cutter.

If examples of work done by any grinding process be examined, it will be seen that there is not a trace of the definite grooves, such as are in the specimens alluded to. On modern lapidaries' work, done by a wheel fed with loose diamond powder, numerous shifts in the plane of the cut may be seen, showing the outline of the wheel; but no grooves or definite plowings in the material produced by individual points of diamond. Similarly in the tubular drillings done with soft iron and sand by the Chinese, or in similar work by other nations, there is never seen any trace of plowing-out of the material; and, indeed, it seems physically impossible that any particle of a loose powder could become so imbedded in a soft metal by the mere accident of rubbing, but it could bear the immense strain needed to plow out a groove of considerable depth in such a hard material as quartz; or make a groove passing continuously through hard and soft material without any interruption or differnce. The systematic use of jewel points set in some basis, may therefore be considered as proved by the existing work, and the fact that the loose sand left in a cut, and also the sides of some of the cuts are found to be stained green, leads to the conclusion that the metal of the setting was bronze.

What the jewels were is not yet known. The range of possible materials is limited to five minerals—beryl or emerald, topaz, chryso-beryl, sapphire and diamond. Experiments made with beryl and sapphire show that their edges will fail under far less pressure than is necessary to produce cuts such as above described. Some amorphous stone is needed, and it is only the scarcity of diamonds which makes us obliged to refer to corundum as a likely agent.

The forms of the tools were just such as our modern experience has led us to use in the present generation. Long straight saws, circular disc saws, solid drills, tubular drills, hand gravers, and lathe tools were all made on the principle of jewel points set in a metallic base, while hammer and chisel, pick, and hammer-dressing were also freely used where suitable. The straight saws were certainly as much as eight feet in length, as they cut a granite coffer seven feet six inches long from end to end. Their thickness varied from $\frac{2}{10}$ inch, as on large blocks of basalt, down to $\frac{1}{30}$ inch on a small syenite trinket. The principal examples of sawing are the granite coffer of the Great Pyramid, on which the saw has been twice run too deep, and on each side of which the grooves of the saw may be seen; the granite coffer of the Second Pyramid, where the saw has been run too deep on the bottom, though the marks are polished out elsewhere; and a great pavement of basalt one-third acre in area, containing some thousands of blocks, all sawn into form and finely fitted together. This last adjoins the Great Pyramid, and is probably coeval with it. A fragment from it is shown in Fig. 2. A hand specimen of sawing in grey syenite, picked up at Memphis, is here illustrated (Fig. 3). It is probably a piece of a statuary's waste, and is sawn on four sides, and has a cross cut also on the top.

Of circular saws we have but one evidence as yet; this is a slice of diorite, (Fig. 4), with the repeated circular sweeps so familiar to our eyes on steam-sawn

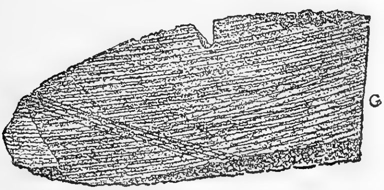

FIG. 3.

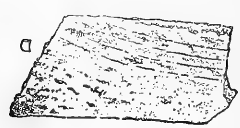

FIG. 4.

timber. These must have been produced by the successive revolutions of the most prominent cutting point at the side of a disc edge set with jewels; and though the surface has been polished sufficient traces of the lines remain to show their character, and to prove by their exact equality, uniformity of cut, and regular spacing apart, that they are not due to any casual or accidental cause. It has been suggested that the marks might have been produced by a series of points set on a flat rotating face for planing down the flat bottom of a dish; but beside the fact that no flat-bottomed dishes are known, and that the polishing lines cross the surface in all directions, it would need greater skill to set a row of stones on a face so exactly to the same level as to make such marks than to set them on an edge for slicing. So the simplest explanation of the specimen is that a circular saw was used.

Though sawing was thus freely used for cutting the outsides of the great granite and basalt coffins, some other means was requisite for hollowing out the insides of such vessels. Here the inventive genius of the fourth dynasty exactly anticipated modern devices by adopting tubular drills, as the readiest and cleanest way of removing material with the least waste of force. These tubular drills varied much in diameter, thickness, and length. Those in softer materials, as alabaster, were smaller and thinner, not needing to carry set stones on the edge, but being merely worked with powder. But the larger ones used for hollowing out granite on a large scale, were usually about four inches in diameter. One of the finest examples (about two inches in diameter) is in the pivot-hole of a door in a lintel of the granite temple at Gizeh, built by the king of the Second Pyramid, Khafra. This is shown here, (Fig. 5,) drawn from a cast which Mr. Petrie obtained by means of a gutta-percha mould. Here it will be seen that the core could not be broken out entirely, owing to its running into a tough patch of horn-blende. The granite-core already described, (Fig. 1) is also a fine illustration of tubular drill work, and would be considered a creditable result by modern men using modern tools. The various examples of such drilling that have been found, mainly at Gizeh, may be tabulated thus:

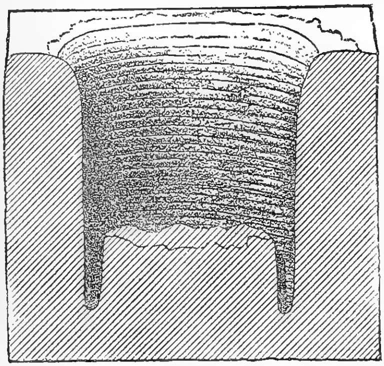

FIG. 5.

DIAMETER.	MATERIAL.	
.24	Alabaster	Tube .02 thick (Fig. 6): others up to.
.7	"	Tube .04 thick.
1.8	Basalt	A hole in a vase.
1.9	Limestone	A core.
2.2	Granite	Tube .1 thick (Fig. 5).
2.5	Alabaster	A core.
2.8	"	A core.
4.2	Granite	Inside of Great Pyramid coffer.
4.5	Greenstone	Fragment of waste.
4.8	Limestone	Two holes joined (Fig. 7).
4.8	Diorite	
18 about	Limestone	Rock dressing.

Of these the holes inside the Great Pyramid coffer show the length of drill used, as they end about eight inches below the top. The holes in limestone show how closely they are placed together for hollowing out material; and the holes were all skillfully spaced so that each annular groove of the tool overlapped and used as much as possible of the cut next to to it, so as to economize labor to the utmost. The rock-dressing at El Bersheh shows apparently

FIG. 6.

FIG. 7.

the use of large tubular drills for clearing away masses of rock, the surface of a large excavated platform being covered with circular grooves, smooth around their bottoms as if produced by a continuous cut, and not by chisel work, and just joining one another. This could not be the result of cutting out columns, as the rock surface is rough-broken both within and outside of the smooth grooves, and the grooves sometimes intersect. This work is probably of the twelfth dynasty, or about 2000 B. C.; and hence later than the pyramid work, which is the principal subject of examination in the present inquiry.

Hence it seems almost certain that the tubular drill principle, of which examples are here described from one-quarter of an inch to nearly 5 inches in diameter, was carried still further into sizes suitable for removing rock on a large scale; sizes which must have needed several men to turn the capstan head of the drill. Many other traces of the use of tubular drills were mentioned, as, for instance, in roughing out statues, but more particularly for beginning the hollowing of the insides of vases and bowls, which were afterward finished in the lathe.

A peculiar feature of the cores and holes made by the tubular drills is a certain amount of tapering, which is always to be found. This tapering cannot have been produced by the rubbing of the side of the drill in turning round in the hole, since not only would such a cause be quite inadepuate, but the grooves plowed out by the cutting points are just as distinct on the sides of the tube or core where it is tapered, as on the lower part. Hence it seems that not only did the Egyptians set cutting jewels round the edge of the drill tube, as in modern diamond crown drills, but they also set them in the sides of the tube, both inside and out Thus the hole was continually reamed larger by the tool, and the core turned down smaller as the cutting proceeded, and so the tool could be withdrawn more readily from the groove, as the annular space was thus wider at the top than at the bottom. Other drills, not tubular, were used for very small holes, such as those in the symbolic eyes, which are drilled in syenite, 1.2 inches long, and only 0.08 inch in diameter.

Experiments made by the author seem to show that the minimum pressure upon a four-inch drill could not be less than half a ton, and was probably two tons, and this is amply confirmed by the speed at which the tool is seen to have advanced, and is in accordance with the experience of modern engineers. Upon the granite core (Fig. 1) the grooves are a double spiral, showing that they were made by two stones at opposite sides of the tubes; the pitch of the thread is $\frac{1}{10}$ inch, the circumference of the core about 7 inches, and therefore the rate of sinking was $\frac{1}{70}$ of the distance traveled by the tool. The wonder is how any bronze tube or saw blade could bear the requisite pressure without doubling up, and how the jewels could be set in sockets to support them against such a violent drag.

Not only was a rotating tool employed, but the further idea of rotating the work and fixing the tool was also familiar to the earliest Egyptians. This is evidenced by the fragments of bowls turned in diorite. One piece of the bottom of a bowl (Fig. 8) shows the characterized marks of the turning. Not only are there the circular grooves of the jewel pointed tool, but also the marks of two different centerings, showing that the work had been displaced by the force applied in turning, and afterward reset, but not accurately, the old and new surfaces meeting in a cusp. Other specimens of turning in black granite, basalt, and alabaster, all of the pyramid period, were exhibited by the author. The finest examples of turning in hard stone, however, are in the British Museum. Among these are a small, highly-polished, narrow-necked vase in diorite, or rather ln transparent quartz with horn-blende, which has its neck only 0.05 inch thick, and a large vase of syenite turned inside and out remarkably thin considering the size of the component crystals. But the greatest triumph is a bowl of diorite, translucent and full of minute flaws, which must render it very brittle; yet this bowl, six inches in diameter, is only $\frac{1}{40}$ of an inch thick (.024) over its greatest part; just around the edge it is thicker, but a small piece broken out of the body of it shows its extraordinary thiness, no stouter than a thin card. An

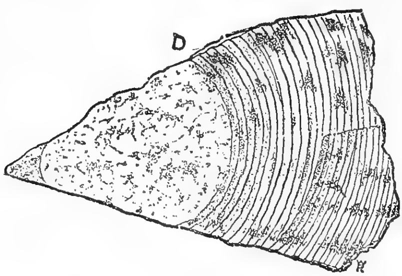

FIG. 8.

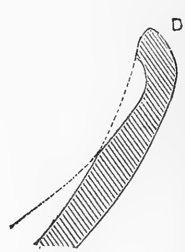

FIG. 9.

alabaster vase of Unas of the fifth dynasty, almost rivals this in thinness, being only $\frac{1}{25}$ inch to $\frac{1}{30}$ inch thick, but the softness of the material makes it of far less interest. A very favorite plan for narrow necked vessels was to turn them in two or three parts and join these together, sometimes finishing off the inside on a fresh centering of the lathe. One example shows that the early Egyptians were familiar, not only with jewelled turning tools, but with mechanical tool rests, and with sweeping regular arcs in cutting. A fragment of a diorite bowl (Fig. 9) shows that the original article was turned as a segment of a sphere inside by a tool working from a fixed center in the the axis of the lathe, with a radius of 3.94 inches. Having cut this spherical curve, the center of play of the tool was shifted about .5 inches higher, and .7 inches out of the lathe axis, and a fresh arc on the bowl was struck from this centre, thereby cutting out a fresh curve which left a raised lip around the edges. The proofs of this explanation of the process are found in the exact equality of the two curves,—that of the bowl in general and that under the lip,—in the fact of the principal surface exactly coinciding with the inner edge of the lip, in the fact of the circularity of the section curves, and in the cusp formed where they meet, an awkwardness which no hand-turner would ever take the trouble to make, but which necessarily results from a sudden change in the centre of the arc of the tool. All these details have been worked out by the author from very careful measurements of the fragment, using successive templates of slightly varying radius to measure the exact curvature, etc.

In addition to the tools we have already described, graving instruments were employed in the production of intricate forms. Blocks of stones were likewise hammer-dressed; sometimes saw nicks were cut one-half an inch deep round a block; and then the hammer-dresser was left to work the surface down to the plane of the grooves. Also on sawn blocks the surface to be placed in contact was usually hammer-dressed to have sufficient space to hold the cement, while the edges were left quite smooth. For dressing surfaces to a true level, the regular custom of the workmen was to use a trial or face-plate prepared as a true plane and smeared with red ochre; wherever the ochre came off on the stone they knew there was an excess and accordingly dressed it off. The tool used appears to have been a sort of small adze, with which the stone was sliced down very delicately and regularly by hand. All the blocks of the Great Pyramid casing were prepared with these facing plates, as may be seen by the remaining touches of ochre on the prominent points. Not only on building stones, but also on rock-dressing the same ochreing is visible. Where the stone was much larger than the facing plate, as was the block of granite over the king's chamber doorway, about 8x12 feet, then a diagonal draft was cut along the stone from corner to corner, and thus any wind in the plane of the face was avoided. In a painting at Thebes the workmen are apparently shown chiseling down a stone to a plane face; they have a string stretched quite clear of a stone over an offset block at each side, and are then applying an offset piece to the face of the stone to see whether the face is in excess. This is a skillful method of working, as the excess does not bulge out the string, and can be exactly measured as they proceed, while the string does not need to be removed, as the chisel can be used under it. Working on a vertical face, the beveling of the string does not affect it.

This completes the list of Egyptian tools dealt with by Mr. Petrie, but he adds many interesting details of the methods of building and quarrying, which, however, we can hardly notice as fully as the tools, since they do not present so great a novelty. The centre line of passages and stone blocks were carefully marked in red to guide workmen, and reference marks were added in case the first grew illegible or were covered up. In the rough courses of the mass of masonry of the pyramids the irregularities of the stones of one course were let into the course below them; thus each course bears on it a sort of plan, sunk to different levels, showing the stones that came above it. The method of fine dressing all the limestone was by carefully picking, as if with a small adze, and the standard of flatness appears to have been that no more than a couple of inches across should miss touching the true plane within the thickness of the smear of ochre. The method of quarrying the limstone was by driving galleries into the hillside and taking out a stratum of stone, leaving the hill standing above on the support of pillars. The manner of raising the blocks is not known except by inference, and that points to rocking them and packing them up on two piles of timber near the centre, but this does not afford a satisfactory explanation of the way in which some of the stones were got into place. For instance, the lower granite portcullis of the Second Pyramid, a block that would need forty to sixty men to lift it, was slid on its edge along a passage only three and a half feet wide, and then slewed round in a complex way to turn it up into the grooves prepared in the rock for it to slide in. Not more than four men could well work at it, and these in a cramped space; hence some great advantage of leverage skillfully applied must have been available.

These investigations of the mechanical methods employed by the pyramid builders are but a small portion of the researches carried on by Mr. Petrie during two winters' residence in a tomb at Gizeh. The main object of this work was the accurate surveying of the pyramids with instruments of first-class precision, the results being obtained to within one or two tenths of an inch over ground, half a mile across, by means of an extensive and closely-checked triangulation. We hear that the Royal Sosety have recognized the value of the work by giving a grant for its publication from the Government grant for research, and we may soon expect to have a full account of the instruments employed, the measurements obtained. and the bearing of these on the various theories of the pyramids, besides various historical and architectural notes, and a discussion of new methods in the mathematical treatment of observations.—*Engineering.*

EARLY MAN IN AMERICA.

W. BOYD DAWKINS.

Who were the earliest inhabitant of America, and when did they live? are questions which have generally been approached solely from the point of view offered by discoveries in the United States, and, until within the last three or four years, have been discussed only on the slender basis of the Calaveras skull and the implements found in gold-mining in California. In the following essay I propose to deal with them as portions of the great problem common to the Old and New Worlds, and to show that the first traces of man, as yet discovered, prove him to have lived in the same low stage of culture on both sides of the

Atlantic, at a time when the hands of the geological clock pointed to the same hour over the greater part of the world. The story of early man in America is a part of the greater story of the first appearance of man on the earth, so far as he has yet been revealed by modern discovery.

Before we enter into these questions, we must define clearly what is meant by the geological clock. * * * * * *

The change in life has been so regular, definite, and orderly in the geological past, that it enables us to classify the rocks over the whole world into Primary, Secondary, and Tertiary groups. In the last of these, the higher types of Mammalia become more and more specialized as we draw nearer to the frontiers of history; and their pedigrees, when traced from one period to another, assume the shape of genealogical trees, such as that which Professor Marsh has discovered for the horse. The living orders first appear in the Eocene, the living genera in the Miocene, a few living species in the Pliocene, while nearly all the living species come into the Pleistocene division. Again, in the interval dividing the last from the Historic period, the domestic animals appear and the cultivated fruits, and this—the Prehistoric—gradually passes into the period embraced by the written records. The succession of events may be used as the figures on our dial-plate, marking the lapse of geological time in the Tertiary period, as follows: (1). The Eocene period, in which the placental mammals now on the earth were represented by extinct allied forms belonging to existing families and orders. The order Primates, to which man belongs, is represented by creatures allied to the lemurs both in the Old and New World. (2). The Miocene, in which the alliance between living and extinct mammals is more close, and living genera appear. The Primates are represented by a higher division, the family of apes, in Europe and in the United States. (3). The Pliocene, in which, for the first time, living mammalian species appear; but they are few in number compared with the extinct species. (4). The Pleistocene, in which the living species are more abundant than the extinct among the Mammalia, and the Primates are represented by their highest development, the family of man. (5). The Prehistoric, characterized by the present fauna and flora, being in possession of the regions in which they have been known historically. Man has increased and multiplied on the earth, and is possessed of domesticated animals and cultivated fruits, and has acquired the arts of spinning, weaving, mining, and pottery-making in the Old World, and gradually passed through the Neolithic, Bronze and Iron stages of civilization. (6). The Historic, or period covered by written records, which varies in each country, going back to 4000 B. C. in Egypt, and in America to the time of Christopher Columbus. Were the extinct species taken into account, it would be seen that they fill up the interval separating one living form from another, and that they approximate to living species as they approach nearer to the present time.

It will be seen from the examination of the above periods that the inquiry into the antiquity of man is limited to the last four. The most highly specialized form in the animal kingdom cannot be looked for until the lower animals by which he is now surrounded made their appearance. We cannot imagine him to have been living in the Eocene age, when animal life was not sufficiently differentiated to present us with living genera of placental mammals. Nor is there any probability of his having appeared on the earth in the Miocene, because of the absence of placental mammals belonging to living species. It is most unlikely that man should appear in a fauna in which there was no other living mammal. He belongs to a more advanced stage of evolution than that presented by the mid-Miocene of Thenay, in which flint splinters fashioned by man are said to have occurred. Up to this time, the evolution of the animal kingdom had advanced no farther than the *Simiadæ* in the direction of man, and the apes then haunting the forests of Italy, France and Germany were the most highly organized types. We may also look at the question from another point of view. If man were upon the earth in the Miocene age, it is incredible that he should not have become something else while those changes were going on in the conditions of life by which all the Miocene land mammalia have been so profoundly affected that they have either assumed new forms or been exterminated. It is impossible to believe that man should have been an exception to the law of change. Nor in the succeeding Pliocene age can we expect to find traces of man upon the earth. The living placental mammals had only then begun to appear, and seeing that the higher animals have invariably appeared in the rocks according to their place in the zoölogical scale, Fishes, Amphibians, Reptiles, Placental Mammals, it is hardly reasonable to suppose that the highest of all should then have been upon the earth. The few scored bones in the Pliocene strata of Italy, referred by Prof. Capelini to the work of Pliocene man, are considered by Evans and Mortillet to have been marked by the teeth of the large sharks abundant in those seas. and if they be artificial it is not, in my opinion, proved that they were marked in the Pliocene age. "The fossil man of Denise" is of uncertain age, and other alleged cases of Pliocene man in Europe have now been given up.

The question has however been revived in the United States by Prof. Whitney, in his work on the Auriferous Gravels of California, and the existence of man in California, in the Pliocene age, has been accepted by such high authorities as Marsh, LeConte, and others. It becomes, therefore, necessary for us to see how the facts will stand the test of criticism. In the first place it is assumed that the auriferous gravels in the Sierras, with traces of man, which are in some places three hundred feet thick, and sometimes covered with ancient lava streams, are of Pliocene age. They are, however, proved by their fossils, identified by Dr. Leidy, to have been deposited by the streams from the Miocene (*Elotherium*) age down to the present time. Among the animals we may note the skull of a mustang, identical with that of Mexico and California, which could not have been buried in the gravels of Sierra County before the time of the Spanish conquest, when the living race of horses was introduced. Consequently, the discovery of human remains in the auriferous gravels does not prove that man was an inhabitant of Pliocene America, even if it be allowed that they are of the same age as the strata in which they lie. There is, however, no evidence of this in any one instance.

The objects themselves point to a directly opposite conclusion. The stone mortars, pestles, polished stone axes, beads, etc., found at various depths, are identical with those scattered over the surface, and used by the Indian tribes of California, described by Bancroft in his "Native Races of the Pacific States," and more recently by various writers in the seventh volume of the United States Geographical Survey under the direction of Captain Wheeler. The human bones are indistinguishable from those of the Red Indians. The famous Calaveras skull, according to Prof. Wyman, is related to the Indian type, with a doubtful affinity with the Eskimos. It was obtained from a shaft sunk through three alternate layers of gravel and basalt, at a depth of one hundred and thirty-two feet from the surface, was associated with the remains of other individuals, and had been buried along with shell-beads of the kind usually met with in Indian interments. Had these remains been found near the surface they would have been undoubtedly classified with the ordinary traces of Indians, and their occurrence at so great a depth is the sole cause of their being the object of special interest.

Nor have we to go far to account for their presence at great depths. It is very strange that Prof. Whitney should have ignored the fact that mining operations have been carried on in those very districts long before the time of "the forties." "In 1849," writes Schoolcraft ("Archæology," Vol. I, p. 105), "the gold-diggers at one of the mountain diggings, called Murphy's, were surprised, in examining a high, barren district of mountain, to find an old site of a mine, with a shaft two hundred and ten feet deep, at the bottom of which were a human skeleton, an 'altar,' and other remains of an ancient people,—probably Indian." In other ancient mines in the Western States, as Dr. Southall has recently pointed out, human skeletons have been met with, which prove that gold mining was extensively carried on long before the discovery of gold in the present century. The whole group of human remains, therefore, in the auriferous deposits, instead of proving the existence of Red Indians in California in the Pliocene age, belong to a comparatively modern period. Some are probably the results of interments which took place in deep mines or in superficial deposits, while others have found their way by accident into the auriferous gravels from the surface at various times. * * * * *
The remains, looked at purely from the archæological point of view, are Neolithic, and identical with those which unmistakably belong to the ancient Indian tribes of North America. We cannot seriously entertain the idea that mankind first appeared on the earth in the Neolithic stage of culture, identical, so far as we know, in every respect with the ancestors of the present Red Indians, at a time when there were but few living species of the higher mammalia, and that he lived in California before cañons from two to three thousand feet had been cut by the existing streams out of the solid rock. Neither in the New nor in the Old World is there any trace of Pliocene man revealed by modern discovery.

We come now in our inquiry to the succeeding period, when the higher Mammalia, now contemporary with man, appeared in force on the earth, and man himself may be reasonably looked for. We will take the point of view, first of all, offered by Europe. The Pleistocene, or Quaternary, period in Europe is characterised by the arrival of numerous living species, which are divisible into four natural groups, according to their present *habitats*. To the first belong those now living in the temperate zone in the northern hemisphere, such as the mole, musk-shrew, beaver, lynx, wild-cat, wolf, fox, martin, ermine, stoat, otter, brown and grizzly bear, horse, bison, urus, saiga antelope, stag, roe, fallow-deer, and wild boar. They emigrated from Asia, and some pushed their way as far south as northern Africa. The second consists of arctic animals, such as the arctic hare and lemming, musk-sheep, reindeer, and wolverine. These animals also came from Asia, and found their way as far to the south as the Alps and Pyrenees, and as far to the west as Ireland. The third group is composed of those animals now enjoying the cold climate of high altitudes in Europe, such as the chamois, ibex, and Alpine marmot. The fourth is represented by animals now only found in warm countries, such as the lion, panther, African lynx, spotted and striped hyena, hippopotamus, and African elephant and porcupine. The remains of these animals lie scattered over southern Europe, and as far to the north as Yorkshire, and to the west as Ireland. With these, certain extinct species appear, hitherto unknown, such as the straight-tusked elephant, mammoth, pigmy elephant, woolly and small-nosed rhinoceros, the Irish elk, pigmy hippopotamus, and the cave-bear.

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Owing to these climatal changes every inch of ground, in middle and western Europe, would successively form a frontier between the northern and southern animals, and their remains would be mingled together as we find them to be. During the extreme cold, the arctic animals would arrive at their southern limit. Closely following on this lowering of the temperature to its minimum, geographical changes of great magnitude took place in the north of Europe. The area to the north of the line passing from the lower valley of the Severn eastward into Russia was depressed beneath the waves of a berg-laden sea, and again lifted up so that the British Isles, then an archipelago, again formed part of the main land. As the land emerged from the water, the Pleistocene forests crept over it, and the animals found their way over the southern and midland counties.

Such as this was the scene on which man first appears in Europe. Rude splinters of stone, and roughly chipped pebbles of flint and chert, at their very best trimmed to an almond shape, and mostly intended for use in the hand, occur abundantly in the river deposits of England and France, in association with the remains of the above animals. They are the implements of savages living by the chase, and probably also by fishing and fowling. Not only have the implements been discovered, but the very spots on the river-bank where the hunter sat and made them have been identified, as at Crayford and other places in the valley of the Thames. Could we have penetrated to the banks of the Thames, or of the Seine in those times, guided by a thin column of smoke rising over the trees till we reached the camp of the river-drift hunter, we might have seen the men selecting blocks of flint and chipping their implements out of them, the women preparing the half raw meal of flesh, it may be of reindeer, mammoth, or rhinoceros, while the children broke the silence of the evening with their shouts on those very spots where are now to be heard, day and night, the voices of London and Paris.

Nor can there be much doubt as to the relation of the river-drift hunter to the above mentioned changes in climate and geography, which are usually summed up under the term Glacial. The balance of evidence is in favor of the view that the hunter at Crayford was in the valley of the Thames before the submergence, and before the temperature had reached its minimum, or in other words, in Preglacial times. The river-drift hunter whose implements are left at Abbeville traversed the shore of a berg-laden sea, and possibly may have inherited a tradition from his ancestors of the famous hunting-grounds then lying at the bottom of the British Channel and the great Northern Ocean. The hunter who followed the hippopotamus and the reindeer in the valley of the Ouse, near Bedford, was there after the re-elevation of the land and the cutting of the valley through the mantle of boulder clay which had been dropped from the melting bergs. He probably went far enough northward to see the glaciers then crowning the Pennine chain and the mountainous regions of Wales.

Southward, the river-drift man wandered far and wide over France, hunting the same animals in the valleys of the Rhone, Loire, and Garonne as in the Valley of the Thames. In the Iberian Peninsula he was a contemporary of the African elephant, the mammoth, and the straight-tusked elephant, and he camped in the neighborhood both of Lisbon and Madrid, showing here, as in France and Britain, singular facility in choosing places, which became, in the long ages which were to follow, the sites of great capitals. He also ranged over Italy, leaving his implements behind in the Abruzzo; and in Greece, in the neighborhood of Corinth, he was familiar with the extinct pigmy hippopotamus. We can also track him south of the Mediterranean by the implements found in Oran, and near Kolea in Algeria, in the Sahara, and in several places in Egypt. At Luxor, they have been discovered by General Pitt Rivers in the breccia, out of which are hewn the tombs of the Egyptian kings. In Palestine, they have been obtained by the Abbé Richard between Mount Tabor and the Sea of Tiberias, and by Mr. Stopes between Jerusalem and Bethlehem. Throughout this wide area the implements are of the same rude type, and generally of the same materials, flint or quartzite, those of Luxor and Palestine being identical with those in the river valleys of Britain and of France. Throughout this area, too, the river-drift man hunted some or other of those animals which we have mentioned above.

Nor is our survey yet ended. He is proved by many discoveries to have ranged over the Indian peninsula, from the valley of the Nerbudda in the north as far as Madras. Here we find him forming part of a fauna in which are to be numbered species now living in India, such as the Indian rhinoceros and the arnee, as well as extinct types of oxen and elephants. There were two extinct hippopotami in the rivers, as well as living gavials, turtles, and tortoises. It is plain, therefore, that at this time the higher mammals of India stood in the same relation to the present Indian animals as the European fauna of the Pleistocene does to that now living in Europe. In both there was a similar association of living with extinct forms, and in both the central figure is the river-drift hunter.

We are led from the region of tropical India to the banks of the Delaware in New Jersey, by the recent discoveries of Dr. Abbott, in the neighborhood of Trenton, which I have had the opportunity of examining with that gentleman and Professors Haynes and Lewis. The implements are of the same type, and occur under exactly the same conditions as the river-drift implements of Europe. They are found in a terrace of river gravel and loam overlooking the river, and are composed of materials derived from the old terminal moraine which strikes acoss the States of New Jersey and Pennsylvania in the direction of Lake Erie. The large blocks of stone which it contains indicate that during the time of its accumulation there were ice rafts floating down the Delaware in the spring, as in the Thames, the Seine, and the Somme in those days. According to Professor Lewis, it was formed either during the time when the glacier of the Delaware was retreating ("Late Glacial") or a latter period ("Post-Glacial"). The physical evidence is clear that it belongs to the same age as the deposits with similar remains in Europe. The fossil animals—the reindeer, bison, and mastodon—found in it also point to the same conclusion. These animals belong to a fauna occurring in fluviatile deposits in North America, composed of the same elements, and even some of the same species (as may be seen in Dr. Leidy's lists) as that of the Pleistocenes of Europe. In it living and extinct forms, and those now found in warm and cold regions, were mingled together. To the temperate division belong the Virginian deer, the bison, raccoon, and the stag, the beaver and the elk; to the northern, the reindeer and musk-sheep; to the southern, the tapir and peccary. Among the extinct species we may note the American variety of the mammoth, the mastodon, and the great sloths—*Megatherium*, *Megalonyx*, and *Mylodon*, as well as a species of capybara and of musk-sheep. The *Felis atrox* of Dr. Leidy I am unable to distinguish from the cave-lion of Europe. All these animals were probably familiar to the river-drift hunter as he passed northward to the edge of the great glacier, or southward into the tropics of Central America. He was encamped at Trenton either while New York lay buried under the ice—which has left its unmistakable marks in the smoothed rocks of the Central Park—or while that ice was melting away. Thus, in our survey of the conditions of life when man first appeared in Europe, India, and North America, we see that the animal life was in the same stage of evolution, and that "the old order" was yielding place "unto the new" in these three regions so widely removed from each other. The river-drift hunter is proved by his surroundings to belong to the Pleistocene age in all three.

It remains for us to weave the scattered threads of the inquiry in general conclusions. The identity of the implements proves that the river-drift hunter was in the same rude state of civilization, if it can be called civilization, in the Old and New Worlds, while the hand of the geological clock pointed to the same hour. It is not a little strange that his mode of life should have been the same in the lands bordering on the Mediterranean, in the tropical forests of India, and on both sides of the Atlantic. The hunter of the reindeer in the valley of the Delaware was the same kind of savage as the hunter of the reindeer on the banks of the Thames or the Seine. It does not, however, follow that this indentity of implements implies that the same race of men ranged over this vast tract. While this may be left an open question, it certainly indicates a primeval condition of savagery, from which mankind has emerged in the long ages that separate it from our own time. We may also infer from his wide range that the river-drift hunter (assuming that mankind sprang from one center) inhabited the earth for a long time, and that his dispersal took place before the glacial submergence and the lowering of the temperature in northern Europe, Asia, and America. It is not reasonable to suppose that the Straits of Behring could have offered a free passage either to the river-drift man migrating from Asia to America, or to the American animals from America to Europe, while there was a great barrier of ice, or of sea, or of both, in the high northern latitudes.

It will be naturally asked who and what was the river-drift hunter. The question can only be partially answered in the present stage of the inquiry. The few fragments of human bones, beyond doubt associated with the implements, are too imperfect to offer any evidence as to race. They, however, point out unmistakably that he was a man, and not "a missing link," and that he was without traces of Simian ancestry, such as have been ascribed to him by Mortillet and others. On this important point I entirely agree with Dr. Virchow. The river-drift man has vanished from the face of the earth without leaving any clew to his identification with any living race. After him the race of the cave-men appeared in Europe, now represented by the Eskimos.

We may realize before the rock-hewn tombs at Luxor the impossibility of measuring the date of the river-drift hunter in terms of years. In the interval between the time of his encampment on the site of ancient Thebes and the rise of the splendor of Egypt, the conditions of life described in the preceding pages passed away, and man had progressed from the hunter stage of civilization into that of the Neolithic, of the Bronze, and of the Iron ages. He stands on the other side of an abyss of past time, the depth of which has not been, and which in my opinion cannot be, fathomed.—*North American Review, October, 1883.*

MASTODON BONES FOUND AT CHESTER, ILL.

Messrs. Mitchell & Needles, the contractors of the Penitentiary brick-works, are getting their clay from the hill back of the prison buildings and about 150 feet above the river. For some time they have been taking out immense bones, teeth and jaw-bones, etc., but recently a mastodon's tusk and head was uncovered at a depth of fifteen feet. The tusk is or was a most beautiful and perfect specimen, all complete, without a flaw in it. The root of the tusk was slightly flat on the under side and measured exactly 8 inches in diameter: in the center it measured 6½ inches, and its total length is 5 feet 6 inches. The head is an immense affair, but as yet is not entirely exhumed, and will not be until Prof. A. H. Worthing, of Springfield, Ill., arrives to take care of it. There is everything to indicate that there is more than one mastodon, as a few days ago a much smaller tusk was found.

ASTRONOMY.

THE CORONA.

EDGAR L. LARKIN.

Of late, there seems to have been a reversal in scientific opinion regarding the coronal light seen around the Sun when eclipsed. Research made by American astronomers stationed on Caroline Islands, South Pacific, on the total solar eclipse May 6, 1883, led to the change in current beliefs. The discoveries of Professors Hasting, Holden and Rockwell appear to decide that the corona instead of being a solar appendage, is simply a diffraction phenomenon.

The preliminary report of Prof. Hasting in the Baltimore *Sun*; the partial report of Prof. Holden made at American Association for the Advancement of Science, Minneapolis, at its recent session, and a conversation with Astronomer Rockwell, at Minneapolis, fully convinced me that the corona is in no way connected with the Sun. The difficulties in the way of such conclusion have always been formidable, for if the corona is solar, then the pressure on the Sun's surface would be far greater than the spectroscope shows to exist. By experimenting with Geissler's tubes, it was discovered that difference in pressures of gases wrought changes in their spectra. Geissler's tubes are made of glass, and have apertures through which they can be filled or emptied by a Sprengel pump. Each tube has a platinum wire burned through either end so that when the wires are attached to the poles of a battery, electric sparks pass from one wire to the other through the length of the tube. Suppose it is desired to watch the changes in hydrogen spectra developed by different pressures; all that is needed is to force more hydrogen into the tube when the electric sparks are traversing the space between the platinum terminals.

Then we read in Lockyer's Star-Gazing, p. 414,—"We shall find the color of the gas through which the spark passes, varies considerably as we increase the pressure of the hydrogen in the tube. The hydrogen at starting is nearly as rare as it can be, and if more hydrogen be let in we shall see a change of color from greenish white to red, the hydrogen admitted has increased the pressure and the color of the spark is entirely changed. It is of a very brilliant red color, the color of the prominences round the Sun."

From this, we see that red appears when pressure on hydrogen is no greater than can be resisted by a thin shell of glass; a pressure about that exerted by the atmosphere of the earth. We have proof, then, that hydrogen composing the solar protuberances does not exist under abnormal compression,—proof derived from color. That is, it is not necessary that hydrogen be subjected to a greater pressure than fifteen pounds to a square inch in order that it may emit a vivid red light when subjected to the action of electricity.

Confirmation of the idea that excessive pressure does not exist on the Sun's surface from superposed gases, is available from another fact in spectroscopy. In Lockyer's Star-Gazing, pp. 416–17, may be found a complete description of spectra of compressed or of abundant gases. The main fact brought out is that the greater the density or what is the same, the greater the pressure on the vapor of a metal, the more complex—that is, having more lines—is its spectrum. Experiment was made, p. 416, with the electric spark between magnesium wires; when spectral lines were found of unequal length. The explanation offered is that the vapor of the magnesium had different densities in the ratio of distances from the wires. The denser layers of vapor gave three lines, the next dense two, while the outside or layer of at least density gave only one line in the spectrum. We quote p. 417, "Of late, experiments have been made in England on other metals—for instance, aluminium and zinc, and their compounds; and it is found that, when the vapor is diluted, as it were, one gets only the longest line or lines; and in the compounds, where the bands due to the compound compose the chief part of the spectrum, the longest line or lines of the metal only appear. Now what is the application of this? In the Sun are found some of the dark lines of certain metals, but not all; for instance, there are two lines in the solar spectrum corresponding to zinc, but there are twenty-seven bright lines from the metal when volatilized by the electric spark. Why should not these also have their corresponding dark lines in the Sun? The answer is, that the non-corresponding lines of the metal are the short ones, and only exist close to the metal where the vapor is dense; and in the Sun the density is not sufficient to give these lines." Surely the pressure of gases on the Sun cannot be enormous, else more than two of twenty-seven lines of zinc could be detected. Prof. C. A. Young, The Sun, p. 237, says: "Every one now, we think, admits the presence of an atmosphere of incandescent gases reaching to an elevation of at least 300,000 miles, and this although there are enormous difficulties in harmonizing an atmosphere of such extent with the low pressure at the surface of the photosphere, indicated by the fineness of the Fraunhofer lines in the spectrum." It is well known that revelations of the spectroscope are to the effect that pressure on the surface of the Sun is low.

Prof. Hasting's informal report as printed in the Baltimore *Sun* reads: "It is known from study of the Sun that gaseous pressure at the surface must be less than an inch of mercury, and is probably less than one-tenth of an inch." These quotations from eminent physicists indicate that there is either no corona, or that it is of very little importance in cosmical physics. But then, this appendage has been seen at enormous distances in all directions from the solar limb. Thus: Newcomb and Holden's Astronomy, p. 299, says: "The total phase lasts for a few minutes (never more than six or seven), and during this time, as the eye becomes more and more accustomed to the light, the outer corona is seen to stretch further and further away from the Sun's limb. At the eclipse of 1878, July 29th, it was seen by Professor Langley, and by one of the writers, to extend more than 6° (about 9,000,000 miles) from the Sun's limb.

Now what shall be said of this fact where as we have seen before, that the pressure of the superincumbent gases on the Sun, is only one-tenth of an inch of mercury ?

The pressure of the terrestial atmosphere is thirty inches; and should the air suddenly become hydrogen, then the pressure would still be two inches! The force of gravity on the earth's surface is equal to 1, and on the Sun's surface it is equal to 27.8365, whence a depth of hydrogen on the Sun, no greater than that of the air on the Earth would press with an intensity of fifty-five inches of quick-silver! How, then, account for the low pressure known to exist on the exterior of the Sun ?

Is there an unknown force of repulsion whose laws are still a mystery? Or, is the heat developed by the chemism of the Sun, an ample repulsive energy? Or, really is there no such thing as a mass of gas around the solar globe? If the gas is nine million, or even one million miles deep, it seems incredible that the total repulsion exerted by the heat or any other mode of force on the Sun should be able to so nearly counteract the colossal power of gravity that a column of mercury—assumed cold—would subside to one-tenth of an inch or an inch.

Astronomers are wrong concerning the co-efficient of pressure on the Sun, else there is no corona; or being right in both of these, then, there exists on the Sun an energy of repulsion, whose laws are wholly unknown to science. Or, perhaps repulsive force evolved from thermal or electrical modes of energy accounts for the slight pressure.

Speaking of the Eclipse Expedition the Baltimore *Sun* relates: "When the Moon covers the Sun an envelope of light is seen all around it; the envelope is not visible, when the Sun is shining, on account of the Sun's greater brightness; this light is called the corona. * * * The opinion has been that this light was due to an atmosphere extending for millions of miles from the Sun. According to Dr. Hasting's view it must be light from the Sun which has undergone refraction, *i. e.*, has been bent from its regular course by the interposition of an opaque body like the Moon."

The plan adopted was to place prisms in the tele-spectroscope tangent to the limbs of the Sun, in an arrangement so that both sides of the Sun could be seen at one view side by side. If the corona is a solar appendage the slight motion of the Moon, ought not to work many change in the lines of its spectra as seen from both sides of the Sun. But if the corona is a diffraction phenomenon caused in the Earth's atmosphere by light refracted by the Moon's edge, then as the Moon moves, the spectral lines should change. That is, the lines should make changes in relative length when caused by light reaching the spectroscope from the west on east sides of the solar orb.

We quote from Prof. E. S. Holden's report made at Minneapolis, and published in *Science*, August issue. "With the spectroscope, the chief point of observation was as to the relative lengths of the line 1474 east and west of the

Sun. At second contact, this line was 12′ longitude east and 3′ west. The length of 1474 east diminished, while 1474 west increased. At mid totality these were equal. Before the third contact, the appearances were reversed; 1474 west was longer and brighter than 1474 east." The results of the observation coincided with previous computations made by Dr. Hastings, whose calculations were based on the mathematical laws developed by the wave theory of propagation of light.

The expedition gives two results most valuable to science. It aids us dispel belief in the existence of a corona around the Sun, besides serving to remove this barrier which has so long stood in the way of comprehension of solar physics; and lends confirmation to the undulatory theory of light, since computations made by means of its laws were verified. If it shall be demonstrated that there is no corona,—matters will be much less complex in solar studies; no unknown laws will be required to be assumed in action on the Sun; nor hitherto unsuspected force. With the corona gone, we can behold in the Sun a heated sphere with no more gases surrounding it than would naturally arise from so massive a body in the Sun's known chemical activity. With the revival of astronomy two centuries ago, mysteries in cosmical research begun to vanish, and if the corona shall prove illusory; and if more delusive ideas disappear, doubtless we shall all be surprised at the simplicity of that vast machine—the solar system.

New Windsor, Ill., September 10, 1883.

ASTRONOMICAL NOTES FOR OCTOBER, 1883.

W. W. ALEXANDER, KANSAS CITY, MO.

The earth's annual motion around the Sun brings time on the 1st to R. A. 12 h. 30 min., on the 31st 14 h. 22 min. His south declination will increase from 3° 14′ on the 1st, to 14° 9′ on the 31st. The sidereal time of local Mean Noon on the 1st is 12 h. 40 min. 32.4 sec., on the 31st 14 h. 38 min. 49 0 sec.

Venus—is evening star, but as yet too near the Sun to be of much prominence. On the 4th she will be in conjunction with Mercury.

Mercury—will pass inferior conjunction on the 6th, and attain its greatest western elongation on the 22d. A few days before or after that date it can be seen risng about eighty minutes before the Sun at a point on the horizon almost due east. On the 20th it will be close to Gamma Virginis; the star will be to the north 1° 07′.

Mars—is in the constellation Gemini on the 1st, where it will remain until the 7th, after that time it will be in Cancer. On the 3d it is in line with Castor and Pollux and south from these two stars. It rises about 11 o'clock P. M , 20° north of east. Its apparent diameter is slowly increasing, also its brilliancy. On the 19th Jupiter pays him a visit and at nearest conjunction will be south 59′, or about one and a half times the Moon's apparent diameter. On the 24th it goes through Præsepe where it makes two beautiful telescopic occultations of faint stars.

JUPITER—is in right ascension 8 h. 12 min. to 8. 25 min., declination 20° north. It is in the constellation Cancer and rises about 11 o'clock P. M , 20° north of east. The mean apparent diameter is 36″. The four satellites, Io, Europa, Ganymede and Calisto present many beautiful eclipses this month.

SATURN—will rise early in the evening about 19° north of east. Apparent right ascension on the 1st 4 h. 34 min., on the 31st 4 h. 29 min.; this position places it within the confines of the constellation Taurus. The rings are probably situated for observation, the earth being elevated above their southern surface 25° 47′.

URANUS—is in right ascension 11 h. 41 min. to 11 h. 47 min., declination north 2°; it will rise about two hours before the Sun a little north of east. It will be in the constellation Virgo. On the morning of the 13th it will be in close conjunction with Beta Virginis; the star will be south only '5, about one-sixth the diameter of our Moon.

NEPTUNE—will be in the constellation Aries during the entire month. Its position is favorable for telescopic inspection. Without the aid of a very fine glass it is a waste of time to try to see this planet. The right ascension on the 1st will be 3 h. 15 min., on the 31st, 3 h. 12 min., declination north 15°. It will rise about 7 o'clock P. M. On the 17th it will be occultated by the Moon.

The Moon will be partially eclipsed on the 15th; all the phases are visible. The time used below is Kansas City mean solar:

	Days.	Hours.	Minutes.
Moon enters penumbra	15	10	22.1
Moon enters shadow	15	11	40.2
Middle of the eclipse	16	00	36.0
Moon leaves shadow	16	1	31.8
Moon leaves penumbra	16	2	50 2

Magnitude of the eclipse =0.280, (Moon's diameter =1).

Circumstances of the eclipse are, first—contact of shadow with the Moon's limb 132° from the north point toward the east, when she is in the zenith in longitude 93° 55′ west from Greenwich, and latitude 9° 29′ north. Last contact of shadow with the Moon's limb 165° from the north point toward the west, when in the zenith of west longitude 120° 50′, and latitude 9° 49′ north.

The best time to see the circular form of the earth's shadow will be at the middle of the eclipse, when it will be projected on the southern limb of the Moon.

Eclipses are caused by opaque bodies casting a shadow when the rays from any luminous body fall upon them. Every primary and seconary planet in the solar system casts a shadow towards that point of the heavens which is opposite to the Sun. If the Sun were smaller than the earth, the earth's shadow would increase in diameter as the distance increases from the earth, but if the Sun and earth were of the same size, the shadow would be of the same size, no matter how great the distance from the earth. But as the Sun is immensely larger than the earth, the earth's shadow terminates in a point at about 850,000 miles distant; the length of the earth's shadow is, however, subject to considerable variation. When the earth is nearest to the Sun, which takes place about January 1st, the shadow is much shorter than when the earth is at its greatest distance, which is about the 1st of July. The Moon revolves around the earth in about twenty-nine and one-half days, from one new moon to another. If the Moon passed at every new moon exactly between the centres of the Sun and the earth, we would have a great eclipse of the Sun at every new moon, and a total eclipse of the Moon at every full moon, but the Moon's orbit or path makes an angle with the plane of the ecliptic (the plane of the ecliptic is described by a line drawn from the centre of the Sun, passing through the centre of the earth and extended to the heavens,) of about 5½°, consequently one-half of the Moon's orbit is above the ecliptic, and the other half is below it. The two opposite points where the Moon's orbit cuts the plane of the ecliptic, are called the Moon's nodes. The nodes do not keep in the same position with respect to the earth and Sun, but have a retrograde motion of about 19° in a year. This causes the Moon at new moon to be too high or too low, so that the Moon's shadow passes above the north pole or below the south pole, hence there is no eclipse; and at full moon, the Moon passes either above or below the earth's shadow. A total eclipse of the Moon occurs when the whole of the Moon is immersed in the shadow of the earth, but we occasionally have a partial eclipse of the Moon (as the one above), which is caused by the Moon's being so high or low as to be only partially immersed in the shadow of the earth. The Sun and Moon appear to be about the same size, but the apparent size of both is subject to some variation. Eclipses of the Sun are more frequent than of the Moon, because the ecliptic limits of the Sun are greater than the Moon's, yet we have more visible eclipses of the Moon than of the Sun, because eclipses of the Moon are visible from all parts of the earth, where the Moon is above the horizon, and are equally great to each of these parts; but eclipses of the Sun are visible only at those places upon which the Moon's shadow falls.

Eclipses are among the most interesting phenomena presented to us by the heavenly bodies. In all ages, when an eclipse has taken place, it has excited the profound attention of the learned, and the fears and superstitions of the ignorant. The causes of eclipses before the seventeenth century were known only to a few, and they generally took advantage of this knowledge to impose upon the credulity of the ignorant by pretending that they were inspired by the gods. Among the ancient nations, the Chaldeans were the foremost in their observations of the phenomena of the heavens; perhaps this was owing in some measure to their occupation. They being shepherds, were obliged to watch their flocks by night to protect them from the wild beasts which were at that time very numerous.

The Chaldeans, by a series of observations extending through several centuries, discovered a very important fact in relation to eclipses, although they did not understand the cause. By comparing the records for many years past they found that a certain period of time elapsed between eclipses of the same kind and magnitude; that is, if 18 years 11 days 7 hours and 43 minutes were added to the time of the happening of any eclipse, it would show the time of the return of the same eclipse.

SUN AND PLANETS FOR OCTOBER, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's R. A. October 1st is 12 h. 30 min., and 14 h. 22 min. on 31st—a much greater increase of R. A. than in September. His declination south will be marked during October; being from 3° 15′ to 4° 10′ south of equinoctial. This causes a decrease in the length of days from 11 h. 40 min. on the 1st to 10 h. 22 min. on the 31st. Spots on the Sun have been quite numerous during the first half of September. The greatest number observed thus far (Sept. 17th,) is 90, on the first; least number 50, on the 10th; on the 14th, 80 were counted. A very large sun-spot was visible to the naked eye (with shade-glass) from 3d to 14th. An aurora with several bright streamers occurred on the 16th at 9 P. M.

New Moon occurs within a few minutes of the advent of October, and also on the 30th, about 6 P. M. On the latter date there will be an annular eclipse of the Sun, visible over the northern Pacific Ocean; central from Japan to Hawaii. Full Moon occurs October 15th, soon after midnight; when there will be a small eclipse of the Moon visible throughout the United States. The Moon will pass over a small star on the 18th, near 8 P. M. This occultation can probably be observed with a good sized spy-glass. There will be several occultations of stars by the Moon during the month, but not of much interest to those not having large glasses.

Mercury comes to its inferior conjunction with the Sun October 6th, after which it will be morning star. The best time to observe it will be about the 22d, when it may be seen with a small glass, and possibly with naked eye about 4° south of the east point. Venus is evening star, but too near the Sun all the month for observation. Jupiter is the brightest of all the morning stars. It is high up in the sky, and crosses the meridian soon after 7 A. M. in the early part of the month. On the 31st it souths at 5:40 A. M. Its declination is about 20° north all the month. Its four moons and most prominent belt may be observed with a good spy-glass. It is a grand object with a telescope three inches or more in diameter. Mars is about 7° or 8° west of Jupiter in the first of the month; comes up with and passes the great planet on the 19th; and about the 24th passes through the Bee Hive cluster in the constellation of Cancer. Saturn is a fine morning star (as to meridian passage) near 4° north of Aldebaran in Taurus. It rises at 8:40 P. M. on the 1st, and two hours earlier on the 31st. Its declination is the same as that of Jupiter, 20° north. It is about 15°, one hour east of the seven stars. For observation with a good sized telescope, Saturn is one of the finest and most interesting objects which the heavens afford. Uranus is just entering the constellation Virgo. It is now a morning star, and too near the Sun to be observed, though it might probably be seen with a telescope toward the end of the month, especially as it is very near a third magnitude star, Beta in Virgo. Neptune occupies a blank region in Taurus, near 8° southwest of Pleiades; R. A. 3 h. 15 min.; declination 16° 12′ north on the 1st. It changes place but little during the month. The brightness of this planet is about that of an eighth magnitude star, and hence requires a pretty fair little telescope to show it.

CORRECTION.

Editor Review:—I have noticed two errors in my Table of Eclipses (Review, No. 4, Vol. VII,) which it might be well to publish with their corrections. (They are my own, not the printer's). The eclipse of 1881, November, should read November 21st, 7 A. M., instead of "November 20th, midnight," as I put it; and 1882, "May 16th," should read May 17th.

W. Dawson.

METEOROLOGY.

PRACTICAL HINTS REGARDING TORNADOES.

JOHN D. PARKER, U. S. A.

The following hints regarding tornadoes are given in the belief that many people are killed every year who could save their lives by a little practical knowledge of the movements of these destructive storms.

The tornado *season* is embraced between the 1st of April and the 1st of September, but in the latitude of Kansas City most tornadoes occur in the months of May and June. As we go north or south of this latitude they are proportionally earlier or later, and early or late seasons vary the time of their occurrence correspondingly.

Tornadoes occur in the *afternoon*, generally between two o'clock and evening, four o'clock being called the tornado hour.

Tornadoes move from southwest to northeast, generally *east about twenty degrees north*, and their linear movement is ordinarily from thirty to forty miles an hour.

Tornadoes occur on *sultry* days, or when the temperature is very high and the air is thoroughly saturated with moisture.

Tornadoes occur when the *electrical conditions are high*, or when the air is highly charged with electricity.

The approach of a tornado may be known by ominous clouds appearing in the southwest and northwest. The clouds sometimes resemble the smoke of a hay-stack, at other times they appear like iridescent fog. Sometimes they present a deep greenish hue, or are intensely black, or have a purplish, yellowish or bluish tinge. When these two masses or banks of clouds, under the impulse of opposing currents, approach each other they are thrown into great confusion, there is a roaring, likened to the rumbling of distant thunder, and an upward expulsion of air and vapor. Soon the funnel of the tornado is let down to the earth, and moves to the front, while scuds of clouds play around it. The tornado now formed has four characteristic movements: a linear movement toward the northeast; a gyratory movement, (north of the equator,) contrary to the hands of a watch; a zigzag or swaying movement which leaves dentated edges in the path of the tornado, and a rising and falling movement, the poise of the upper current, by which the tornado leaps over portions of its path.

If one is familiar with these premonitory signs, he is put on his guard, and when the tornado appears, he is prepared to act intelligently and promptly. Under the preceding principles he can easily determine the projected path of the tornado, from the location of the funnel, and whether it will be necessary to run north or south to escape from it. He must, of course, not run east or west.

When a tornado is imminent certain precautions should be observed. Doors and windows in houses should be closed, animals in harness unhitched, and animals in stables let out. The safest place in a house is the southwest corner on the first floor, or better perhaps, the southwest corner in the cellar. If a tornado overtakes one on a prairie, lie face downward, head toward the east, and place the hands over the head for protection. If near a low solid object, like a large stone or stump, lie face downward, east of it, head towards the object, with hands over the head for protection.

Every home should have a dug-out at a convenient distance from the house, or what is better, a tornado-room built into the west or south wall of the cellar, large enough for the family, and for things of great value like deeds or money.

The destructive effects of tornadoes result from the gyratory movement, which is estimated at from one hundred to five hundred miles an hour. Tornadoes with the hour-glass form of cloud are the most intense, and seem to be irresistible, but the greater number of tornadoes are of a lower intensity and we can build against them. Frame houses are more tenacious or elastic than brick or stone, and when overthrown are not so destructive to life. They should have strong frames. Brick houses should have an extra layer of brick laid in cement in the west and south walls. Stone houses with very thick walls laid in cement are comparatively safe against most tornadoes.

Houses built near a hill or a bluff presenting an elevation should be located on the northeast side, as the elevation tends to lift the tornado over the house. A grove of hard wood, such as oak, maple, walnut and hickory, southwest of a house, or a forest southwest of a town has a tendency to break the force of a tornado and drive it into the upper air, although it is not safe for a person to be near a tree, or in a grove during a tornado for fear of being struck by flying timber. Occasionally a tornado of great intensity will cut a clean swath through a grove, but forests tend to break the force of tornadoes, and will drive most of them into the upper air. All towns in prairie States should plant heavy groves of hard timber southwest of them. During a residence of forty years in southern Michigan when it was heavily timbered, tornadoes were unknown; that is, they were driven into the upper air and rendered harmless, but since the forests have been cut away tornadoes in that part of the State have become somewhat frequent and destructive. Not to build and protect against tornadoes seems like not taking medicine for fevers. Sometimes a fever proves fatal, but most fevers can be cured, and so most tornadoes can be rendered comparatively harmless.

By a careful study of the principles which underlie these storms, and an observance of the premonitory signs, during the tornado season, it is believed that few, if any persons, who keep their presence of mind and act intelligently and promptly, when the storm appears, need be killed by a tornado. Still it is always best to have a clear conscience whatever may happen.

Meteorologists are carefully studying these storms. The Signal Service already, in their daily reports during the season, indicate the barometric trough of low pressure, extending from the southwest toward the northeast, along which tornadoes move, and it is believed that the time is not far distant when they will predict to certain districts probable tornado days.

FORT STOCKTON, TEXAS.

TORNADO THEORIES.

In the discussion which followed the reading of Dr. P. R. Hoy's paper upon The Tornado at Racine, Wisconsin, May 18, 1883, before Section B of the American Association for the Advancement of Science at the Minneapolis meeting, the following statements and suggestions were made by some of the distinguished physicists present:

Mr. Hoy's paper began by stating that the early part of the day was pleasant, but about 6:45 in the evening two clouds of ominous appearance joined, from opposite quarters of the heavens, and at once the cyclone began. Its general direction was to the north of east. There was no rain at Racine with the storm, but there was noticed a very strong odor of ozone while the cyclone was at its height. At the start it was barely two rods wide, but when it reached Racine it had expanded to twenty rods. Its motion was rotary and oscillatory, and all *dêbris* was thrown to the centre of the track. When the cyclone crossed the lake it formed huge water-spouts, one central, and seven to eight accessory, whirling about the main trunk.

Prof. H. A. Rowland proceeded to discuss the paper as follows: Most observers of tornadoes just perceive that there is a whirling motion of the air, and t knocks down objects, and that is the principal thing they see. But that is very ordinary observation. Of course, a column of air in such swift rotation will tear houses down, spurt water up, and do everything of that sort. The particular point which I observed in this paper was the description of the formation of the tornado. The phenomenon which is to be explained is the formation of the tornado, and very few have observed this. This description was very short; merely, that, over in the west or southwest, the clouds formed. Of course, to an observer from the west, one would appear north, and the other south. The point I wish to bring out is, that there was lightning passing between the two clouds. In Mr. Finley's description of six hundred tornadoes, I do not see any similar account. Many observers have seen lightning play around these clouds, but not passing between the two clouds. Mr. Finley applied to me to know whether there was anything in the electrical theory of a tornado. Of course, any theory of the destruction being caused by electricity, houses being attracted, etc.,—all that is mere nonsense. We know that the attraction of electricity is only a mere fraction of an ounce to the square inch Before the force becomes sufficient to raise a great weight, a spark passes, and a discharge of electricity takes place. But in this case (these two clouds passing from north to south, and boiling up, having flashes of lightning playing around them), I thought that there might be something in the electrical theory, as far as formation was concerned; and I calculated for the Signal Service and Mr. Finley what amount of energy there was in two clouds approaching each other in this way. The rotation of the earth will cause them to come together, not in a straight line, but a little aside from each other, forming a spiral motion. The direction of the rotation of the tornado is a necessary consequence of the earth's rotation: so that it might be possible to have these electrified clouds approach each other by mutual attraction, and form a tornado at the point where they meet. I calculated the energy, and found there was sufficient for a rather small tornado in the case I took. I would not be willing to say that is the theory of all tornadoes. I say that it is only possible. There is a great deal more energy in a mass of air heated up to a considerable temperature, and rising by force of gravitation,—a great many times more. If it were not for the electrical phenomena observed in the case, I should say there was very little probability of the electrical theory. I believe Mr. Finley will direct the Signal Service observers to watch the direction of the wind. If it flows in from all directions at the point where the tornado is formed, we should determine it to be due to the rise of hot air at that point. When the ground is very hot and the air very sultry, we have two causes; and it is only by observation that we can find out its true manner. I do not lay very much stress upon the electrical theory. But it is an interesting point, to me, to notice that flashes of lightning have been observed between these two clouds, showing that they were differently electrified, and that there was some plausibility for the theory which I sent to the Signal Service.

Prof. F. E. Nipher continued this discussion the next day, as follows: One matter connected with the effects of this tornado contained a point, it seems to me, of sufficient interest to call the attention of observers to the matter, in case any one should have an opportunity to observe the effect of a tornado upon water. Mr. Ferrel, I think, in his description of a tornado, states that we have a rising of the water, forming a sort of cone in the centre of the tornado; the effect being, of course, ascribed to the diminution of pressure which is known to to be there. In the cyclone proper, where we have a large area, we have a storm-wave as the principal element in the case, and there is an upheaval of the water in the area of low pressure. In the tornado it seems to me very questionable whether that occurs. I base that upon this observation: A smaller wind-whirl which was observed by myself in northern Missouri, which was rather violent though not destructive,—a column of dust several hundred feet high being raised,—passed out upon a pond of water five or six feet deep, and a depression was formed in the water, extending to the bottom of the pond,—an immense cup. The water was revolving rapidly; and it was thrown into rotation with a centrifugal effect,—the same effect as when a vessel is whirled. It seems to me that this is an element which has not been considered as it should be. If the whirl is small, and you have not only a diminution of pressure in the centre, but of the whole body of the water, the friction producing a rotation of the water, if the result is sufficiently small you might get a depression instead of an elevation. I call attention to this, so that those who may be fortunate enough to see a tornado on the water may not take it for granted that it is all known.

As to the remarks of Professor Rowland in regard to the possible electrical origin of a tornado, I know that he was very careful to say that he did not think any of the destructive effects could be ascribed to the action of electricity. I gathered the idea that he thought a tornado might originate in that way,—that two electrified clouds will attract each other, and come together; and he calculates the energy of the attraction which bodies can have for each other in air. It seems to me that the simple observation that was made by Mr. Hoy, together with another fact which we know,—that when the discharge passes between electrified bodies they are almost wholly discharged,—would show that when that happens the cause for that motion has disappeared. When these two clouds approach, a spark passes, and the whole thing is gone. So long as there is no spark passing, we know very well that the attraction is very much less than the maximum attraction of $\frac{16}{100}$ of an ounce on the square inch. I think, perhaps, that is a matter Professor Rowland did not consider. It does not seem to me at all likely that any such origin can be ascribed to the tornado. When it is developed, you may have a rarefied column which may be very highly rarefied, connecting the earth with the upper regions, which is precisely the reason that the lightning which was observed in the case of the Racine tornado was not accompanied by thunder.

Professor J. T. Lovewell said that it occurred to him, from his observation, that a good deal of care is necessary in order that the observer may know exactly what he sees. It was my fortune, said he, to witness a small whirl at a distance of three of four miles. I saw the funnel-shaped cloud descend toward the earth, and it looked to me as though there were a column of water. Many people who saw it spoke of it as a waterspout. It might have been water, for aught that we could have said from our point of sight. I immediately drove to the spot, and it appeared that not a drop of rain had fallen in that track. The whirl had been sufficient to overturn a few stacks of grain and hay, and a man was thrown about with his team in the road. I think, if it had struck a body of water, I should be slow to believe that it lifted any solid column of water into the air one hundred feet. It would have made a grand scattering of the water, and a great deal of it would have been thrown up into the air. I believe that a good deal of that which is commonly ascribed to columns of water rising up, and pouring down the sides in cataracts, is optical illusion. I should be slow to take the testimony of a person seeing them, unless he had his mind disabused of the common notions about these waterspouts. So far as their electrical origin is concerned, I quite agree with Professor Nipher that it is not by any means proven that electricity has anything to do with them, except that it is a necessary adjunct, of course, to all such disturbances.—*Science.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Temperature of the Air.	Aug. 20th to 30th.	Sept. 1st to 10th.	Sept. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	..	..	..	..
Max	.	..	..	..
Min. and Max	..	..	..	..
Range	..	..	..	..
Tri-Daily Observations.				
7 a. m.	64 4	60.95	58 60	55.0
2 p. m.	84.8	79.50	81.00	69.8
9 p. m.	66.9	64.00	63.00	58.7
Mean	70.7	68.15	66.40	60.3
Relative Humidity.				
7 a. m.	.91	.85	.93	.87
2 p. m.	.44	.51	.60	.60
9 p. m.	.81	.78	.84	.84
Mean	.71	.72	.86	.77
Pressure as Observed.				
7 a. m.	29.15	29.217	29.217	29.01
2 p. m.	29.12	29.077	29.042	29.98
9 p. m.	29.11	29.038	29.059	29.97
Mean	29.13	29 177	29.106	29.99
Miles per Hour of Wind.				
7 a. m.	8.2	..	..	..
2 p. m.	12.2	..	..	..
9 p. m.	11.0	..	..	..
Total miles	1282	2785	2313	6380
Clouding by Tenths.				
7 a. m.	1.5	4.7	5.9	..
2 p. m.	1.0	3.7	4.0	..
9 p. m.	0.6	2.4	4.8	..
Rain.				
Inches	.00	.00	.55	.55

The month included in this record has been warm and dry compared with the two preceding months. There was no rain during the first two decades, and the slight rains, from September 14th to 16th, ushered in a change, so that on the 17th slight frost was reported in low lands near Topeka. This is the only frost so far this season and it did no damage.

The wind-travel has been less than usual, the most noticeable being that of September 20th which came from the north and was so marked a disturbance as to have attracted general attention through the conntry. This cold wave would doubtless have brought the frost predicted by the Signal Service had it not brought instead a cold rain.

PHYSICS.

THE TELEPHONE SERVICE AT KANSAS CITY.

The telephone service of Kansas City is about to enter upon a new and greatly changed era. Those vexatious delays and uncertain connections, which have caused many righteous men to desire, and often attain, profane heights where their feelings could be vented consistent with the telephonic demands on them, bid fair to soon become features of the past. As has been the case with other cities we have outgrown the telephonic system, so called, that was constructed when this electrical wonder was in its infancy—and its use and abuse unknown, and for eight months past have been experiencing the discomforts of what, in telephone parlance, is known as "reconstruction"—constructing anew the entire telephonic system of the city. The most difficult part of the outside work was that of setting larger and stronger poles in place and transferring to them the multitudinous wires that loaded, beyond their capacity, the unsightly poles that have been a feature of our streets since the advent of the telephone. The new cedars and chestnuts as a rule are straight and clean, and when painted, as they are to be, will be a decided improvement in appearance as well as efficiency. For a distance of a block, and sometimes two, from the new operating room at the corner of Sixth and Delaware Streets fifty-wire cables have been strung, doing away with the necessity of that multiplicity of wires at the "central office," where so much of the line "trouble" has had its origin in the past. This is a new and quite expensive departure in telephonic circles and, if as successful as the cable inventors predict, will greatly aid in solving the aërial wire problem. Each wire is insulated and maintains its individuality from cable-box to operating-room. On each pole, where a cable terminates, a cable-box is secured and here the cable is "stripped," each wire carried to a screw and burr over a lightning arrestor, and out to its proper pin by means of kerite wire, and then connected with the subscriber's line, constructed of No. 14 steel wire. The lightning arrestors are for the purpose of carrying the electric charge, that the heavens may send, to mother earth, preventing it from entering the cable, burning through the insulation and reaching the operating-room where the damage it could do in a second can scarcely be estimated. The cables are supported on No. 4 iron wire, so hung that there is no strain on the cable. At the operating-room, where the strain on the office pole caused by the weight of the cables is something enormous, a very elaborate system of "guying" has been constructed, and the poles evenly held in place that in all probability they would retain their positions were they sawed in two.

The outside work which will increase the capacity more than one hundred per cent and, it is predicted, improve the service so that "trouble" will be reduced to the minimum, is but one of the elements in the improvements being made. The operating-room on the fourth floor of the Wales Building, Sixth and Delaware Streets, is just now receiving its finishing touches. No one except those engaged in the practical management of an exchange appreciates the difficulties to be overcome in handling the connections that subscribers may call for in a large exchange. The *Electrical Review*, of New York, says:

"The people at large, uninformed of the difficulties of the undertaking, are surprised and disappointed that electricity, after giving them so wonderful an instrument as the telephone, hesitates to make the use of it conveniently universal. It is difficult to persuade them that there is, physiologically speaking, *ten times* the amount of valuable inventive tissue already expended on telephonic apparatus that there is on the telephone itself. It is a misfortune of the telephone business that the difficulties in the way of prompt and reliable service are not properly appreciated."

The above paragraph appears in an article accompany ng a full page illustration of the new switchboard of the Kansas City telephone exchange. It is known as the "multiple switchboard," and consists of two more switchboards, to each of which is connected all of the lines of the subscribers of the exchange, and is designed to enable many switchmen (or switchladies, as young ladies are to be the operators in the city hereafter) to operate the same wires on the different boards without interference. A simple test is provided by which the operator can tell instantly, without questioning another operator, whether the line desired is free or "busy." The spring-jack (the receptacle for the connecting plug) used with the board is a small and peculiar looking combination of phosphor-bronze spring, screws and burrs and insulating compounds. The spring and contact point, against which the spring nominally rests, are both insulated from the frame of the jack which is connected by an independent wire to all its duplicate frames. In the Kansas City office three switchboards are in place, giving a capacity of six hundred wires. Others are to be added. All the lines come to the first board from the cable, which is carried under the floor to the back of the switchboard, where it is separated and each wire numbered. They are then carried to the same number on the switchboard, connecting to the spring of the jack, passing through the spring and the contact point without touching the frame of the jack, the wire continuing to the same spring on the second board and from there to the third, and then returns to the subscribers' signalling board, where it passes through the "drop" (also numbered the same as the switchboard connection) and thence to the ground. All wires are run in this manner: from cable to first board, from that to the next and so on to the last, and from that to the annunciators, and from there to the ground. A subscriber can be called up from any of the duplicates or be answered from any, but the idea of the board is to have each operator answer one hundred subscribers and be able to connect them with all other subscribers, be they two hundred or two thousand. Two operators stand, or perch on stools, in front of each board, the annunciators at their sides. For example: should subscriber No. 80 call for connection with No. 430 the operator at the board where No. 80 comes in quickly tests, by means of a plug applied to the duplicate of No. 430, whether that line is busy or not, and if not the two are promptly connected by plugs and cords. The test plug is in circuit with a battery that sounds forth a warning "click" when applied if the line wanted is busy; if not busy there is no sound at all. When through talking the subscriber calling is expected to "ring off", which throws down the clearing out-drop immediately back of the set of plugs and cords that connected the two, and thus signals the operator that they are through. The failure of the subscriber to "ring off" is a very decided source of annoyance in all exchanges.

To set up switching apparatus of this kind, trace out thoroughly, and test the thousands of wires necessary is a task requiring the finest skill. To be able to do this and yet conceal every wire and every connection, shutting out all that might be termed unsightly, required not only skill but also superior taste. The privileged visitor to the Kansas City Exchange, of to-day, is greeted with a vision of elegant switchboards of cherrywood, a room handsomely carpeted and richly papered, and pretty young lady-operators, who in soft and pleasant tones are answering subscribers. No loud talking is heard or permitted, and the thousands upon thousands of connections asked for daily are, as a rule, made quickly and easily.

This work from its conception to its close has been under the personal supervision of Mr. E. L. Smith, General Superintendent of the Missouri and Kansas Telephone Company, and Mr. Chas. W. Price, Manager of the Kansas City Exchange. These gentlemen take a just pride in the work they have done and to-day have the honor of being the executive officers of what has been pronounced by leading electricians, the finest telephone exchange in the United States. And Kansas City, now looking forward to better things in the telephone service, can feel proud that she has in her midst a company with the capital and enterprise to carry through this work, with its thousand and one annoying features, to so successful an end. To expend not less than $40,000 in improvement of what is one of the greatest public conveniences and necessities of the present age, is a creditable thing for any company to do, and this is what the Missouri and Kansas Telephone Company has done for Kansas City.

BOTANY.

CONCENTRIC RINGS OF TREES.

A. L. CHILD, M. D.

In the Kansas City Review, Vol. VI, No. 8, an article is published which was prepared by me on the "Annual Growth of Trees," in which I announced the (to me) surprising fact that the concentric rings of trees, were not a reliable index of their age.

The proof on which that article was based, was confined to four red maples of twelve years' growth; one of which exhibited forty eccentric rings, and the others only a few less.

Having no positive evidence of this singular departure from the world-wide and time-honored law, that the age of a tree is known by the number of its concentric rings, I was in doubt as to whether this departure was confined to the maple, or might extend to other families.

The assistance of kind friends has enabled me to accummulate evidence, which I think authorizes me to say that the concentric rings are not reliable indications of the age of any tree.

Desiré Charnay in *North American Review* of September. 1881, p. 401, says on the subject of this reliability of annual rings "Unfortunately for the argument, it is altogether fallacious, and proves nothing. I have put the evidence to the test."

J. T. Allan, Esq., Superintendent of tree-planting for the U. P. R. R., says in a letter of July 31, 1883: "Every man who has given any attention to this matter of yearly tree-growth *knows* that the rings are no index to the age of the tree."

Hon. J. J. Wilson, of Bethel, Vt., an experienced lawyer, and late Senator in the Legislature of Vermont, writes me, August 15th, that in a land title suit in the Windsor County District Court, held in Woodstock, in June, 1883, where claim was based on a certain marked hemlock tree, that a section of the tree inclosing the mark was produced in court, and that the rings outside of the mark counted up to forty or fifty; while the same rings followed around to the opposite side coalesced and joined till there were but nine or ten. The court ruled them out as evidence inasmuch as "they gave no indication, as to the age of the tree, or the time since the mark was made."

Hon. Rob't W. Furnas, of Brownville, Neb., late Governor of the State, and a practical forester of almost world-wide reputation says, (commenting on a letter of mine): "In reply to the letter of Dr. A. L. Child, in reference to the discussion concerning annual growth of trees * * * * , I have to say briefly that my experience coincides with that of the doctor. Formerly, I believe it was almost or quite universally conceded that what were familiarly known as annual rings, were unerring indications of the age of the trees. I *know* they are not."

Governor Furnas attended the recent American Congress of Forestry at Minneapolis, Minn., and reports that this subject was introduced in the Congress, and that Prof. Budd, of the Iowa Agricultural College, presented a specimen of known age, or near fifteen years, with thirty rings; also some specimens of spruce frome Puget's Sound, one foot in length, with eighteen rings on one end and twelve on the other.

This drew from Commissioner Loring, the opinion that "it settled the question that rings could not at all times be relied upon."

The Governor has also kindly presented me with sections of several trees of his own planting or of positively known growth and age; viz.: a black-walnut of five years with twelve rings. A green ash of eight years and twelve rings. A pignut hickory of eleven years and twenty four rings. A burr oak of ten years and twenty-four rings. A Kentucky coffee tree of ten years and twenty two rings.

H. P. Child, Superintendent of the Kansas City Stock Yards, contributes a pine of eight years and twelve very distinct rings with nineteen additional finer or sub-rings; also a soft maple of near fourteen years and sixteen very distinct, and *sixty-three* fainter or sub-rings.

I will add, that of most of the previously described specimens, there can be more generally found certain more distinct and pronounced rings, which will answer to the commonly received annual rings; and yet they very frequently, in other parts of the circumference, run into and are lost in, or entirely overshadowed by the sub-rings to such an extent that it authorizes the common expression of all who have thoroughly examined the question that "the rings cannot be received as a reliable index of the years of trees.

EXPLORATION.

THE LOSS OF THE PROTEUS.

On June 29th the United States Steamers, Proteus and Yantic, sailed from St. Johns in search of and for the relief of the Arctic exploring party that went out under Lieutenant Greely in 1881. On the 13th of September the Yantic returned to St. Johns alone, bringing the officers and crew of the Proteus, which was crushed in an ice pack at the entrance to Smith's Sound, 200 miles south of Lady Franklin Bay—the point of destination—on the 23d of July, less than one month after her departure from home. The story of the disastrous voyage is briefly told:

The Yantic and Proteus left St. Johns at 4 P. M., June 29th. The Proteus arrived at God Haven, Bay Disco Island, July 6th. The Yantic arrived at the same place July 12. When the necessary preparations were made the Proteus sailed for Cory Island, arriving there on the 16th. It left on the 21st, and two days afterward was crushed, sinking at 7 P. M., July 23d. Twenty-nine days were spent in the boats, several storms were encountered, from which the boats took refuge under lee of the icebergs, and Lieut. Colwell and six of the crew parted company with the others at Cape York. They found the Yantic July 31st. It reported Capt. Pike and the remainder of the crew moving southward. The Yantic reached Cory Island August 2d. The same night she proceeded to Pandora Harbor, where records from Pike and Garlington were found. She next proceeded south along Greenland coast, sending boats all around the islands in search of the missing crew. A storm and heavy pack of ice, August 9th, forced the Yantic to anchor to leeward of the Northumberland Island. The next day she bore away for Upernavik, arriving there August 22d. On the 27th she started for the Waigate coal mines, and returned to Upernavik September 2d. Capt. Pike and crew were found and taken on board the Yantic. It seems that at the first intimation of the Proteus disaster, which was found August 3d, at Littleton Island, by the Yantic, Lieut. Garlington left a record there that he was coming south, describing the shipwreck and indicating the general movement of Capt. Pike and the ship's company. On the 4th search was instituted along the Greenland coast from Cape Alexander to Cape Roberts, on every point likely to bring up with the retreating party. They searched until September 2d, when Upernavik was reached, and the whole Proteus party was found in good health and tolerable spirits. They were exposed during thirty-one days and nights in their boats, making some stoppages at intermediate harbors. The Proteus was crushed in the floe of ice at 3 o'clock in the evening of the 23d of July and sank within four hours. Fortunately sufficient time was given to save clothing, provisions, compass and other necessaries to meet what might prove a protracted voyage. On the 25th, the boats being equipped, provisioned and manned, a start was made. The scene of the disaster was eight miles north-northwest of Cape Sabine, latitude 79° 51′ N. Over 600 miles of ice and frigid sea was passed before Upernavik was reached.

The worst feature in the unfortunate Proteus expedition is that no provisions were landed or caches made, and all stores intended for the Arctic Colony's relief went down in the steamer. It does not follow that the band of scientific explorers who went out two years ago must be lost. But it makes their loss very probable. They have already passed two winters in their remote harbor, and on the 1st of September, if they followed instructions, they set out with their boats and sledges for the southward, expecting to fall in with and be picked up by sledging parties from the relief ship. That ship they will never see. It will be impossible to send another vessel far to the north this year. The Greely company must therefore work their way for several hundred miles over almost impassable jagged ice, or they must go into winter quarters again when traveling becomes altogether impossible. In either event there is grave danger that their supplies will fail, and that their experience will repeat the sad history of Sir John Franklin and Lieut. Commander DeLong.

The officers of the Signal Service freely admit that the present situation of affairs is a serious one, but they do not regard it as in any sense hopeless.

In the first place, they say, Lieut. Greely's party had originally a supply of provisions which was calculated to last three years, or until the summer of 1884. This supply, they think, must have been very considerably augmented by the fish and game procured in the immediate vicinity of the Lady Franklin Bay station, so that if the party remains there it will not be in danger of starvation before next summer.

Gen. Hazen's orders to Lieut. Garlington, it is true, stated that the food supply of Lieut. Greely's party would all be exhausted during the present fall, but it is said at the Signal Office that this was an extreme statement based upon the most unfavorable supposition as to the amount of consumption, waste, loss, etc., and did not allow for any care or economy in the use of food or any increase of the available supply by means of hunting and fishing. It was a statement of the worst possible aspect of the case, intending to emphasize the necessity of relieving Lieut. Greely's party at once. It is positively asserted, therefore, by the acting Signal Officer that notwithstanding the contrary statement in Gen. Hazen's orders to Lieut. Garlington, Lieut. Greely has provisions enough at the Lady Franklin Bay station to last him until the summer of 1884, if he remains there until that time. If, however, as seems more probable to the authorities here, he should have abandoned his station on the 1st of September and retreated down the coast of Grinnell Land to the mouth of Smith's Land, expecting to find there a relief party or a depot of stores, his situation may shortly become critical.

How large a quantity of provisions he would find at Cape Sabine and Littleton Islands is not known, but it is feared that the supplies left there last year, and the small quantity saved from the wreck of the Proteus would not maintain Lieut. Greely and his men at the mouth of Smith's Sound through the coming winter, even if the party had shelter and fuel. Some help might be obtained from the Esquimaux of the Greenland coast could Lieut. Greely find and open communication with them, but this is admitted to be an uncertain reliance.

Persons who are not connected with the war or navy department, but who have long been interested in Arctic research and are familiar with the history of exploration in Smith's Sound, express grave doubts as to the ability of Lieut. Greely's party to retreat down to the coast of Grinnell Land on sledges after September 1st. Autumn sledge travel along that coast was found by the officers of the British Arctic expedition of 1875 to be practically impossible.

Nothing, it is thought, can be done to rescue the unfortunate men this fall. Their lives are now in their own hands, and their future depends almost entirely upon their own skill and judgment, and upon the chances of wind and ice.

Lieut. Danenhower, formerly of the Jeannette, and Mr. Tyson, formerly of the Polaris, express their willingness to take part in another Arctic expedition for the relief of Lieut. Greely.

The people of St. Louis are deeply interested in the fate of Dr. Octave Pavy, who went out with the Greely expedition. He was a citizen of that place and has many warm friends there. Dr. Pavy was a member of the first Howgate expedition and suffered the disappointment of its failure on account of the unseaworthiness of the Gulnare. He, however, did not return with the party but remained with Mr. Clay, of Louisville, Kentucky, at Disco Island off the coast of Greenland. Mr. Clay finally returned home but Dr. Pavy remained, and joined the Greely expedition on its arrival in 1881, as acting Assistant Surgeon, U. S. A.

Capt. H. W. Clapp, 16th Infantry, U. S. A., Chief of the Arctic Division of the Signal Service, now in St. Louis, gives his views of the condition of the Greely party to a *Globe-Democrat* reporter as follows:

"The least that can be done is to fit out another relief expedition at once. Efforts should be made to reach those twenty-five men even if there wasn't one chance in a hundred of success. Unfortunately the Signal Service Department has not one cent of money which can be used for such purpose, and the Government is placed in the attitude of standing idly by while there is a possibility that the prosecution of active measures would save the lives of the men who have gone out in its service. I don't see how any relief can be expected unless from private sources, and the people of the country ought to respond to the emergency. I have studied the subject carefully and I am firmly convinced that the least that can be done is to send out another party at once."

"From where would you start it?"

"St. Johns is the headquarters for the sealing trade, and it was there that the Neptune and Proteus were both obtained. There are other ships at that port nearly as good as either of them, which were considered admirable for their purpose, and at the proper time of year a crew of men could be obtained without difficulty for the trip. It is not too late in the season yet to set out. An expedition could be got away from St. Johns by October 1st. This should push as far north along the coast of Greenland as possible, reaching the Carey Islands, if possible, before going into winter quarters. They would then be in position to succor Greely should he make a successful retreat thus far, and would be in position from which they could move north in the spring if Greely failed to come before that time. There is prospect that such an expedition as this I mention could get into a pretty high latitude this fall. The Alert, in 1875, reached her winter berth north of Greely's permanent station September 1st, and was not closed in for the winter until the 10th. She was released from the ice in the following year on July 31st, reached Discovery Harbor, August 10th, and the two boats, Alert and Discovery, crossed Lady Franklin Sound on the return August 20th, passed Cape Isabella September 9th, and arrived at Disco September 25th, only one stream of light having been fallen in with during all the voyage. The ships recrossed the Arctic circle October 4th, showing that navigation of these waters is practicable some years until late in the season. An expedition going up this fall might find the ice fully as open as did the one which has just returned, without apparently having left supplies at the vital point of Littleton Island.

"Lieut. Greely, himself, after reaching his permanent station at Lady Franklin Bay, made out an elaborate plan under date of August 19, 1881, and this was delivered to Gen. Hazen on the return of the vessel which took the expedition out. No deviation has been made in the attempts to carry out his plans, but they have miscarried. Lieut. Greely's plans involved the establishment of caches and supply depots at frequent intervals along the west coast of Smith's Sound, on Grinnell Land, along the route over which he is probably now making a laborious retreat, but the Sound has been found impassable by reason of ice, both last year and this, and instead of having deposited supplies, the 1882 relief expedition got no farther north than Cape Sabine, and was unable to leave but a small quantity of supplies. The expedition this year appears not to have got much above Littleton Island, and not to have deposited enough supplies there to be of any importance. The expedition last year did everything that could possibly have been expected of it, unless possibly, in not having landed enough stores at Littleton Island, although they might have been ransacked by the natives if they had done so. Supplemental orders to this year's relief expedition required the landing of supplies before going north from Littleton Island, and even after the Proteus was caught in the ice there must have been an opportunity to save some of the stores. Lieut. Garlington is a thoroughly reliable man, and must have fully appreciated the importance of leaving the Littleton Island station thoroughly provisioned. It is not my province to criticise any officer, and even if criticism were just it is not necessary to discuss the reasons why the two relief expeditions failed to reach Lady Franklin Bay. The fact remains that Lieut. Greelv and party are in a very precarious condition, and that, it seems to me, an attempt to relieve them should be made as early as possible."

Dr. Emil Bessels, of Washington City, who was chief of the scientific staff of the Arctic exploring steamer Polaris in 1871–3, and who has also had extended Arctic experience on the coasts of east Greenland and Navaya Zemaly, says: I was afraid there might be difficulty in communicating with Lady Franklin Bay stations, and bringing the party away at the conclusion of their work. It isn't every year that a vessel can sail up Smith's Sound and Kennedy Channel, as the Polaris did with Greely's party on board in 1881. I have a letter from Commander Markham, of the British Arctic expedition of 1875, written a year and a half ago or more, in which he, too, expresses fear that the United States Government will have trouble in relieving and bringing home this party. It has been suggested that a vessel might still reach the Danish settlement of Upernavik this fall and a sledge party might be dispatched northward from there up the Greenland coast to meet Lieut. Greely at the mouth of Smith's Sound, but this would not be practical. Greenland coast north of Upernavik and around Melville Bay is intersected by extensive glaciers which it is practically impossible to cross. If sledge journeys could be made along this coast, the Etah Esquimaux, who live near the mouth of Smith's Sound, would communicate with the Esquimaux of Danish settlements, whose existence they are well aware of. Especially would they be likely to do this in times of famine, when, if they could reach Danish settlements, they could get food. But they have never done it simply because it is not practicable, even for them, and still less for white men. I think it is too late to do anything for the relief of the Greely party this fall. If Lieut. Greely and his men are now at the mouth of Smith's Sound they can without doubt find the Etah Esquimaux. Some natives of the tribe are almost sure to be living either at Etah or Sorrfolik, near the mouth of the Sound. Whether the Esquimaux could and would help so large a party as that of Lieut. Greely through the winter or not, I do not know. It would depend upon circumstances, and during the winter we spent at Polaris house, the Etah Esquimaux couldn't have been able to help anybody, for the reason they were at the point of starvation most of the time themselves. There are only a few of them. The whole tribe consisted of about 100 souls when we wintered in their country, and they are scattered along the the coast from the vicinity of Littleton Island to Cape York. I think there is a reasonable chance of Greely's being able to extricate his party from its difficulties. Lieut. Greely is, of course, in a dangerous situation, but it is possible for the party, if led with courage, skill and good judgment, to make its escape from almost any part of Smith's Sound unless the conditions are more than usually unfavorable.

Capt. Tyson is confident the Greely party is on its way to a place of safety, and that if it is attended with ordinary good luck it will reach a point where it can winter over, and where it can be found next June or July. In any event, he thinks there would be little use in starting out now to find the men. He confirms what has already been said about the hopelessness of trying to reach the shores of Kane Bay or Kennedy's Channel by sledging along the Greenland coast in the fall or winter. The Esquimaux of Upernavik and those living further up Melville Bay have no means of communication in winter, and if they cannot travel none others need try.

Sir George Nares, the distinguished Arctic explorer, writes the *Times* a few hopeful words to friends and relatives of those composing the Greely expedition. He says that there is still hope that Lieut. Greely may have reached Port Foulke late in the season.

Mr. Ford, of the New York *Tribune*, advises the sending of two vessels, one to go directly north and the other to skirt the Greenland coast north of Upernavik. The practicability of sending an expedition around the east coast of Greenland and attempting to reach Greely station from the north has been suggested, but the plan at this stage finds few advocates. The voyage has never been made, but Jan Mayer and a number of German and Danish navigators have sailed within a very few degrees of the pole by taking the water between Spitzbergen and Greenland, and it is stoutly maintained that there is an open sea to the north and west of that point.

ARCHÆOLOGY.

ANCIENT RUINS IN SONORA, MEXICO.

Ancient ruins have recently been discovered in Sonora, which, if reports are true, surpass anything of the kind yet found on this continent. The ruins are said to be about four leagues southeast of Magdalena. There is one pyramid which has a base of 1,350 feet, and rises to the height of 750 feet; there is a winding roadway from the bottom leading up on an easy grade to the top, wide enough for carriages to pass over, said to be twenty-three miles in length; the outer walls of the roadway are laid in solid masonry, huge blocks of granite in rubble work, and the circles are as uniform and the grade as regular as they could be made at this date by our best engineers. The wall is only occasionally exposed, being covered over with debris and earth, and in many places the sahuaro and other indigenous plants and trees have grown up, giving the pyramid the appearance of a mountain. To the east of the pyramid a short distance is a small mountain, about the same size, which rises about the same height, and if reports are true, will it prove more interesting to the archæologist than the pyramid.

There seems to be a heavy layer of species of gypsum about half way up the mountain, which is as white as snow, and may be cut into any conceivable shape, yet sufficiently hard to retain its shape after being cut. In this layer of stone a people of an unknown age have cut hundreds upon hundreds of rooms from 6x10 to 16x18 feet square. These rooms are cut out of the solid stone, and so even and true are the walls, floor and ceilings to plumb and level as to defy variation. There are no windows in the rooms and but one entrance, which is always from the top. The rooms are about eight feet high from floor to ceiling; the stone is so white that it seems almost transparent, and the rooms are not at all dark.

On the walls of these room are numerous hieroglyphics and representations of human forms with hands and feet of human beings cut in the stone in different places. But, strange to say, all the hands have five fingers and thumb, and the feet have six toes. Charcoal is found on the floors of many of the rooms, which would indicate that they built fires in their houses. Stone implements of every description are to be found in and about the rooms. The houses or rooms are one above the other to three or more stories high; but between each story there is a jog or recess the full width of the room below, so that they present the appearance of large steps leading up the mountain.

Who those people were, what age they lived in, must be answered, if answered at all, "by the wise men of the east." Some say that they were ancestors of the Mayas, a race of Indians who still inhabit southern Sonora, who have blue eyes, fair skin and light hair, and are said to be a moral, industrious, and frugal race of people, who have a written language and know something of mathematics.—*Chihuahua Enterprise.*

BOOK NOTICES.

STUDIES IN LITERATURE: Edited by Titus Munson Coan. 12mo., pp. 267. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; Cloth, 50c.; Paper, 25c.

This is No. 3 of the "Topics of the Time" series and contains the following choice selections: American Literature in England, from *Blackwood's;* Hamlet—a New Reading, by Franklin Leifchild, from the *Contemporary Review;* The Humorous in Literature, by J. Henry Shorthouse, from *Blackwood's;* The Bollandists, by Rev. George T. Stokes, from the *Contemporary Review;* Isaiah of Jerusalem, by Mathew Arnold, from the *Nineteenth Century;* Concerning the Unknown Public, by Thomas Wright, "The Journeyman Engineer," from the *Nineteenth Century.*

The first of these is a sharp criticism of the writings, characters and methods of such writers as Charles Dudley Warner, W. D. Howells, and Henry James, which, though just in some respects, betrays an unwarranted degree of bitterness. The other essays are all readable and suggestive.

This series grows in favor with each number. Number 4 will consist of "Historical Sketches," by prominent writers.

A TEXT-BOOK ON THE ELEMENTS OF PHYSICS: By Alfred P. Gage, A. M. 12mo., pp. 414. Ginn, Heath & Co., Boston, 1883.

The peculiar excellence of this work, which is intended for the students of High Schools and Academies, is found in the fact that the pupil works his way through it, *i. e.*, he accepts as fact only that which he has proved by experiment or personal investigation. He is taught to think and draw his own inferences, hence the statement of principles and laws follows their discovery in the laboratory or work-room. Suggestions and questions open the way and progressive experiments lead to a full grasp of the law before it is actually formulated. The whole work is condensed into six chapters, viz: Matter and its Properties; Dynamics; Molecular Energy,—Heat; Electricity and Magnetism; Sound; Radiant Energy,—Light. Each of these is ably handled and clearly illustrated, all of the most recent discoveries and laws plainly and fully set forth, and the doctrine of the conservation of energy, which is now regarded as the basis of physical science, given due prominence. The experiments given are simple and practical, just such as almost any student can find materials for without inconvenience or expense, and the tendency of the whole treatise is to throw the student upon his own resources and to cause him to become, as it were, an original investigator of nature's processes. More than three hundred cuts serve as illustrations and a full index closes the work, which has received the commendations of some of the best physicists and teachers of the country. After a careful examination of its plan and methods, we regard it as the most practical and thorough treatise upon physics that we have yet seen, and cordially recommend it to the teachers of the advanced schools of Missouri as a fitting text-book for their use.

MANUAL OF TAXIDERMY: By C. J. Maynard. Illustrated; 12mo., pp. 111. S. E. Cassino & Co., Boston, 1883. $1.25.

This little work is intended to meet the wants of amateur ornithological collectors, says the author, for it is written by one who has at least had the advantage of a very wide experience in collecting skins, making and mounting. He has also had the advantage of comparing his methods with those of many excellent amateurs and professional collectors throughout the country, and the results are now laid before the reader. The several topics discussed are collecting, skinning birds, making, *i. e.*, dressing, skins, mounting birds, making stands, collecting mammals, mounting mammals, mounting reptiles, batrachians and fishes. The work is well illustrated and the amateur will find a great deal in it that will be of use in learning the taxidermist's art.

MODERN LOCOMOTIVE ENGINES: By Emory Edwards, M. E. Illustrated; 12mo., pp. 372. Henry Carey Baird & Co., Philadelphia. $2.00.

This work is the completion of a series by the same author, entitled respectively "A Catechism of the Marine Steam-Engine," "Modern American Marine Engine, Boilers, and Screw Propellers," "The Practical Steam Engineer's Guide," and is published at the suggestion of numerous correspondents in different parts of the country, who have read the others with interest and profit. It is complete account of modern locomotive engines, their design, construction, and management, and is presented as a practical work for practical men. There are seventy-eight illustrations and a copious and comprehensive index. The publishers in London, who are Sampson Low, Marston, Searle & Rivington, as well as the well known house of Henry Carey Baird & Co., of Philadelphia, the original publishers will send it postpaid to any part of the world for the above named price.

In the introductory chapter the properties and peculiarities of steam are fully discussed. This is followed by chapters upon Steam Engineering, with careful instructions to engineers upon the theory and practice of the subject: The Properties of Water; Economy of Fuel; Quality of Steam; Mechanical Powers—Virtual Velocities. History of Railroads and Locomotive Building in America; Construction of Locomotives; High Railway Speeds; Recent Improvements in Locomotives, etc., concluding with nearly one hundred pages of useful notes, tables and rules. Every engineer will find in this work many practical points beyond the mere mechanical handling of a locomotive, which cannot fail to be of great value to him, not only while on the footboard but after he has graduated from that into higher positions.

POEMS OF PASSION: By Ella Wheeler. 12mo., pp. 160. Belford, Clarke & Co., Chicago, 1883. For sale by M. H. Dickinson, $1.00.

This very elegantly and tastefully prepared book contains the outpourings of the author's soul in the form of some four-score short poems on various subjects; nearly all, however, properly enough coming within the scope of the title of the work, "Poems of Passion," though as many as fifty of them are classed as "Miscellaneous." Passionate they certainly are, all of them, and poems some of them are, but not all. The prologue or preface presents a fair sample of both the poetry and the versification which pervades the whole, and accordingly we copy it:

"Oh, you who read some song that I have sung—
What know you of the soul from whence it sprung?
Dost dream the poet ever speaks aloud
His secret thought into the listening crowd?
Go take the murmuring sea-shell from the shore—
You have its shape, its color—and no more.
It tells not one of those vast mysteries
That be beneath the surface of the seas.
Our songs are shells, cast out by waves of thought;
Here, take them at your pleasure; but think not
You've seen beneath the surface of the waves,
Where lie our shipwrecks, and our coral caves."

The "passion" appears prominently in such poems as "Love's Language," "Communism," "Guilo," "Conversion," "Delilah," "The Duet," etc., through all of which the poetical vein runs with more or less harmony and rhythm. As intimated above, we find some halting feet, some defective rhymes and some rather arid thought, but as an whole we decide these verses to be fully up to the average.

The work of the publishers is, with the exception of a few errors of proof-reading—for instance "chasée" for chassé, "VALLFY" for VALLEY, "tonight" for to-night, "today" for to-day, etc.—extremely well done.

TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCE, Volume VIII, 1881-2. Octavo, pp. 85. Kansas Publishing House, Topeka, 1883.

In this volume are combined the Transactions of the fourteenth and fifteenth annual meetings of this Association, together with the Report of the Secretary.

We find in it papers by Professors Snow, Smith, Patrick, and Carruth, of the Kansas State University; Professor George F. Gaumer, of the University of New Mexico; Professor F. W. Cragin, of Washburn College, Topeka; Erasmus Haworth, Col. N. S. Goss, S. C. Mason, Robert Hay, and E. N. Plank. Also a description by Professor A. R. Grote of the entomological specimens discovered and collected by Professor Snow, in New Mexico.

These papers are all of a practical character, showing a large amount of original investigation and research by the writers, and all tending to the development of the resources of the State of Kansas. We shall reprint some of these papers from time to time, as being exactly appropriate to and in accordance with the objects and design of the REVIEW, from its inception to the present time.

OLD ITALIAN PATTERNS OF LINEN CROSS-STITCH WORK: Collected and edited by Frieda Lipperheide, and published by Franz Lipperheide, Berlin, Germany.

This work contains two collections: No. 1 contains thirty plates, fifty-six patterns, also thirty-two pages of explanatory matter, with eighty-one engravings.

No. 2 contains fifty plates, eighty-five patterns, with thirty-six pages of instructions, and seventy-eight engravings. Both are large quartos. Price of each collection is six marks.

This is a very tasteful and useful work for ladies, and handsomely gotten up. The patterns have been selected with care, many of them were secured at the museums at Berlin, Hamburg, Vienna and Dresden; some dating as far back as the sixteenth and seventeenth centuries. This work gives complete instructions as to learning this beautiful art. It explains the patterns, materials, and the stitching, such as the ancient Greek, Italian, and Dutch stitches.

It is very highly recommended by the German press. Among others we notice the widely circulated "*Over Land and Sea*," "*Science and Art*," and other famous journals. The director of the Hamburg Museum recommends it highly also.

As specimens of typographical work, these volumes are unexceptionable. Both printing and engraving are most admirably done.

OTHER PUBLICATIONS RECEIVED.

Bulletin No. 5 of the Illinois State Laboratory of Natural History. The North American Batrachia and Reptilia found east of the Mississippi River, by N. S. Davis and Frank L. Rice. Bulletin No. 6, do., Studies of the Food of Birds, Insects and Fishes, by Prof. A. S. Forbes. The *St. Louis Medical and Surgical Journal*, September, 1883, Vol. XLV, No. 3, Thos. F. Rumbold, Editor and Proprietor; $3.00 per annum. Crop Report of the State Board of Agriculture of Kansas for July, 1883, Wm. Sims, Secretary, Topeka, Kansas. "Technical Training," an address by Dr. Thos. M. Drown before the Alumni Association of Lehigh University, June 20, 1883.

First Annual Report of New York State (Agricultural) Experiment Station, 1882, E. Lewis Sturtevant, A. M., M. D., Director. Professional Papers of the Signal Service, No. VIII, The Motions of Fluids and Solids on the Earth's Surface, by Prof. Wm. Ferrel, with notes by Frank Waldo; No. IX, Charts and Tables Showing the Distribution of Rainfall in the United States, by Lieut. H. H. C. Dunwoody, Acting Signal Officer; No. XI, Meteorological and Physical Observations on the East Coast of British America, by Orray Taft Sherman; No. XII, Popular Essays on the Movements of the Atmosphere, by Prof. Wm. Ferrel. Observations of the Transit of Venus, Dec. 6, 1882, made at the University of Virginia by Professor Francis H. Smith, LL.D., and Ormond Stone, M. A., Director of the Observatory. On the Characters of the Skull in the Hadrosauridæ: On some Vertebrata from the Permian of Illinois, by E. D. Cope. A Lecture on Man, by Chas. S. Bryant, A. M. Legends of the Northwest, by H. L. Gordon, St. Paul, Minn.

SCIENTIFIC MISCELLANY.

MONEY: ITS ORIGIN AND HISTORY.—CONCLUDED.

H. A. HAGEN.

The treasuries of the Roman Catholic churches and monasteries contain still, in some countries, an immense amount of precious metals, which may be considered as lost forever to circulation, except in extreme calamities.

That lack of money will not become absolete is true. Lack of money can be divided into three categories: Either an individual has no money, or the State where he lives has no money, or the money itself has in fact disappeared.

The causes of the first category are mostly best known to the individual himself, and may be left to his own consideration. The third category has been spoken of before, will never cease, and will rise in proportion to the increase of the metals.

The second category—when the money has left the State—needs some explanation. That a State can meet with the same misfortune as an individual is obvious, but there are different casualties to be considered. In former times it was thought fit to stop entirely the exportation of precious metals, or, as it was said, to keep the money in the country. In 1726 and 1731 edicts were promulgated in Prussia forbidding, by heavy penalty, the export of gold and silver. The same king had paved the immense hall in his palace at Berlin with thalers, and the balcony for the music was of pure solid silver. I am happy to say that no trace of this is left

Similar intentions forgot entirely that gold and silver lose directly a part of their value, if it is not possible to buy with them all that is needed. The best proof of this statement is found during the early times of the California gold production. The value of the California gold was directly made out by the United States Mint—the ounce of gold dust equal to $18.05, or in bars to $18.48. But the gold in California retained this value only a few months after the discovery. The amount of coined money was at the time entirely insufficient, and for the largest part needed for payment to the Custom House. Therefore, by the lack money, which was here curiously the consequence of an enormous production of precious metals, the gold dust itself became a medium for exchange. An ounce of gold dust had declined the next month (in August) from $18.50 to $16, and later on even to $10. Therefore the citizens of San Francisco together united in resolutions, of which I shall read only the last:

4. "That every merchant taking gold dust at $16 per ounce in payment is to be meritoriously acknowledged."

The consequence of the fixed value of gold was simply that all merchandise and wages rose outrageously. There is a queer relic of the old California times still in existence in Oregon, Washington and the other northern Territories. The smallest currency there is in fact a quarter of a dollar, called two bits. If anybody buys a thing and tries to pay for it with the dime just returned to him, perhaps it will be taken, but in the eyes of the merchant you see clearly that you are classified among the meanest set of customers he ever met with. Of course, you have the chance to lose 20 per cent on each dollar, and you are sure to lose 10 per cent of it.

The prohibition to export gold is similar to prohibiting an individual from spending the money he has in his pocket. If he buys with profit he grows richer than before, though the money paid by him is no longer in his pocket. It would be therefore more advisable than prohibitory to order that everybody shall buy with profit. I do not know that any such edicts are still in force, except perhaps in some Asiatic Government.

A very similar incongruity exists when the wealth of a nation is calculated according to the returns of exports and imports. Suppose a merchant has exported $100,000 worth of merchandise, and has bought with it and imported with profit goods worth $150,000. The returns quote $50,000 more imported than exported, and calculate this balance as disadvantageous to the State. But if the goods which were to be imported had been taken by pirates or lost at sea, the $100,000 more exported would show a splendid balance to the State, which in fact had grown so much poorer. Everybody is aware that the fact of receiving a large amount of money is not necessarily identical with becoming richer; the more so as the wealth of a nation, as well as of an individual, consists in the value of all he possesses, and that the money is only a part of it, and mostly a smaller part, if he is very rich. Therefore, a larger receipt of money shown by the balance of trade cannot be considered as established proof of an increase of wealth of a country.

The increase of population and wealth throughout the whole world has been so rapid that no increase in the production of precious metals can be thought of which would be large enough to influence seriously the value of those metals. The immense production of silver by the Nevada mines has not shown a marked influence on the value of the silver. If really mountains of precious metals were to be discovered, the industry and the speculation would very soon find the right way to make the right use of them.

There lies much money on the road which only needs a keen eye to pick it up, says a German proverb; and I think the wonderful ice industry first discovered in Massachussetts is an evidence of the truth of this proverb. The deep impression made on my mind by a story told to me by the late Prof. L. Agassiz may excuse my repeating it here, though probably known to every person present. When the captain ordered to take the first ship with ice to Bombay returned, and reported that just enough ice had been left to invite the officers in Bombay to an *iced bowl*, a thing never seen there before, Mr. Tudor tapped gently on the shoulder of the captain, with the words, "You have made my fortune." The captain, believing he would be dismissed for incompetency, stood somewhat bewildered, when Mr. Tudor said, "You have shown the possibility of carrying ice to India; the next time we will arrange things better." And this was done.

The sources of wealth originate not in the money, but, besides, in our brains and in our industry—only in the productive powers of nature. As the successful use of these powers can only be based upon the intimate knowledge of them, political economy grants freely the first rank to the sciences of natural history as the real corner-stone of wealth.—*Boston Transcript.*

PERSEPOLIS.

FRANCIS L. MACE.

Here is the royalty of ruin : naught
Of later pomp the desert stillness mars;
Alone these columns face the fiery sun,
Alone they watch beneath the midnight stars.

Forests have sprung to life in colder climes,
Grown stalwart, nourished many a savage brood,
Ripened to green age, fallen to decay,
Since this gray grovè of marble voiceless stoon.

Not voiceless once, when, like a rainbow woof
Veiling the azure of the Persian sky,
Curtains of crimson, violet, and gold
In folds of priceless texture hung on high!

And what have sun and shadow left to us?
What glorious picture in this marble frame
Ever, as soundless centuries roll by,
Gives this lone mount its proudest, dearest fame?

The sculptured legend on yon polished cliff
Has lost its meaning. Persia, gray and old,
Upon her bed of roses sleeps away
The ages, all her tales of triumph told.

But here Queen Esther stood; and still the World,
In vision rapt, beholds that peerless face,
When with a smile which won a throne, she gave
Joy to her king and freedom to her race.

—*October Atlantic.*

CHANGING THE COLORS OF FLOWERS BY CULTIVATION.

Our knowledge of the chemistry of vegetable pigments is not yet sufficiently advanced, for which reason the effect of artificial influence upon the color-tone of flowers has not yet received its merited attention. According to my view, tannin is an important factor in the generation of vegetable colors; it is found in almost every plant, the petals not excepted, and by the action of the most varying reagents—alkalies, earths, metallic salts, etc.—it assumes the most manifold hues from pale rose to deep black. A darker color, therefore, is produced in flowers rich in tannin, when manured with iron salts, since, as everybody knows, tannin and iron-salts dye black, and produce ink. A practical use has been made of this fact in the raising of hortensias and dahlias. The former, which in ordinary soil blossomed pale-red, became sky-blue when transplanted into soil heavily manured with iron-ochre, or when occasionally watered with a dilute alum solution. English gardeners succeeded in growing black dahlias by similar manipulations. It is well known to every florist that a change of location, that is, a change of light, temperature, and soil (replanting) occasionally produces new colors, whence it may be deduced that an interrupted nutrition of the flower may, under circumstances, effect a change of color. We see no valid reason why the well-authenticated fact of the change of color produced by manuring with iron-oxide, thereby changing the nutrition of the plant, should not be practically employed by the hot-hous gardener. Another very singular and successful experiment, in producing a change of color in a bird, has recently been made. A breeder of canary-birds conceived the idea of feeding a young bird with a mixture of steeped bread and finely pulverized red Cayenne pepper. Without injuring the bird, the pigment of the spice passed into the blood, and dyed its plumage deep red. The celebrated ornithologist Russ believes that the color of the plumage of birds might be altered according to desire, by using appropriate reagents. —August Vogel, in *Popular Science Monthly* for October.

HISTORICAL DEPARTMENT JOHNS HOPKINS UNIVERSITY.

This is emphatically an age of historical study; in American history there is unprecedented activity. Among other indications of an awakened historical spirit is the appearance at short intervals of very interesting historical monographs from the Johns Hopkins University. In his eloquent "History of the English People" Mr. Green says that one studies the early popular meetings of the English communities before the conquest of England with something of the same awe with which one follows a great river back to its sources. It was with some such feeling as this that the Spectator, not long ago, found himself seated in the pleasant rooms devoted to the historical studies and researches of Dr. Adams in the Johns Hopkins University at Baltimore, where the data for American history are being so rapidly collected. The parlor floor of an old dwelling had been fitted up for the work of the historical department of the University; the walls from floor to ceiling are lined with books, including the library of an eminent German scholar to whose instruction many American students look back with profound gratitude; a long table, surrounded by comfortable chairs, accommodates the classes in history, and the entire absence of any of the conventional features of a college recitation-room is very agreeable. The atmosphere of the place gives no hint of dry recitations, but rather suggests the pleasant intercourse of a teacher with a band of students who are, as in this case, his companions in active historical research. In these pleasant rooms a very fruitful and promising historical work is steadily going on and bearing visible fruit in monographs on all manner of themes in our early history. —*Christian Union.*

VIBRATION FROM TRAINS.

At the meeting of the American Society of Civil Engineers, September 5th, a paper was read by James L. Randolph, member of the society, and chief engineer of the Baltimore & Ohio Railroad, upon "vibration, or the effect of passing trains on iron bridges, masonry and other structures." Mr. Randolph refers to the fact that double-track bridges are moved in the direction of passing trains and are consequently twisted, and strains are produced not provided for. Also that cattle-stops and open culverts where built of rubble work have the walls shaken to pieces by vibration. The remedy he has supplied for these culverts and stops has been to build them of large stone as nearly the same size as possible. The tall, thin bridge-piers and abutments on whieh iron bridges rest have their stone so much disarranged by vibration as to make it necessary to secure them with timber and iron straps. Iron bridges resting on stone pedestal vibrate in this manner, and receive a return blow from the vibrations of the pedestal, particularly if the pedestal is of a light structure, but as the iron and the stone do not vibrate in the same period there must be times when the result is a movement in the direction of the force. The effect of this vibration has been particularly noticeable at the Harper's Ferry bridge, where there was a movement of four inches in four years. After the insertion of planks between the stone and iron, this movement ceased where the masonry of piers has a platform of timber between its foundation and rock, no displacement of stone has been noticed. Mr. Randolph contends that a monolith would be the best support for structures subject to vibration caused by strains, but that a monolith of the specific gravity of granite would give a damaging return blow. Timber would answer the purpose, but is perishable. The material which, in his opinion, is most serviceable, is an artificial stone which is about two-thirds the weight of granite, is compact, durable and with very little elasticity.—*Railway Age.*

THE MAP OF SEBASTIAN CABOT.

The library of Harvard College, in Gore Hall, has recently been enriched with a photographic fac simile of the large map of the world in the National Library in Paris, known as the map of Sebastian Cabot. This interesting memorial was discovered in Germany about the year 1844 in the house of a Bavarian curate, and, through the good offices of M. de Martius, was in that year purchased for the Paris Library. It is a large elliptical mappemonde, engraved on copper, 1 metre 48 centimetres in width, 1 metre 42 centimetres in height. Along each side of the map, that is to say outside the circle, is a table 30 centimetres in width; the first, on the left, inscribed at the head Tabula Prima, and that on the right Tabula Secunda. On these tables are seventeen legendes, or inscriptions, in duplicate, that is to say in Spanish and in Latin, printed and pasted on the map. Each legend in Latin immediately follows the Spanish original and bears the same number.

Besides these seventeen inscriptions there are five others in Spanish which have no Latin exemplars. The ancient map, composed, as we shall see further on, in the year 1544, while Cabot was yet living in Spain, contains geographical delineations of discoveries down to about that period. In representing the north-east coast of our continent, NewFoundland is laid down as a group of islands, and we easily recognize the River and Bay of St. Lawrence, Cape Breton and the Isle of St. John. The west coast of America is delineated as far north as latitude 35°, California being drawn from the well known chart made by the pilot Castillo in 1541. To the north of this, of course, is the unknown region, for nobody then knew certainly whether America and were one continuous continent or were divided by straits, and the conjectures of the geographers were at variance. But the interest in this map centres principally in its inscriptions; and, though the most of these contain little of value in a geographical or historical point of view, a few of them are of special significance. The seventeenth inscription, by turning it into English, reads as follows:

"Sebastian Cabot, captain and pilot-major of his sacred imperial Majesty, the Emperor Don Carlos, the fifth of his name, and the king our lord, made this figure extended on a plane surface, in the year of the birth of our Savior Jesus Christ, 1544, having drawn it by degrees of latitude and longitude, with the winds, as a sailing chart, following partly Ptolemy and partly the modern discoveries, Spanish and Portuguese, and partly the discovery made by his father and himself; by it you may sail as by a sea chart, having regard to the variation of the needle," etc.

Then follows a discussion relative to the variation of the needle, which Sebastian Cabot claimed to have first noticed. Here we have the declaration that the map was made by Sebastian Cabot, pilot-major of the Emperor Charles V., and in the year 1544, at which time we know he was living in Spain and held that office. And this is accompanied by the statement that, in making the map, he was guided by the discoveries of his father, John Cabot, and himself. Description No. 8 reads thus: "This country was discovered by John Cabot, a Venetian, and Sebastian Cabot, his son, in the year of our Lord Jesus Christ, MCCCCXCIV (1494), and on the 24th of June, in the morning, which land they called 'prima vista,' and a large island adjacent to it they named the Island of St. John, because they discovered it on the same day," etc.

EDITORIAL NOTES.

THE first meeting of the winter session of the Kansas City Academy of Science was quite well attended and several new members were added to the list. The opening address was delivered by Mr. Ermine Case, the subject being The National Museum at Naples. It was extremely instructive and interesting, and will be published in full in the November REVIEW.

The Academy is now in its eighth year, and has, through the efforts of a few citizens, attained a recognized position among the scientific institutions of the country. Many of the papers read before it and published in the REVIEW have been copied in standard periodicals, both in this country and Europe, as valuable contributions to scientific literature, while its cabinet and library are creditable to it, as far as they go.

In view of the value of such lectures and such collections to a community, especially to so busy an one as this, it seems strange that they are not more freely made use of by our citizens, who can thus so easily keep pace with the scientific progress of the day. In a utilitarian point of view, when so many persons are prospecting in this vicinity for coal, iron, lead, and other minerals, a full set of fossils and geological specimens is a key to the locality, and may direct the work of the miner or save him much labor and money.

With such things in view, aside from the general information to be gained from connection with such a society, it would seem that our business men, our capitalists, our teachers, and our intelligent class generally, should foster it and with alacrity and enthusiasm come to its aid in its struggle to acquire a permanent home and in building up a museum and library that will be an honor to the community and State.

DR. E. LEWIS STURTEVANT, Director of the New York State Experiment Station at Geneva, among other agricultural experiments, has been testing relatively the fertility of tip, butt, and central kernels of corn. It has hitherto been the custom of farmers to select for planting only the central kernels, as being the most perfect on the ear, and consequently the most likely to produce the best grain. The results of Dr. Sturtevant's experiments, however, show a very different result: as (1) the tip kernels were the most prolific of good corn; (2) the butt kernels were more prolific of good corn than the central kernels; (3) the tip kernels bore longer ears than the other kernels, the butt kernels the next, and the central kernels the shortest; (4) the merchantable ears from the butt seed were distinctly heavier than those from the tip seed, and those from the tip distinctly heavier than those from the central kernels; (5) the butt kernels furnished more unmerchantable corn than did the central kernels, and the central kernels more than did the tip kernels.

THE publisher of the REVIEW has for sale, very low, a large, fine, new parlor organ, suitable also for college chapel, lecture room, or church. It is one of the very best styles, and can be had at a decided bargain.

THE address upon "Technical Training" referred to in the September REVIEW was delivered by Dr. Thos. M. Drown, Secretary of the American Institute of Mining Engineers, before the Alumni Association of Lehigh University, June 20, 1883. It was published by the University, and has received the highest commendations from the scientific press.

ERASMUS HAWORTH, who has contributed several valuable articles to the REVIEW within the past two years, has recently been chosen Professor of Physics in the College at Oskaloosa, Iowa. He is a graduate of the University of Kansas, and has since taken a course in the Chemical Department of Johns Hopkins University, which, taken in connection with his natural aptitude and love for scientific studies, renders his appointment peculiarly fitting.

PROF. W. H. PRATT, Secretary of the Davenport Academy of Sciences, writes us a personal letter in which he says: "I always find good things in the REVIEW, both original and selected."

No. XI of the "Johns Hopkins University Studies," of which Dr. Herbert B. Adams is editor, is entitled The Genesis of a New England State (Connecticut), and was read before the Historical and Political Science Association, April 13, 1883, by Alexander Johnston, A. M.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost for one year.*

THE question of succesful sugar-making from sorghum seems to have been finally settled in Kansas. The works at Sterling and Hutchison are now manufacturing large amounts of excellent sugar, well grained and of a high percentage of saccharine matter, as well as syrup of superior quality. It is believed that within another year enough of both will be made to supply the demands of the whole State.

THE success attend the experiment of boring artesian wells in Denver and other localities in Colorado is quite remarkable, and justifies the suggestion made by the writer, in a lecture delivered several years ago, that the time would come when such wells would not only provide water for irrigating the desert lands of the great plains, but also possibly solve the question of draining the mines of the Rocky Mountain region.

PRINCIPAL GREENWOOD, of this city, has commenced the delivery of a series of thirty lectures upon the Philosophy of Teaching, before the teachers of Kansass City and such other citizens as propose making teaching a profession or are interested in the subject. they are delivered at the High School building Friday afternoons.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *American Naturalist* stands among the foremost of the scientific periodicals of the country, and at the same time it has a host of friends among non-professional readers. It probably occupies a field intermediate between the *American Journal of Science* and the *Popular Science Monthly*; less technical than the first and less speculative than the latter. We always take it up with the certainty of being entertained as well as instructed, and are seldom disappointed. The October number presents geological articles by Prof. T. Sterry Hunt; a continuation of the report of the Naturalists' Brazilian Expedition, by Herbert H. Smith; Man's Place in Nature, by W. N. Lockington; a well-timed editorial upon Questionable Innovations in Nomenclature; reviews of late works; notes by the various co-editors upon Geography and Travels, Mineralogy, Botany, Entomology, Zoölogy, Physiology, Psychology, Anthropology, and Microscopy.

Science of August 31st apologises for an error in a statement in a previous number regarding the customs duties on periodicals, but excuses itself by saying that "our post-office regulations are so frequently changed that one can rarely tell whether he is the victim of a blunder or a whim." Inasmuch as such duties pertain solely to, and are regulated by, the Treasury Department, it would appear that an apology to the Post-office Department is now in order.

THE *Princeton Review*, edited by Jonas B. Libbey, is now in its fifty ninth year. The September number contains a reply by President Porter, of Yale College, to Mr. Charles Francis Adams' attack upon the study of ancient languages in our colleges; a tariff article by Herbert Putnam; one upon Incineration by Rev. John D. Beugless; "The Artist as a Painter," by John F. Wier, N. A.; "The Antecedent Probabilities of a Revelation," by David J. Hill, Ph. D.; "Recent French Fiction," by J. Brandner Matthews. Bi-monthly, $3.00.

WE learn from *Science Observer*, Sept. 21st, that the comet discovered by Prof. Lewis Swift on the 15th is probably that of 1812, though it has arrived some three months sooner than was anticipated. It will be within 60,000,000 miles of the earth about the middle of January, and visible to the naked eye.

THE September *Magazine of American History* comes freighted with entertaining and instructive reading in generous measure, and with thirty or more attractive illustrations. It is one of the best numbers of this standard publication yet issued. The leading article is by Gen. John Cochrane, entitled "The Centennial of the Cincinnati," and is illustrated with portraits of several of the founders.

THE October number of the *Popular Science Monthly* closes the twenty-third volume of that well-known periodical, which has had a most successful career of nearly twelve years. This number contains many valuable articles, partly original and partly selected, while the book notices and editor's table are always able, fresh, and instructive.

THE *Educational Advance*, published by Thomas H. Frame, at Liberty, Mo., and edited by Gilbert B. Morrison, improves with each number. It commenced its second volume with September, and should receive a generous patronage as a home school journal. $1.00 per annum.

W. H. McAdams, the Alton, Ill., geologist and archæologist, is now in Dakota with Professor E. D. Cope, exploring the geological formations in quest of new palæontological monsters. He is writing an account of his trip to the *Alton Telegraph.*

According to the *Scientific American*, the cable railway at the Giessbach in Switzerland is operated by water. On the arrival of a car at the upper station it is weighted with a sufficient quantity of water from a reservoir, supplied by a spring, to draw up the other car; so that each car alternately acts as a motor at a very small cost. This idea might be turned to account among the mountains of our own country, and even, perhaps, at Niagara Falls, where at present the transportation is so expensive.

The *Engineering and Mining Journal* describes an ingenious device near Virginia City, by which a Mr. Townshend substitutes sand for water in working several arastras. He lifts the sand into a reservoir by means of an endless chain of buckets, operated by a wind-mill, and then lets the sand pour in a stream upon an overshot wheel.

The *Revue D'Ethnographie*, published by M. le Dr. Hamy, and edited by Ernest Leroux, at 28 Rue Bonaparte. Paris, was founded in 1882 and has secured a firm footing among standard periodicals of the day. It is devoted to original memoirs upon ethnological and archæological subjects; to reviews and analyses of books; to accounts of discoveries and of remarkable collections; to bibliography, and to appropriate notes and queries. Annual price 30 francs, single numbers 5 francs. It is issued bi-monthly, and copiously illustrated.

Number 48 of the *Humboldt Library* presents "Life in Nature," by James Hinton, forty-eight pages, octavo, for 15 cents. This closes the volume, which consists of 600 pages of valuable popular science literature, and can be bought for $1.50, postpaid.

At a meeting of the stockholders of the Florida Ship Canal and Transit Company, on Tuesday, the board of directors was authorized to make a contract for the construction of the canal, the work to be commenced at the earliest possible day. The canal will probably take the route which *The Age of Steel* pointed out last summer as the most desirable, both as regards distance and the cost of construction per mile. The canal will be between 130 aud 140 miles long, 230 feet wide, and 30 feet deep.

Besides the very valuable and interesting artlcle upon "Early Man in America," by Prof. W. Boyd Dawkins, of which we give the greater portion in this issue, the *North American Review* for October contains an article by Prof. C. A. Young, late President of the American Association for the advancement of Science, entitled "Astronomical Collisions;" a very full discussion of the bimetal question, by Senator N. P. Hill of Colorado; a most valuable critical historical article upon the French Revolution and its histories, by Mr. Frederic Harrison; "The Saint Patrick Myth," by Moncure D. Conway, etc. An unusually popular number in our estimation.

The *American Trade Journal* quotes the London *Morning Advertiser* in advocating the ship railway system of Captain Eads, with Captain Eads to carry it out, in lieu of the ship canal of De Lesseps, with De Lesseps in charge; and hopes that such an achievement may be added to the list of those already accomplished by him.

We are indebted to Thos. Pray, Jr., editor of *Cotton, Wool and Iron*, one of the leading commercial and mechanical papers of this country, published at Boston, for the loan of the electrotypes which illustrate the very interesting article in this number of the Review upon "The Tools of the Pyramid Builders," which article is also reprinted from that paper, though it was originally written for *Engineering*.

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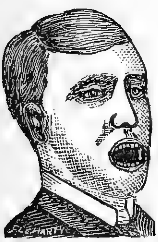

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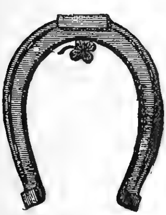

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SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VII. NOVEMBER, 1883. NO. 7.

PROCEEDINGS OF SOCIETIES.

THE MUSEUM OF NAPLES.[1]

ERMINE CASE, JR.

It is not to be wondered at, that the average American comes to have a pretty low opinion of that sort of institution denominated a museum, and naturally recurs to the type which has a hand-organ at the front door, and a stuffed mermaid on the staircase. The museums of European cities are somewhat different—not being confined to curiosities and by no chance ever containing monstrosities. A museum there may be only a gallery of pictures—possibly a collection of statuary.

Ordinarily, however, the word is used to designate a general collection of works of art—in oil, marble, bronze and plaster, archæological objects, ceramics and gems, coins, and books, prints, autographs, and illuminated mediæval missals, tapestries, curious carvings and relics of historical personages.

These collections are most usually owned by the government—sometimes by the cities in which they are situated. They are preserved in immense fire-proof structures, architecturally accurate. Costly too, in a degree we have no measure for even in our capitol buildings. However, in point of cost, these ornate buildings and extensive grounds bear no comparison to the value of the articles which constitute the museum.

I feel free to estimate the building which contains the British Museum, and

1 Read before the Kansas City Academy of Science, September 25, 1883.

its grounds in the heart of London, to be vastly more valuable than the grounds and Capitol building of the United States; while its contents range still higher, especially during sitting of Congress.

There are seven of these grand collections in Europe that are entitled to especial pre-eminence. The British, before mentioned, especially eminent for its archæological remains, of which there are some acres—notably the Elgin marbles—for its geological, mineralogical, and zoölogical cabinets; its library, unrivalled so far as English books are concerned.

The Louvre in Paris, which is even more magnificently housed, and more elegantly surrounded. This museum is, considering all topics, the most valuable in the world.

The gallery at Dresden, first among collections of paintings. The Pitti and Ubizzi Palaces at Florence which contain in mediæval paintings and antique statuary together the most famous gathering.

The Vatican, first in statuary and Roman, Grecian and Egyptian architectural remains, containing also a half dozen of the very first of paintings.

And sixth the Museum of Naples.

These collections are carefully and scientifically catalogued by men of great learning in the specialties which their museum covers, and one may see these grey old *savants* slipping about the corridors in big felt slippers and silk skull caps, now carrying a precious fragment of some Theban temple, or studying a cast of a far-off cuneiform inscription, surrounded by old tomes and charts, and now pointing out to some congenial, slippered and skull-capped scholar a newly arrived bone of Saurian from Nova Zembla or Arizona.

In several particulars the Museum of Naples is more especially unique than any I have specified, containing as it does the excavated treasures of Herculaneum and Pompeii, of Stabiæ and Cumæ. These are simply unrivalled in all the world. Here we have the household effects of a populous city, hermetically sealed by the ashes of Vesuvius, during the storms and tempests, during the wars and improvements of eighteen hundred years.

In order to emphasize the intense interest that gathers about the treasures excavated from these buried cities, let us for a moment contemplate the Rome of the Cæsars preserved to us by such an accident as befell Pompeii. Here again, there is the Forum with its surrounding temples of marble, decorated with that army of living marbles, rifled from Greece, Egypt and all the eastern world; possibly a pilaster still holding the skull of Cicero, or some one of his successors. Here are the triumphal arches, carved with victories from York to the third Cataract. Here is the colosseum not yet unrobed of its marble veneering; the golden house of Nero and his statue one hundred feet in colossal height. Here are the golden chariots and the gorgeous armor of the imperial legions. Here is the Circus Maximus with its 140,000 seats. The Fora of Augustus and of Trajan. The walls, the gates, the battlements, the unbroken arches of the eleven aqueducts stretching yonder to the Alban Mountains across the Campagna, among the unruined tombs of emperor and conqueror, of warrior, historian and poet; aye, and by the entrance to those catacombs where the early Christians held their secret worship.

So too, we should have the interior of the dwellings of the emperor, the nobleman, the rich citizen, and the plebe. How many of those good Romans would our modern enthusiast of science be willing to know were smothered eighteen centuries since, in order that he might see imperial Rome in the grandeur of the first century. The countenance of that enthusiastic member of our Society who digs unweariedly in the mounds along the Missouri—methinks I see it light up with a sort of scientific joy as he discovers the crumbling bones of a possible prehistoric man, lying amidst his wretched arrowheads and potsherds. What, then! Could he find the skeleton of Augustus, mayhap under the shadow of the unstripped Pantheon, lying on his golden chariot, the skeletons of whose horses there lying, with gilded hoofs and brazen trappings. Around him would be found all that Greece had gathered from the world and Rome had brought from Greece.

This may never be. Five hundred years of war, and five hundred of robbery, left Rome what it is still—a dismal Italian city, with ruins so utterly ruined as to barely suggest to the imagination what the ancient city might have been; the works of Praxiteles turned to lime.

Let us turn, then, to the Museum of Naples and learn what the volcanic scoriæ of A. D. 79 did for the nineteenth century. I find I cannot write of this collection without trying in a measure to reproduce the atmosphere of the place. I believe environment is recognized as an influential element in all scientific matters. We will suppose that you have come out of your hotel on the Chiaja on a warm January morning; that you invested five cents in rose buds and orange blossoms with the black-eyed flower-girl in the vestibule, and that you stand on the steps a moment to look out on the famous bay, now curling with blue (they are very blue) waves. You see a dozen orange-colored sails of fishing boats—a steamer just starting for Alexandria—and a three-master coming in from the Golden Horn. Just at that point you find five yelling, whip-cracking cabmen roaring at you from the gutter, a coral-girl hanging her strands on one arm and a beggar with a colossal sore at the other. You will take refuge in a cabriolet and drive off up the long ascending slope of the Toledo, teeming with humanity as no other street. Arriving at the Capo di Monte, half a thousand feet above the shore, the whole of the magnificent bay of Naples lies before you. There is no other such view, I believe, on this earth.

Vesuvius you will necessarily notice first, for the volcano is close at hand, and its fire-stained black plume is floating just over you—its vineyards and olive orchards extending right up to the line of black lava of 1871. You cannot see Pompeii for it is opposite the mountain, but the site of Herculaneum is marked by the town of Portici, built upon the sixty foot bed of lava that still holds the greater part of its treasures. Around the entire bay sweeps a line of mountains, with the white towns clinging to their sides. Castlemmare, over buried Stabiæ and Sorrento. In the dim distance are the islands of Capri and Ischia. It is, however, the western shore of the bay that appeals most warmly to the classical scholar. In a warm and sheltered nook was Baiæ, the most magnificent watering-place of the Cæsars, and where Cicero, too, had a villa. Now all is ruin, save the sunshine, the balmy air and the view of the bay entire. Only a mile along the coast and there is Lake Avernus, with a good, honest smell of sulphur. There is the Sibyl's Cave; there flows the literal Styx. Along this coast many of the labors of Hercules were performed. Here was Cumæ, which has contributed many superb statues to the museum. Here at Puteoli Paul landed and began at this terminus of the Appian way his journey to the judgment seat of Nero. Here is pointed out the tomb of Virgil, and we need not inquire too closely as to its authenticity. Suppose it was built in the sixteenth century, have we not created busts of the same old poet 300 years later? So then we have the atmosphere of natural beauty, of antiquity, of sculpture, of poetry, and may descend to the scores of enormous halls which hold the remains of this most interesting region.

Classifying in the order of those topics to which I shall give the least attention, we come first to the library. Though not a notable collection, there are over 200,000 volumes and 4,000 MSS. Among them are rare MSS. of antique date—missals illuminated by the masters, and some rare first editions. After all, a library cannot be described and must not be enumerated. One is never able, however, to enter one in the old world without finding something curious and unique. In this at Naples the chief attraction for the curious traveler is the library of Papyri—being some 1,800 rolls of MSS. on papyrus written in Greek. They were found in a carbonized state among the ruins of Pompeii. German scholars have been engaged years in deciphering them, but with no very valuable result.

Next in order will be the gallery of paintings. In respect of works of the old masters it is by no means rich, and yet nearly all are represented by several specimens. One must speak of these galleries of pictures relatively. In Italy this collection is fifth rate, while the city of London would pay any designated sum for it, as with all their wealth the English have been able to obtain no very good works of the Italian masters. Napoleon accumulated a large number for the Louvre as he was going about Europe on other business. Although there are some two thousand pictures here, and among them the usual assortment of Raphael's, Correggios, Guidos, Carraveggios, and Tintorettos, there is no one picture so pre-eminent as to have a world-wide reputation, but were there many they could not be depicted here. Only the technical features of a painting can be described, and then only to an artist by technical terms. No books are so tedious as those which posture and exclaim before the works of the old masters. It is very hard in a practical city like this—exclusively utilitarian in its pursuits—to understand what a hold art has upon the intelligent people of the old world. Not simply nor chiefly that they love to look upon a picture or a statue as mere decorative articles cleverly representing interesting subjects. Art is given a high place in education. It is made an instructor, historical, technical, archæological, anatomical, mythological. Educated men, in Europe, all know its principles, its methods, and its schools. They arrange themselves definitely as the disciples either of the pre-Raphælite or the renaissance, just as aggressively as we are for or against a metal currency.

Next we come to the collection of statuary, probably the very best in Europe, as it includes many specimens of the very highest order, preserved to us in perfect form by the ashes of Vesuvius, and not with broken noses, dislocated ankles, and armless trunks, so common among the statues of northern collections.

The most productive quarry of statues at Rome has been the moat outside the old walls from whence they were thrown as missiles upon the invading Huns.

Here, at Naples, is a league of corridors filled with heathen deities and busts of Grecian and Roman emperors, consuls, famous soldiers, orators, and poets.

One comes to have a personal acquaintance with many of these marbles by their attributes. Here is a Minerva with her helmet; a Hebe with her cup; a Mercury with winged sandals. You know old Hercules by his muscle and his club; and Æsculapius by his staff entwined by a serpent. Here is a Venus, she has no attributes; she left them at home with her clothes. Fauns and Satyrs abound—half human, but wholly animal. Indeed it is from these marbles that the modern world obtained its idea of the Gods of the ancients. From these and a scant literature we have reconstructed their mythology, drawn our poetical figures, and our highest ideals in the art of sculpture.

It is certainly most curious, not to use a more discouraging term, that we are not now able to make a copy of a few of these noblest sculptures; only the plaster casts are fully equal to them. One is almost disposed to complain that they were ever discovered, then we should have been satisfied with the great mass of ancient and modern sculpture. But there stands this living dozen and the rest are stones.

So it is with the bronzes. Those that were exhumed from the ruins of the buried cities are the finest known. They too evince the inimitable grace of the Greek art. There are many large rooms filled with them, and they seem untarnished by long centuries of exposure to the wet soil.

There are those here who have had experience of the fragile character of the plaster on our western houses. They will be interested in the article produced by the builders of the first century. One of the methods of decorating a family residence in those days was by painting in fresco, and this was done upon the plastered walls. Fortunately for the preservation of this painting, now bearing the greatest antiquity of any extant, the plaster was not only able to bear the terrific shock of centuries of earthquakes; and withstand the drouth and moisture of the soil which pressed against it, but also after being exhumed, bore the process of being sawn from the walls in sheets, and carriage to the museum, where it now lines the sides of many large rooms. These frescoes are all light, graceful and fantastic. They are of brightly colored fruits, flowers, and birds—of bacchanals, nymphs, and fauns, of dancing figures, and cup-bearing Hebes. All are intended to delight and make life merry.

I have said that they are the oldest paintings now in existence. In all the ruins of Athens not one picture has been preserved. Here and there are famous buildings are traces of color, showing that at one time they were decorated with paintings. Here then at Pompeii, in Greek painting, is an invaluable commentary on the methods of decoration, that were certainly in vogue in Athens and the Piræus. Only here can we learn how different was Grecian taste from that of the fifteenth century, when the old masters filled the churches with crucifixions, dolorosas, adorations and madonnas. I can only suggest the value of these paintings in showing the customs, in Græca Majora during the first century. We must pass to other rooms equally interesting.

In a long series of great rooms are preserved the articles in domestic use. There are many thousands of them, and yet a plain catalogue of them is interesting reading, or would be, had one ever been made. None has.

In the first place is a large model of Pompeii as it now exists. I estimate it to be forty feet in diameter. It is made upon a scale of exact proportions. Every street, every temple, every residence, or wine shop; every broken wall, every shattered column and broken fountain; every sentry box or amphitheatre. Whenever a building is newly excavated, its counterpart is placed here. Had the furniture of a modern house been subjected to the test these have, little would have been left but the casters of beds, and tables, and broken chairs, but here are bronze beds, bronze tables, bronze lamps, candelabra and dishes, and in the forms of these brazen articles we see the Greek taste that required ornament and lines of beauty in utensils of the most common use. Here is a frying-pan whose handle terminates with a fleur de lis, or a guelder rose, and of a bronze that has perfectly defied all these centuries; a candelabrum from the villa of Diomedes ornamented by a Bacchus riding a panther. Lamps with a standard representing an Ionic column. Hundreds of lamps are scattered through all the collection—all are different in design; all are tasteful and unique, but none of them are adapted to furnishing a light. A rag in a tin cup of oil is the pattern so far as practical use is concerned. No wonder the ancients were afflicted with ophthalmia. We read wonderful stories of elaborate dinners extending deep into the night, of perfumed lights and other similar etcetera. The lamps of Pompeii give these stories conclusive contradiction. A few small dull sheets of glass are shown, but windows are as scarce in Pompeii as in the catacombs of St. Calixtus. So we reason that these merry Greeks lived in the open air of their sunny clime, and so also did their Roman imitators, and made hay while the sun shone; that theatrical displays and gladiatorial games were held in the daytime. Further supporting this idea about light is the fact that each house of any pretension was built around an open court, which was surrounded by galleries. There are a number of other articles in glass, such as vials for medicine, and tear-bottles. I believe there is but one chair in the collection; however, there are many couches, and lounges, such as were used during their protracted dinners. These are often daintily decked with horses' heads, swans, limbs of beasts of prey—of course all in bronze. There are knives, forks, steelyards, a cooking-stove, kettles, pans. We have invented little in kitchen furniture since then—possibly explosive stoves.

A race of plumbers died at the destruction of Pompeii, for in the museum is a water-cock that has held water ever since.

There is a great room filled with cases of jewelry in gold, chains, necklaces, brooches, bracelets, rings, cameos, intaglios, gems, musical instruments, surgical instruments, and weapons. All of them richly wrought in designs, still the models of our best workmen. Vases, goblets, spoons, buckles, combs, silver-plate of many patterns.

I must conclude with what is perhaps the most beautiful part of this museum. The collection of vases. It is the most extensive and valuable in the world. Seven very large rooms are filled with them. The period of their manufacture is believed by the best authorities to have been shortly after the time of Alexander the Great. They are made of ordinary pottery and are usually of the shape of what we call urns. They vary in size from a common wine-glass to a height of six feet. Their great value lies in the historical cartoons with which they are decorated. From them the classical scholar obtains the illustrations of his study. They are done in brilliant colors and show the most vigorous action. The mention of a few of the subjects will give an idea of the value they are to modern scholarship. Perseus releasing Andromeda. Electra and Orestes mourning at the tomb of Agamemnon. Condemnation of Marsyas. A Battle between Greeks and Amazons. Marriage of Bacchus and Ariadne. Hercules pursued by Apollo. Bacchanalian Sacrifice. Achilles with the body of Hector. Darius planning the Conquest of Greece. Rape of the Golden Fleece. Ajax and Cassandra. Artemis in a Chariot drawn by Stags. Here we have, vividly illustrated, all important matters of ancient Grecian life. Marriages, funerals, battles, races, sacrifices, costumes, vehicles.

From them, and them only, we can illustrate the writings of Homer and Virgil. It is impossible to estimate how much has been added to our knowledge of antiquity by the articles in this museum.

From a tripod upon which sacrifices were made we have a chapter of history. From the iron stocks, found at the barracks of the gladiators, near which three skeletons were found, we have another. We know that the tradesmen advertised, for upon a charred loaf of bread, of the same shape now used in country families, is the name of the baker plainly stamped. They were gamblers, for here are the dice. They drank deeply, for amphoræ for holding wine are numerous and capacious. For the ladies there are mirrors, combs, perfumes, and even cosmetics. There are tools for the mechanic, implements for the farmer. There are locks to keep out thieves, bits for horses, hinges for doors, inkstands and styles for the scribe. In fact from the innumerable objects we find that these people of the first century had about them a vastly higher realization of art, than we of America have now. That their temples, their theatres, their parlors, and their tombs were most richly decorated; but that they had no windows, no bed chambers, no pleasant, private domesticity.

Let us examine this collection for a moment, with a view to the changes that have taken place since it was hermetically sealed up for us by the kindly ashes of the volcano. Heathen Greece went over into heathen Egypt and brought back the graven deities; taking from them her first lessons in art, but the Gods of Egypt became not the Gods of Greece, but came to decorate her architecture and give ideals in conventional forms. In time Heathen Rome crossed over to Greece and brought back at the wheels of her war chariots an army of living marbles to decorate her capital and to decorate Pompeii, and other fashionable watering-places. And again came the Goth and Vandal southward to Rome, and heeding neither art nor deity, destroyed forever all that was typical of the high civilization of the era of the Cæsars. Meanwhile ashes and pumice and lava, had covered Pompeii and Herculaneum, Cumæ and Stabiæ, and when at the end of eighteen hundred years they were exhumed, heathen worship had passed from among civilized nations. Jupiter and the lesser divinities found themselves illuminated by the white light of scientific investigation and not by the lurid torch of incense, burning priests or by sacrificial fires. They were still the highest achievements in the art of sculpture, but they were no longer Gods. Artists and archæologists, antiquarians, and expert critics go there to study, but the day of their sanctity has forever passed away.

It would have been easier for me to have written much more than I have, than to have attempted to make typical selections as I have. If I have succeeded in giving an idea of the extreme value and unique character of this great collection, I must be content.

PHYSICS.

ELECTRICAL PHENOMENA IN THE ROCKY MOUNTAINS.

GEORGE H. BOEHMER.

In June, 1873, the Chief Signal Officer of the Army ordered the erection of a station of observation on the summit of Pike's Peak, Colorado, the establishment of which became entrusted to me; and while engaged in the execution of this task I had occasion to observe some electrical phenomena which, in consideration of the altitude at which they were observed—an altitude at which thus far very few, if any, observations on the subject had been made,—are supposed to be of sufficient interest to justify their publication.

In addition to my own observations—terminating in December, 1873—I have collected from the daily journals kept by the observers stationed at Pike's Peak until the close of the year 1880, with permission granted by the late General Albert J. Myer, all the facts bearing upon the subject, giving them in the exact language of the respective observers and without venturing to discuss them and offering only a few explanatory remarks on my own observations.

The proper execution of the work—the construction of a trail of approximately seventeen miles in length, which, starting from the foot of the mountains at an elevation of about 6,000 feet, had to be located in accordance with the topography of the mountains, and which was followed immediately by a telegraph line—rendered it necessary to change our camp often, thus causing a frequent changing of one terminus of the line while the other was permanently located in the office—Colorado Springs—at the foot of the mountains.

The battery employed for the purpose, being located in Colorado Springs, was of sufficient strength to successfully operate double the distance, and of its efficiency I was fully convinced, having had occasion to test the same repeatedly.

While camping in the lower regions of the mountains up to about 8,000 feet elevation, the signals arrived at either terminus of the line perfectly intelligible, yet, I noticed on several occasions that they were much more precise and marked at the lower station (Colorado Springs). I was at first puzzled to find a solution for this occurrence, but when, notwithstanding the most careful selection of a ground-connection, the intelligibility of the electrical signals received in camp, diminished with increase of distance and ascent into the higher regions of the mountains until, at an elevation of 11,500 feet (the timber line of the Rocky Mountains) not any were received in camp, while those sent down arrived in Colorado Springs plain and sharp, it appeared to me that such irregularity might be ascribed to the following cause:

The electricity left Colorado Springs at the positive pole of the battery; therefore, when the signals sent from that place did not reach camp at all or only indistinctly, it may be supposed that on such occasions the state of the atmosphere was highly negative electric, and thus resulted in the partial or entire neutralization of the voltaic electricity, while in sending down from the negative pole, a stronger current was produced by the consolidation of the atmospheric and voltaic electricity, both being negative.

Another phenomenon which came to my personal notice—though being felt more than seen—taught me a rather severe lesson.

After the passage of a very severe storm which had been raging in the mountains for several days, not any electricity, could be perceived in my line and even that sensitive electrometer—the tongue—failed to recognize its presence, thus indicating a break in the line, and which I found to be at an elevation of approximately 9,000 feet.

The day set apart for the repairing of the damage proved to be misty and rainy. Expecting a slight shock in making the connection I protected myself to the best of my ability, but the shock received upon *nearly* joining the two ends was such that upon twice repeating the experiment without success, my arms were rendered absolutely useless and pained me for a whole day. A few days later, on a fine and clear day, not any difficulty was experienced in making the desired connection.

In August, 1873, while spending a few days in my office, in Colorado Springs, I noticed, during the passage of a heavy thunder-cloud, a very interesting phenomenon. The self-registering apparatus attached to Robinson's anemometer suddenly, and without the application of an electric battery, commenced registering the velocity of the wind, which at that time was blowing quite briskly.

The most interesting phenomenon, however, I had an opportunity to observe on the very summit of Pike's Peak, during the occurrence of a severe thunder-storm, probably 3,000 feet below our feet. On this occasion my party became somewhat alarmed at the effects of the atmospheric electricity upon men in producing an itching sensation in all extremities, a crackling noise, slight nausea and a humming noise, somewhat resembling that produced by the swarming of a hive of bees. On this occasion I recalled a certain experience I had in 1871. At that time I was in charge of the meteorological station in Leavenworth, Kansas, and had established my office on the third floor of a very tall house, the roof of which was covered with tin. On the roof I had placed quite a number of instruments, among which was a wind-vane with telescopic rod, the lower end extending to the ceiling of my room, where a gilded arrow, connected with the rod indicated the direction of the wind. The elevation of the upper extremity of the rod, ending in a gilded point, was about twenty feet above the roof. Quite frequently I had noticed, while sitting at my desk, and most especially during the prevalence of thunder-clouds, a peculiar, singing noise, which I then compared to that produced by swarming bees, without being able to detect the cause of the noise. At one time, however, being employed on the roof, in making repairs to some of the apparatus, my attention was drawn to this singing noise proceeding, apparently, from the iron structure of the wind-vane. Upon applying my ear to the rod I could plainly and distinctly hear this sound. Now, in placing the telescopic rod in position I had observed a gas pipe in close proximity, I removed a portion of the ceiling and by means of a copper wire made a connection with this pipe—and indirectly established a ground connection—and from that time I failed to notice the recurrence of this noise, although I paid the closest attention during the entire next year, the last one I spent in that office.

While thus employed in comparing the peculiar sound I extended my finger towards one of my companions and instantly a spark was seen to pass over. The hair on our heads stood on end, and a diverging position was noticeable in the hair on the tails of our horses, which we had left standing about seven feet off. Bits of paper which I threw into the air became attracted by the horses and attached themselves firmly to their tails. A discharge from the clouds restored the equilibrium, but the phenomenon repeated itself several times during the next ten or fifteen minutes, the duration of the thunder-storm.

ABSTRACTS FROM THE JOURNAL OF MR. R. SEYBOTH, FOR 1874.

January 5.—Humidity increased during the day and reached saturation at night, although the weather was nearly clear. The line worked badly all day. I could plainly hear the (Colorado) Springs calling me but could not break until night.

January 31.—From some unexplainable cause the afternoon report was delayed several hours, the line being open but commencing to work again without either summit or base station having made any repairs.

February 28.—About 8 A. M. I heard some one calling me very indistinctly, it sounded as if the wire had been cut and some one was trying to send by working the two ends of the wire. I asked him to repeat and he sent back "answer again" which were the only words I could understand.

The afternoon report was not taken at Springs—probably line worked too poorly—neither did I hear Springs call me up when it was time.

March 1.—Line worked miserably through the afternoon, so that I could not break the Springs. At night line worked better.

March 11.—Line went down at 7 P. M., but got all right again on,

March 12.—at 8 A. M.

March 29.—Line opened at 7 A. M. Found no break. Line worked again at noon and operator from below on trial, said that he found no break, but that he had no current on the "Lake cabin," although he had put on a ground at that place.

(It may be mentioned here that the line is patroled from above and below, the rendezvous being at an elevation of 9,000 feet, where, on the shores of a lake —"Mystic Lake"—a cabin has been erected to afford shelter to the repairer.)

Special remark by the observer: The difficulty in communicating with base station increases as the weather grows milder. For a great distance below timber line the wire is imbedded in snow.

April 6.—The line worked miserably all day, and I could not communicate with base station unless the Denver battery was in circuit.

April 15.—Line worked too poorly to send the afternoon reports, and opened entirely in the evening.

April 16.—Line open all day. I walked quite a distance down, but found no break. The task is almost a hopeless one, as the snow hides poles and wires in many places.

April 30.—The base has much difficulty in reading my signals, even in dry weather.

May 21.—Thunder-storm, hail, and sleet. A flash of fire, about two feet long leaped from the lightning arrestor into the office, illuminating the rooms, but doing no damage.

May 24.—Heavy thunder-storm passed slowly and directly over the Peak from 10 A. M. to 3 P. M. The temperature declined during the passage, and large sparks passed constantly through the lightning arrestor, while a strange crackling of the snow could be heard at times.

While making the 2 P. M. out-doors observation I heard the snow crackle as before and at the same time I felt on both temples—directly below the brass buttons of my cap—a pain as if from a slight burn. Putting up my hands, there was a sharp crack and all pain had disappeared.

May 29.—A violent thunder-storm accompanied by heavy sleet passed over the Peak from S. SE. to W. NW. It came upon us so suddenly that I had barely time to cut out the telegraph instrument, before blinding flashes of fire came into both rooms from the lightning arrestor and stoves. At 7 P. M. a bolt struck close to the north window, and at the same time a heavy discharge took place through the lightning arrestor, which made me, for a moment, believe that the building itself had been struck and was on fire. A cloud of smoke filled the embrasure of the north window, which was afterwards found to have resulted from the melting of the rubber insulator on the office wires.

The lightning arrestor was badly burned, and the line did not work that night; very likely the wire has been burnt outside.

June 1.—Line worked poorly.

June 5.—Heard Boutelle (operator on the trail) call base and summit, apparently from some point of the trail, but could not break.

June 6.—Line worked so poorly that I could not raise base at night.

June 10.—Line open; apparently no break.

June 18.—Much lightning passed through the arrestor, although I had the line wire connected outside with the ground wire.

July 1.—Heavy thunder-storm and sleet in the forenoon. Visitors caught in the storm said that they all experienced peculiar burning sensations on face and hands, and heard hissing sounds proceeding from their hair and whiskers.

July 9.—Heavy thunder-storm SW., from 3:30 P. M. to 4:15 P. M.; heavy sparks through lightning arrestor.

July 14.—Thunder-storm. I received a very painful shock while working over the line, my fingers accidentally touching the metal of the key.

July 16.—Heavy thunder-storm. Sharp flashes and reports came through lightning arrestor to the terror of several lady visitors. Outside, the electric effects were still more startling. The strange crackling of the hail mentioned before, was again heard, and at the same time my whiskers became strongly electrified and repellent, and gave quite audible hissing sounds. In spite of the cap I wore, my scalp appeared to be pricked with hundreds of red-hot needles, and a burning sensation was felt on face and hands. Several of the visitors, outside, experienced the same, and a large dog out doors became terrified and made for the door with a pitiful howl.

July 19.—Lightning struck the wire, and for a moment the wire resembled a rope of fire and vibrated violently for some minutes after the discharge. No damage. Frequent loud discharges took place along the ground wire, between it and the rocks on which it rests. Hair and beard of any one out doors were electrified by each discharge.

July 21.—Heavy discharges through the lightning arrestor, and although I had opened the key, the lightning jumped the space and worked the relay until I took all the wires off.

July 22.—Received heavy shock while attempting to send a message.

August 13.—Visitors became electrified.

August 17.—Continuous ground currents through the lightning arrestor.

August 22.—Visitors electrified.

ABSTRACT FROM THE JOURNAL OF MR. THOEDOVIUS.

October 5.—Thunder-storm. Received severe shock while endeavoring to call base station.

ABSTRACTS FROM THE JOURNAL OF MR. J. V. BROWN FOR 1875.

May 24.—Hail. Electricity; at times the office filled with it, while sparks from the lightning arrestor filled the room with sulphurous smoke. Lightning struck wire near the house, nearly knocking observer down. Amount of electricity increased and decreased with increase and decrease of hail, which fact is noticeable in all our storms.

May 29.—Hail with electricity. I notice that in all our hail-storms the fall entirely ceases for about half a minute following a heavy electric discharge, and that the hail-fall is considerably heavier for some little time following the discharge than before.

July 5.—At noon, electric storm with hail. At first its effects were felt or seen on the line, but at 2 P. M. its presence was felt on the summit. From the lightning arrestor there was a constant stream of flame, filling the building with sulphurous smoke. Out of doors it was even worse. There was a constant crackling noise in the air as though it were by pistols.

July 26.—Electricity has been very strong all day, at times stopping communications with the base station.

July 27.—Atmospheric electricity was so strong that signals could not be sent this afternoon.

August 9.—Atmospheric electricity very strong.

October.—Atmospheric electricity through lightning arrestor. Instruments appeared on fire.

December.—Line from summit to timber line covered with snow works excellent; it seems that it works better; but if the line but touches the ground below the lake it goes into bankruptcy at once.

ABSTRACTS FROM JOURNAL OF MR. CHARLES M. HOBBS FOR 1876.

January.—Difficult to keep the electric self-register of anemometer.

April 24.—Almost clear sky. Lightning. The presence of electricity in the air was also manifested by a continual crackling at the lightning arrestor, but I had no difficulty in working the instrument.

April 31.—Replenished the main line battery this afternoon. After I had made the proper connections I could get no current from the Springs and have had none up to the present writing.

May 11.—Thunder and hail. Was compelled to cut out the wires owing to the intensity of the electricity. I attempted it with an ungloved hand and in so doing learned a lesson that was an impression at once. Luckily I escaped with a slightly bruised head.

May 24.—At 6 P. M., thunder and lightning west and southeast of Peak. One bright, long flash leaped out of lightning arrestor, which was continually making the usual crackling sound. About this time, while I was out doors, I heard a peculiar "singing" at two or three places on the wire; when I approached near one of these places the sound would cease but would recommence as I withdrew two or three feet. Thinking at first that the wind might possibly make the noise, though it was only between six and seven miles an hour, and that I cut this off when I approached the wire I stood at a distance and advanced my hand on every side and above and below, but the effect was always the same, the noise stopping when my hand came near the point and recommencing when it was withdrawn.

June 16.—At 5 P. M. as I was sitting on a rock a blinding flash darted from a cloud, succeeded by a quick, deafening report, and at the same time I felt the electricity darting through my entire person, jerking my extremities together as though by a most violent convulsion and leaving a tingling sensation in them for a quarter of an hour. An assistant who was sawing wood in a shed received a similar violent shock, and said that a ball of lightning appeared to pass through the store room and wood-shed, leaving a strong sulphurous smell.

June 17.—Found lightning arrestor at lake house badly burned by yesterday's lightning, making a ground connection.

June 27.—Very decided electrical displays occurred all the afternoon and evening, and many vivid sparks came into the rooms on the wire.

June 28.—Vivid flashes almost constant from 3 to 7 P. M. Bright flashes were of frequent occurrence in the room and the crackling noise in the lightning arrestor did not cease for a moment.

July 13.—Near sunset the peculiar singing noise on the wire previously spoken of was heard very distinctly, and it also seemed to come from the surface of the instrument shelter and house as well as from the wire.

July 23.—Rain-storm with electricity. The anemometer stopped working on account of the electric storm.

July 31.—Rainy day. Could not get the base station.

August 6.—Atmosphere highly charged with electricity. Anemometer stopped working on this account.

August 18.—Mention was made previously of singing noise in wire. To-night it was not only heard, but the line for one-eighth of a mile was distinctly outlined in brilliant light, which was thrown out from the wire in beautiful scintillations. Near us we could observe these little jets of flame very plainly. They were invariably in the shape of quadrant and the rays concentrated at the surface of the line in a small mass about the size of a currant, which had a bluish tinge. These little quadrants of light were constantly jumping from one point of the line to another, now pointing in one direction, and again in another. There was no heat to the light and when I touched the wire I could only feel the slightest tingling sensation.

Not only was the wire outlined in this manner, but every exposed metallic point and surface was similarly tipped or covered. The cups of the anemometer appeared as four balls of fire, revolving slowly around a common center; the wind-vane was outlined with the same phosphorescent light, and one of the visitors was very much alarmed by sparks which were plainly visible to us in his hair, though none appeared in ours.

At the time of occurrence of the phenomenon snow was falling, and I had previously noticed that the singing noise is never heard except when the atmosphere is very damp, and rain, hail, or snow is falling.

1877, March 30.—At sunset I heard on the wire the peculiar singing noise which was referred to several times last summer, and which was generally heard when the air was moist, very quiet and heavily charged with electricity.

April.—Foggy; snow in the afternoon and frequent crackling of the lightning arrestor.

May 24.—Wind, fog, snow, hail, and electricity. The electricity was strong during the day, and assistants and myself received severe shocks. The floor is saturated with water which has leaked through the ceiling and thus a connection is made with the battery and ground-wire, and under these circumstances there is more than usual cause to feel severe, if not fatal shocks of electricity.

July 27.—Electricity very intense. Could not send report.

ABSTRACTS FROM THE JOURNAL OF MR. WILLIAM BLAKE.

1877, August 6.—From 8:50 P. M. to 9:20 P. M., hail-storm accompanied by intense electricity. All metal objects tipped with sparks.

October 13.—Snow all day. During the afternoon the atmosphere was highly charged with electricity.

November 13.—Snow all day. Electricity appears to be very intense.

November 25.—At 7 P. M., brisk snow attended by very intense electricity, which could be heard crackling in a person's hair continuously, although there were no reports of thunder in the storm.

December 26.—Snow. Atmospheric electricity was very intense during day and at times would crackle on various objects in the room.

1878, January 25.—Severe thunder-storms in the afternoon in surrounding parks and gulches. The electricity on the summit was very intense, and there was a continuous snapping of the lightning arrestor.

March 6.—Westerly gale; temperature higher, and in the afternoon a beautiful display of cirrus. Atmospheric electricity was very strong on the summit during the day, and it was difficult to work the line on account of the passage of frictional sparks.

March 26.—Very intense electricity during the forenoon.

April 22.—Heavy thunder-clouds hung over South Park during the day and at times electricity very dense on the summit, without discharges, though incessant crackling on the lightning arrestor and in one's hair. No sunset report was made on account of the atmospheric electricity on the wires.

April 27.—Thunder-storm in the valley. Electricity very dense on summit.

May 12.—A snow storm occurred during the night and at 1 P. M. was drifting furiously by a rising gale. The electricity varied with the winds-gusts and was so intense at times as to render our position exceedingly dangerous. The wires were cut out but violent sparks would still jump six inches between the disconnected wires. One violent discharge seemed to have occurred in the chimney, for a terrible commotion was caused in the soot and ashes.

May 24.—At 8 P. M., snow and severe electricity, very intense for an hour. Wires cut out and parted, and a vivid glaring was continuous in the windows. A lamp set in the north window would, with its flame, cast a shadow on the opposite wall for several seconds.

May 26.—Heavy clouds most of the day with intense electricity at times.

June 3.—Heavy lower clouds in evening. Air appeared to be highly charged with electricity.

June 5.—Snow from 1:30 P. M. to 2:30 P. M. being attended by severe electricity.

June 15.—Line worked hard on account of intense electricity and the storms below the summit.

June 25.—Hail from 3 to 4 P. M. Severe electricity. Wires had to be cut out and great danger was felt in the office. Intense electricity again in the evening from storms below the summit.

July 2.—Sleet from 2:55 P. M. to 7 P. M. with intense electricity. At 3:20 P. M. a violent lightning explosion occurred in room near stove, scattering the wood and knocking down the stove-pipe.

ABSTRACTS FROM THE JOURNAL OF MR. RUFUS CHOATE FOR 1879.

April 2.—Cloudy. Line working well. Can hear the lower station but cannot break.

April 10.—Line heavily charged with a ground current, and it was with difficulty that signals were got off. The current, at times, was entirely reversed.

April 12.—Snow storm. Electricity intense. Very brilliant sparks were jumping from the lightning arrestor all the evening.

April 23.—Telegraph line affected during the day by atmospheric electricity.

April 25.—Clear and fair. Line worked all right but could not raise the lower office by any means. It works through as I cut off the battery at this end and found a current strong enough to work the relay.

April 26.—Line works all right but cannot, by any means, break the lower office.

May 27.—Electricity on the wire interrupted the circuit at sunset. Sparks have been flying from the lightning arrestor during afternoon and evening.

ABSTRACTS FROM THE JOURNAL OF MR. JAMES K. SWEENY FOR 1879.

June 5.—Thunderstorms around near the Peak. Telegraph line affected by electricity.

June 16.—At 12:40 P. M. sleet, and at 1:10 P. M. thunder, but only a few peals were heard when it gave way to a strong, steady current over the wire, and from 1:15 to 1:35 P. M. one of those electric storms peculiar and common to

Pike's Peak prevailed. A queer hissing sound issued from the telegraph line, the wind-vane post and other posts standing in a deep snow-drift near by. I stepped out to view but was not standing in the snow-drift long when the same buzzing started from the top of my head; my hair became restless, and feeling a strange creeping sensation all over my body I made quick steps for the station. Once inside upon the dry floor the effect soon left me. After getting inside I opened the telegraph key and found a continuous bright spark passing between the key and the anvil, even when they were separated one-eighth of an inch, and by putting two thicknesses of writing paper in this space, it was scorched and perforated by numerous holes. By accident I completed the circuit with both hands when I received a shock that set me back on the floor. I then concluded I had had enough of experimenting.

June 29.—Atmospheric electricity was very intense. At 11:19 A. M. a ball passed through the arrestor with a report exceeding that of a rifle and threw sparks all over the office. It was followed in an instant by terrific thunder. The suddenness and violence of the shock stunned me so that it was a little while before I could realize what had happened.

ABSTRACTS FROM THE JOURNAL OF MR. EDMUND DAVIS FOR 1879.

July 10.—Hail storm with terrific thunder and lightning which constantly jumped from the telegraph instrument. On stepping to the door at 6 P. M. the assistant stated that he felt a peculiar sensation about his body, similar to that of an awakening limb after being benumbed, that his hair stood straight out from his head and served to produce a peculiar singing noise like that of burning evergreens. The telegraph line and all metallic instruments produced a noise like that of swarming bees. When he felt on his hat the prickly sensation became so intense that he was compelled to remove it, his forehead smarting as though it had been burned, for fully three hours after. At 7 P. M. the electric storm had ceased.

August 12.—At 5:40 P. M. a bolt of lightning went through the lightning arrestor with the report of a rifle, blowing a ball of fire across the room against the stove and tin-sheeting. The wood-packers, Messrs. Wade and McDonald, had taken refuge in the station for a few minutes but concluded immediately that this was rather an uncomfortable place during a storm, and left. Their dog, however, was far in advance seeking shelter outside. Mr. Wade declared that the lightning struck him in his feet and legs. At 6:35 P. M. the lightning struck the wire and building at the north and where the wires come through the window and lightning arrestor with a crash equal to any forty-pounder. It burned every one of the four wires coming in at the window, into small pieces, throwing them with great force in every direction and filled the room with smoke from the burned gutta percha insulation. The window sash was splintered and the outside pane of glass broken; another pane was coated with melted copper. The anemometer wires were also burned up and the dial of the anemometer burned and blown to pieces. A new anemometer was immediately put up, and within three quarters of an hour the new one was working, but the electricity was still very intense.

Assistant Sweeny was nearly deaf for some time afterwards. One piece of the wire was thrown with such force that when it struck the barometer, three feet distant, it was wound around it without, however, doing damage to the barometer.

October 13.—Atmospheric electricity on wires to-night.

November 19.—This forenoon a boiler lid was noticed to become charged with electricity, and would give off an unpleasant shock.

1880, February 9.—Clear weather, rising barometer and high winds. Telegraph line in bad condition and working poorly. Assistants Davis and Jones called repeatedly by Assistant Blake, but he was unable to raise the base station. Blake remained at the key for more than an hour adjusting and calling, but did not succeed in getting off the signals.

February 10.—Cloudy. Light snow during the day. Line working all right but it was impossible to break the lower station.

April 25.—Cloudy weather. Line working badly at 9:07 P. M. Signals sent with difficulty.

May 19.—Atmospheric electricity in the wire all day.

June 20.—From 6:50 to 8:35 P. M. very small discharges of atmospheric electricity. Line working very badly.

June 23.—Several light thunderstorms passed over and north of the Peak during the afternoon. At 7:10 P. M. a heavy snow storm set in accompanied by terrific flashes of lightning and heavy rolling thunder. Telegraph communication interrupted.

July 3.—Heavy electricity on the wire at midnight observation. No report sent, as each flash of lightning threw the instrument out of adjustment.

July 18.—Hail at 5 P. M. lasted until 7:15 P. M. accompanied by heavy shocks of electricity.

July 20.—Hail accompanied by terrific discharges. Atmospheric electricity quite prevalent during the evening and line working very poorly in consequence.

July 21.—P. M. Hail and heavy flashes of lightning which played around the lightning arrestor and exploded with great force.

July 23.—From 1:35 P. M. to 5:40 P. M. heavy rainstorm. Intense ground currents of electricity quite frequent during the prevalence of the storm.

August 3.—At 11:40 A. M. hail and terrific flashes of lightning which exploded with great force on the lightning arrestor and interfered with the working of the telegraph line.

September 10.—Hail from 1:40 P. M. to 2:50 P. M., accompanied by terrific discharges of electricity which for a time suspended all communication between base and summit and made telegraphing a very dangerous experiment.

October 26.—At 12:50 P. M. a heavy thunderstorm with light snow and sleet. Lightning passed constantly through the lightning arrestor with loud reports.

November 14.—Line working very weak this morning. Circuit is growing stronger toward noon.

ABSTRACTS FROM JOURNAL OF MR. J. P. O'KEEFE FOR 1881.

January 29.—Heard lower office call but was unable to break.

June 23.—Thunderstorm. Lightning snapped at the lightning arrestor and exploded with great force.

July 4.—Heavy thunderstorm. Lightning snapped on the lightning arrestor and exploded with great violence in the office. Several times during the evening I was certain that the station building would be struck and demolished, as the lightning was almost continuous.

HISTORY.

EXPLORERS OF WESTERN AMERICA.

G. C. BROADHEAD.

I. British Explorers.—The main object of the Spaniards in exploring hitherto unknown countries was *gold;* that of the English, trade. For this purpose in 1669, the Hudson Bay Company was organized, including Prince Rupert and one hundred and seventy others. To this company Charles II, of England, gave and granted in fee as lord of the soil, all the territories on the coast and confines of all seas, lakes, and rivers within Hudson Strait, not actually in the occupancy of any other province or State, together with the sole and exclusive right of trading with all inhabitants thereof. The chief aim of Charles in this, was the discovery of a northwest passage. The trade of the company amounted to but little for a long time, and in fact was exceeded by that of the French in Canada, and quite a war raged between the rival companies. The charter of the Hudson Bay Company did not specifically limit their territory.

In 1774 the Northwest Company was formed. Among their chief men were MacKenzie, MacTavish, Frazier, Frobisher, and MacGillivrey. They soon became powerful, pushed trade to the Arctic Ocean, and in 1789 MacKenzie discovered the river bearing his name. In 1794 he crossed the Rocky Mountains and discovered Frazier River, and on the 25th of July reached the Pacific Ocean. In 1772 Sam'l Hearne, of the Hudson Bay Company, reached the Copper Mine River, and followed it to its mouth. In 1812 the Hudson Bay Company disposed of a tract of land on the south shore of Lake Winnepeg to Lord Selkirk, who started a colony there. This was resisted by the Northwest Company, and their agents and men actually warred against its settlement, killing some and in 1814 driving others off. These differences were brought to the British Parliament, and a compromise was finally effected in 1819, by which the two companies were merged into one. Since 1836 Selkirk's settlement has been revived, and is now known as Manitoba. At present the posts of the Hudson Bay Company are scattered all over British America, and up to about 1840 they had posts within the territories of the United States, in Oregon, and traded also east of the mountains. Within their posts and with their men, and toward the Indians their power is despotic. Their traders seriously obstructed the plans of the U. S. Companies and broke up John Jacob Astor's traders.

Beyond these companies there was but little exploring done by the British. Jonathan Carver, in 1763, visited the country west of Lake Superior and near the head of the Mississippi and published a valuable book which can yet be obtained.

II. AMERICAN EXPLORERS WEST OF THE MISSISSIPPI.—My chief object in this is to direct attention to those (now) rare books of explorations now difficult to obtain, in order that students may know what has been written thereon, especially "officially," and procure them if desired. I shall confine myself to the period from 1800 to 1850.

Previous to 1800 the U. S. Government had made several futile attempts at creating a trade with the western tribes, but it was left to the keen foresight of President Jefferson and the able assistance of Lewis and Clark to make the first bold strike. Meriwether Lewis and Wm. Clark led the first exploring expedition west of the Mississippi. The main plan of this expedition was conceived by President Jefferson, Meriwether Lewis being his secretary.

May 4, 1804, Lewis and Clark left their encampment at the mouth of Wood River opposite the mouth of the Missouri and passed up the Missouri. June 21st, they encamped at the mouth of Platte River. November 3d, went into winter quarters among the Mandans. April 9, 1805, they proceeded up the Missouri and on July 28th reached the forks of the Missouri at the junctions of Madison, Gallatin, and Jefferson Rivers. On the 17th of August they reached the extreme point of navigation. August 27th they proceeded through the mountains (Bitter Root) suffering much for lack of food, and ate horse meat. They passed down Kooskookie River, finding great scarcity of game. October 10th they reached the mouth of Lewis' Fork of the Columbia. November 1st they reached the Pacific and went into winter quarters, but were very much troubled by frequent torrents of rain. March 23, 1806, they set out on their return, Captain Lewis by way of the head of the Missouri, and Captain Clark passing up Clark's Fork, crossing over to and down the Yellowstone, joining Lewis, August 12th, at the mouth of that river. They reached St. Louis September 23, 1806.

Captain Zebulon Montgomery Pike, in 1805 made a partial exploration of the Upper Mississippi, but cold weather forced him to return.

On June 24, 1806, Gen. James Wilkinson, U. S. Commander of Upper Louisiana, issued orders from St. Louis to Capt. Z. M. Pike to accompany certain Osage captives to the Osage villages on the Osage River, and if possible to accomplish a peace between the Kansas and Osage tribes; also to establish a good understanding with the Yankton and Comanches, (Panis, Kans, Arkansaw). On July 15th, Lieut. Pike left Belle Fontaine (a fort just above St. Louis). July 28th he arrived at the Osage River and passed up that stream. August 19th he arrived at the village of the Grand Osages (not far from junction of Marmaton and Little Osage River, and probably at or near present town of Papinsville, Bates County. The village of the Little Osages was probably where Balltown now is). September 1st he left the Osage Village and went west. About the last of September he held a council between Osages, Kans, and Pawnees, and was detained nearly a week. He then marched on westwardly up the Arkansaw River. On November 15th he came in sight of the peak of the Rocky Mountains since named in his honor, "Pike's Peak." November 25th he was still among the mountains and in sight of the Peak, and on December 3d he reached the foot of the peak. Pike's Peak he found to be 10,581 feet above the prairie below and he supposed the prairies to be 8,000 feet above the sea. In this he erred, for the Peak is now found to be between 14,000 and 15,000 feet above the sea.

Pike's men suffered much from the winter weather, as they were thinly clad and not prepared for winter; consequently they suffered from extreme cold and hunger, and some men were frost-bitten. The first part of December was stormy but game abounded. They struck a Spanish trail and reached the Rio Grande on December 13th, and passed up it for ten days, supposing it to be the Red River. It was then they suffered most from cold and hunger. They wandered around among the mountains for a month. On January 31st they built a stockade and prepared to winter on the banks of the Rio Grande. February 16th Mexican spies were seen, and on the 26th a troop of Spaniards visited them, and only then did they find out that they were on the Rio Grande and not on Red River. The Spanish troops took them to Santa Fe (as prisoners), reaching there March 3d. From thence they were sent off to Chihuahua, which they reached April 2d. All their property was taken from them. At Chihuahua they were detained until the 28th of April and then escorted east, reaching San Antonio the 7th of June and Natchitoches July 1, 1807. Captain Pike preserved some of his notes by placing them within a gun-barrel. Before reaching the Mountains Pike had sent Lieut. Wilkinson and some men in a boat down the Arkansaw. On May 3, 1806, a party under Captain Sparks passed up Red River to Natchitoches, and thence for 635 miles, but were ordered back by the Spanish authorities.

Washington Irving, in that charming book of his entitled "Astoria," has unfolded to us the many hardships and trials of the hunters and trappers in the (then) wilds of the Rocky Mountains. This book contains a full account of the travels and hardships endured by Wilson P. Hunt, agent of John Jacob Astor. Hunt was a native of New Jersey. In 1810 he prepared for his trip, but it was not until 1811 that he was fully upon his route. During December, 1811, and January, 1812, the company suffered the most extreme hardships while attempting to pass down Snake River and westwardly across the Blue Mountains. He reached Astoria in February, having traveled in all about 3,500 miles from St. Louis, although the direct route was much less. Mrs. Ann L. Hunt who died in St. Louis a few years ago, was the relict of Wilson P. Hunt. She was the sister of the late James H. Lucas and very wealthy.

Many expeditions have been performed, replete with thrilling interest, and some of them have developed important geographical facts by the various trappers and traders between 1810 and 1850, but they have left no record. Volumes of the most interesting matter yet remain unwritten.

Major Steven Long, U. S. A., under orders from the Secretary of War, left Pittsburg, May 3, 1819; passed down the Ohio and up the Mississippi, reaching St. Louis June 9th. Thence his men marched partly by land and partly by water to Ft. Osage, reaching the mouth of Kansas River the 13th of August. From thence they passed across toward the Platte River, and wintered at Council Bluffs.

In 1820 Long again marched from St. Louis along and near the Missouri River, and country near the north line of Missouri, and on June 6th he left Council Bluffs and visited a large Pawnee village on Loup Fork of the Platte, and on the 6th of July he was at the foot of the mountains on Platte River, and ascended several mountains near Pike's Peak. The party divided, one party going down the Arkansas, but Long struck southwardly, reaching Red River on the 24th of July. He explored the country along the Canadian, from thence to Arkansas River, reaching Ft. Smith the 23d of September, and thence to Cape Girardeau by way of Hot Springs.

In the fall and winter of 1818–19, H. R. Schoolcraft journeyed southwest from Potosi, Missouri, through a then pathless and unsettled wilderness to White River, passed over to James Fork of White River and erected the first furnace and smelted lead, (on a log furnace), first in southwest Missouri. This was probably about five miles from where Springfield now stands. He then passed down White River to eastern Arkansas and back to St. Genevieve. The story of this journey was published about 1830 by Lippincott and entitled "Scenes and Adventures in the Semi-Alpine Region of the Ozark Mountains." A copy with a different title had previously been published in London.

In 1820 Schoolcraft explored the head waters of the Mississippi; also, in June, 1831, he visited the head of the Mississippi and discovered Itasca Lake. In 1821 Schoolcraft accompanied Gen. Cass from Detroit, southwest across Ohio, Indiana and Illinois to St. Louis, and again visited the lead mines of southeast Missouri. He then accompanied Gen. Cass to Chicago, where a treaty was effected with the Indians Several books were published as results, viz: "View of Lead Mines of Missouri," and "Account of Tour," also "Discovery of Head of the Mississippi."

An interesting account of the adventures of Captain Bonneville may be found in Irving's work; as that book is accessible to most persons, I will simply sketch his route. He started out in 1832 and returned in 1835. His route was up Platte River thence through Wind River Mountains, and down Snake River. At times the men nearly starved to death, as well as suffered extreme cold. One party of his men made a trip from Salt Lake southwest to Monterey, California, and returned. Bonneville made two trips across the mountains.

General Atkinson made a trip up the Missouri River in 1825, but we have seen no account of it.

In 1835 Colonel Henry Dodge headed an expedition from Ft. Gibson to the Pawnee villages. In 1835 he also commanded eight squadrons of dragoons on an expedition from Ft. Leavenworth to the Rocky Mountains, visiting tribes and effecting peace among the Indians from the Arkansas to the Platte.

Nicollet explored the regions of the Upper Mississippi from 1833 to 1838; during the latter period he was assisted by Fremont.

In 1835 G. W. Featherstonhaugh made a geological examination of the country between the Missouri and Red Rivers. His report was published by authority of the Government, but is not of much value.

In 1838 Captain Canfield, U. S. Topographical Engineer, surveyed a route for a road from Ft. Leavenworth to Ft. Snelling.

Soon after this the Government started Fremont on his eventful expedition. In 1842 (then) Lt. John C. Fremont commanded his first expedition to the Rocky Mountains. Early in June he set out from the mouth of the Kansas River. His route was by way of Platte River to St. Vrain's Fort, Sweet Water River, and South Pass to Three Tetons and back to Ft. Laramie, and returned to St. Louis early in October.

May 29, 1843, he left the present site of Kansas City and passed over much of his last year's route to Ft. St. Vrain, Fontaine qui Bouille, and Arkansas River. He sent Fitzpatrick across to Ft. Hall, and he passed over Cache la Poudre River to the Black Hills, then crossed the Medicine Bow Mountains and the North Fork of Platte to Green River, and reached Great Salt Lake September 6th. Food had become scarce and the party had to subsist on a horse. He thence passed over to the waters of the Columbia River, reaching Fishing Falls of Snake River, October 1st, thence through the Grand Ronde, reaching the Columbia River at the mouth of Walla Walla River, October 25th, thence down to Ft. Vancouver. Partly retracing his steps he passed the Dalles, thence up Fall River and reached Flamath Lake the 11th of December, and Pyramid Lake the 13th of January. His men suffered extreme hardships among the snows of the Sierra Nevada, having to subsist mainly on famished horses and mules. Some of the party became crazed by hunger and cold; one was lost and another wandered off and was lost for many days. On March 6th the party reached Suter's Fort on the Sacramento, explored Stanislaus River and the San Joaquin to its head. Thence the route was across the Sierra Nevada to the Santa Clara Fork of the Rio Virgin, thence northeast to Sevier River, and reached Salt Lake the 24th of May. Thence via the Uintah River to Yampah, and on the 12th of June passed through South Pass and reached Kansas (City) the 31st of July. Without the aid of Kit Carson it is doubtful whether Fremont could have extricated himself from the terrible difficulties of his trip.

In 1845 Fremont accomplished his third expedition to the head of the Arkansas, the Rio Grande and Rio Colorado and westwardly. Of this trip we have seen no official report.

Lieut. W. H. Emory performed a military reconnoissance from Ft. Leavenworth to San Diego, California, passing along the Arkansas, Del Norte, and Gila Rivers, reaching the Pacific coast in December. On the 6th of December Capt. A. R. Johnson was killed in a fight with the Mexicans at San Pasqual, California.

In November and December Col. P. St. George Cooke marched from the Rio Grande to Tucson and thence to San Diego, Cal. About the same time Lieut. J. W. Abert explored the country from Leavenworth to Santa Fe, returning by the Canadian and Arkansas Rivers. The reports of the various expeditions of 1846 and 1847 were published in one volume by the Government.

By authority of Congress David Dale Owen made geological surveys in 1847, 1848, 1849, and 1850 of country now included within the limits of Wisconsin, Minnesota, Dakota, and Iowa. In this he was ably assisted by Richard Owen, Dr. J. G. Norwood, Col. C. C. Whittlesey, Dr. B. F. Shumard, Dr. A. Litton, and F. B. Meek. Their report was the first complete geological report published under direction of the Government. Capt. Howard Strasburg in June, 1849, started on his expedition by way of Platte River and Ft. Bridger to Salt Lake, which they reached the last of August. He remained here in winter quarters until April, 1850, and then made various surveys in Utah and returned to Leavenworth in November.

From 1850 to 1860 the U. S. Government made numerous surveys to the Pacific which were chiefly entitled "Explorations of a Railroad Route from the Mississippi River to the Pacific Ocean."

Since 1860 the surveys have been chiefly conducted by the U. S. Geological and Geographical Surveys under authority of Interior Department, also the Engineer Department of the United States Army, and their publications have been many.

NATURAL SCIENCE IN THE 17TH CENTURY.

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It is a curious fact that the bulk of history is composed of the lives and deeds of men who were great monarchs, valiant generals, base tyrants, or bloody murderers. One grows tired of reading of war and carnage, sin and sorrow, widows and orphans, and all the long catalogue of evils wrought and recorded in the Past. Surely there is another side to this gloomy picture. Surely there are pursuits which men may follow, and which men have followed and therefrom reaped pleasant harvests. Yea, "in the conquests of science no widow's or orphan's tears are shed, no captives are dragged from their homes, and no devoted victims are yoked to the chariot wheels of the triumphant philosopher."

While reading the history of Louis XIV of France, I was struck with the glory of the court, the pulpit, the literature, etc., of the country over which he reigned, and I began to inquire whether the 17th century, in the midst of its splendid achievements, had not accomplished something in the fields of Nature. I turned to look and my search was not in vain. A list of those then engaged in quiet researches for knowledge of Nature and her phenomena constitutes a roll of illustrious names. True, not as many of them belong to France as to neighboring countries; perhaps for the reason that France could not furnish the steady plodding workers that science requires. Frenchmen are better suited to make the "beau monde"; they have ever been a fickle people which every breath of fortune could move.

But at the beginning of the 17th century, what was the status of natural science? What growth had then been made by that tree of knowledge which to-day flourishes in such splendid proportions and yields such varied fruits to mankind everywhere?

Before the 17th century we find very little of true science—that is, of knowledge systematized by the correlation of facts obtained from thorough experimental research. There is sufficient reason for this state of affairs.

The art of printing was inveuted in the 15th century, but did not come into extensive use until the 16th century. Until that time all books had been *written*, and hence were scarce and costly. On this account intercommunication of workers in science were slow and the promulgation of a new truth, discovery or invention took much time. The invention of printing served to overcome this great difficulty. Yet there was a still greater hindrance to the growth and spread of knowledge. It was that sentiment, so prevalent among mankind at that day, that "The horizon bounds the limits of the world." The common herds of humanity supposed the limits of human ken had been reached, and their pastors —the priesthood—permitted them to cherish the notion; because thereby they could the more easily impose upon the credulity of their followers, and lead them into whatsoever pastures they pleased.

Perhaps deep down in the seclusion of some old cloister, a far-reaching mind probed to the core of some hitherto unopened apple of nature and found a wonderful secret hidden therein; the fact was selfishly used for personal aggrandizement by imposing upon a too credulous people, or kept and not disclosed, through a servile fear of the spirit of the times.

Nor was the search of these recluses always in pursuit of real gems of truth, but rather of phantoms born of heated imaginations. Thev sought the means whereby all baser metals could be transmuted into gold and the "elixir vitæ" which would rejuvenate old age and perpetuate the bloom of youth. In the course of these mad and laborious efforts they stumbled upon many things which in after times became useful in the arts and sciences.

Nevertheless the world is now enjoying the high-risen sun of a day that dawned with the 17th century. Day must succeed night, and the long night of the dark ages passed away with the dawning that broke over the world when Louis XIV was King of France. Then it was that men began to emancipate themselves from the old rusty shackles of slavery to the past and its long established order of things, and to strike out for themselves into new ranges and regions of nature and of thought. Independence of thought begets independence of spirit. They who so long had passively worn the harness of servitude and obedience to monarchy and men in power, became recalcitrant and demanded rights and privileges, even going so far in some cases as to compel them to be given. Freedom of thought marks the birth of enlightenment and the beginning of mightier and grander things. Men of inquiring minds, tired of the toil and tumult of war, and quite famished for want of encouragement at the hands of mankind in general, began to meet together and discuss their thoughts where sympathy and interest were sure to attend. From such beginnings arose the idea of scientific societies; and we find before the close of the 17th century the Royal Society of England (1645), the French Academy of Sciences (1666), the Imperial Academy of the Curious in Nature (Germany, 1662), and others in Italy and adjoining countries.

These scientific societies were the centres into which flowed all the streams of scientific thought. At their convocations capable minds discussed the old or the new theories of men, and after due deliberation the bad ones were either rejected or corrected, and the good ones were sent forth into the world with a sanction that rendered them a thousand-fold more acceptable.

A still more important result arising from these scientific bodies must be confessed in the following fact. The disciples of science, who in one country were restrained from making known their work by publication at home, on account of the stringency of prevailing laws, could send abroad and be sure of sympathy and aid. Thus was given to the world for the promotion of human welfare, many a a newly discovered invention or discovery which otherwise might have cowered at home for years and years, held "in durance vile" by ignoble servitude to opinions whose only authority was the weight of hoary years.

Hence we are safe in saying that the temple of natural science had its foundation laid at this time in permanent form, and at this period steady growth of the superstructure began. Workmen came from England, from France, from Italy, from Germany, in fact, from all civilized lands, and lent their enthusiastic aid.

Scaffolds of theory were built around, upon which standing, the workmen laid up the permanent blocks of law and established fact. When the scaffolds became untenable, weak, inadequate, they were removed and others more adequate erected in their stead. Workmen served their allotted time and yielded their places which were forthwith filled by others. And to-day in the broad glare of the 19th century the toilers in science are as vigorously as ever altering the scaffolds and on the already lofty walls laying up other beautiful and substantial stones. The temple will be finished—when? Ah! who can tell?

But let us return to the 17th century and call the roll of master-workmen, and note some of the stones which were placed in the lower walls of the temple of science.

TABLE—COMPILED FROM BUCKLEY'S HISTORY OF NATURAL SCIENCES, AND OTHER SOURCES.

	NAME.	NATIVITY.	LIFE.	WORK.
CHEMISTRY.	Van Helmont,	Belgium,	1577—1644.	Gas, from geist—Spirit. Gas sylvestre=Car-
	Becher,	Germany,	1625—1682.	Theory—2 elements. Boracic acid.[bonic acid
	Hooke,	England.	1635—1702.	Air necessary to life and combustion (1665).
	Mayow,	England,	1645—1679.	Fire air=Oxygen, and a lighter gas in air.
	Stahl,	Germany,	1660—1734.	Phlogiston.
GEOLOGY.	Steno,	Denmark,		Petrifactions (1669).
	Scilla,	Italy,		Fossils of Calabria (1670).
	Woodward,	England,		Collection of Rocks and Fossils (1695).
BOT. AND ZÖOL.	Malpighi,	France,	1628—1694.	Spiracles of insects (1669). Germination of
	Grew,	England,	1628—1711.	Vegetable anat. Stomates (1676). [Seeds.
	Ray,	England,	1628—1705.	} Classification of Animals and Plants and
	Willoughby,	England,	1635—1672.	} publication (1682 ———).
	Tournefort,	France,	1656 ——.	Systematic Classification (1694—1700).
PHYSIOLOGY.	Harvey,	England,	1578—1657.	Circulation of the Blood (1628).
	Asellius,	Italy,	1581—1626.	Lacteals (1622).
	Pecquet,	France,	—— ——.	Thoracic duct (1647).
	Rudbeck,	Sweden,	1630—1702.	Lymphatics (1651).
	Malpighi,	France,	1628—1694.	Capillary circulation (1661).
	Leuwenhoeck,	Holland,	1632—1723.	Animalcular Life.
	Ruysch,	Holland,	1638———.	Injections in Microscopic Work.
ASTRONOMY.	Galileo,	Italy,	1564—1642.	Moons of Jupiter (1610), Sun-Spots (1611),
	Kepler,	Germany,	1571—1630.	Laws of Planetary Movement. [etc.
	Gassendi,	France,	1592—1655.	Transit of Mercury (1631).
	Horrocks,	England,	1619—1641.	Transit of Venus (1639).
	Newton,	England,	1642—1727.	Gravitation (1682), tides, etc.
	Halley,	England,	1656—1742.	Sun's distance by Transits. *Comet.*
NATURAL PHILOSOPHY.	Jansen, } Lippersheim, }	Holland,	—— ——.	Refracting Telescope (1609).
	———	———	—— ——.	Microscope (1660?).
	———	———	—— ——.	Mercurial Thermometer (1670). [Science.
	F. Bacon,	England,	1561—1626.	Novum Organon (1620). Experimental
	Galileo,	Italy,	1564—1642.	Pendulum (1580?). Telescope (1610).
	Drebbel,	Holland,	1572—1634.	Alcohol Thermometer.
	Snellins,	Holland,	1591—1626.	Refraction of Light-Law (1621).
	Descartes,	France,	1596—1650.	Prism and Dispersion of Light.
	Torricelli,	Italy,	1608—1547.	Barometer (1644).
	O. Guericke,	Prussia,	1602—1686.	Air Pump (1650). Elec. Machine (1672).
	Boyle,	Ireland,	1626—1691.	Compressibility of Gases (1661).
	Mariotte,	France,	———1684.	Compressibility of Gases. Blind Spot in Eye.
	Huyghens,	Holland,	1629—1695.	Pendulums in Clocks (1650). Wave Theory
	Gregory,	Scotland,	1638—1675.	Reflecting Telescope (1663). [of Light (1678).
	Newton,	England,	1642—1727.	Light, dispersion, etc., etc.
	Roemer,	Denmark,	1644—1710.	Velocity of Light by Moons of Jupiter (1676).
	Papin,	France,	1650—1710.	Steam-Pump (1690). Safety Valve ——.
	Newcomen,	England,	—— ——.	Steam-Engine (1705).

We find the list of the illustrious names so small that it may be said, there ought to have been more, and for the reason that the great treasuries of nature were all untouched. This is true; but the way to them was unknown. And for this reason we can but admire the perseverance of the few men who plodded through the mazes of the untraversed wilderness and won such wonderful prizes as they did. Just here it may not be out of place to add that the above fact of the recent birth of science is worth a great deal in an argument with the skeptic who denies the inspiration of the Scriptures. Whence came the wonderful knowledge of creation, given in such beautiful order as verified by modern investigation, related in the first chapter of Genesis? Either scientific knowledge such as is now extant was possessed by its author, or else he was divinely inspired. We are prone to believe the latter.

Especially is it to be noted that the wonderful advances and discoveries of age (and future ages as well,) came very largely as the result of the invention of the telescope and microscope. By these instruments admission was gained for the first time to the macrocosm and the microcosm between which man with his native powers had hitherto existed.

Not much was done in geology and chemistry; these sciences had their true birth in the 18th century.

CHEMISTRY.

THE ELEMENTS.

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Though theoretical and practical chemistry are now intertwined, with manifest advantage to each, they appear to have been far apart in their origin. Practical chemistry arose from the arts of life, the knowledge empirically and laboriously acquired by the miner and metallurgist, the potter and the glass-worker, the cook and the perfumer. Theoretical chemistry derived its origin from cosmogony. In the childhood of the human race the question was eagerly put, "By what process were all things made?" and some of the answers given started the doctrine of Elements. The earliest documentary evidence of the idea is probably contained in the Shoo King, the most esteemed of the Chinese classics for its antiquity. It is an historical work, and comprises a document of still more venerable age, called "The Great Plan, with its Nine Divisions," which purports to have been given by Heaven to the Great Yu, to teach him his royal duty and "the proper virtues of the various relations." Of course there are wide differences of opinion as to its date, but we can scarcely be wrong in considering it as older than Solomon's writings. The First Division of the Great Plan relates to the Five Elements. "The first is named Water; the second, Fire; the third, Wood; the fourth, Metal; the fifth, Earth. The nature of water is to soak and descend; of fire, to blaze and ascend; of wood, to be crooked and to be straight; of metal, to obey and to change; while the virtue of the earth is seen in seed-sowing and in gathering. That which soaks and descends becomes salt; that which blazes and ascends becomes bitter; that which is crooked and straight becomes sour; that which obeys and changes becomes acrid; and from seed-sowing and ingathering comes sweetness."[1]

A similar idea of five elements was also common among the Indian races, and is stated by Prof. Rodwell to have been in existence before the fifteenth century B. C., but though the number is the same, the elements themselves are not identical with those of the ancient Chinese classic; thus, in the Institutes of Menu, the "subtle ether" is spoken of as being the first created, from which, by transmutation, springs air, whence, by the operation of a change, rises light or fire; from this comes water, and from water is deposited earth. These five are curiously correlated with the five senses, and it is very evident that they are not looked upon as five independent material existences, but as derived from one another. This philosophy was accepted alike by Hindoos and Buddhists. It was largely extended over Asia, and found its way into Europe. It is best known to us in the writings of the Greeks. Among these people, however, the elements were reduced to four—fire, air, earth, and water—though Aristotle endeavored to restore the "blue ether" to its position as the most subtle and divine of them all. It is true that the fifth element, or "quinta essentia," was frequently spoken of by the early chemists, though the idea attracting to it was somewhat changed, and the four elements continued to retain their place in popular apprehension and still retain it even among many of the scholars who take degrees at our universities. The claim of wood to be considered an element seems never to have been recognized in the West, unless, indeed, we are to seek this origin for the choice of the word "*ulé*" to signify that original chaotic material out of which according to Plato and his school, all things were created.[2] The idea also of a primal element, from which the others, and everything else, were originated, was common in Greece, the difficulty being to decide which of the four had the greatest claim to this honor. Thales, as is well known, in the sixth century B. C. affirmed that water was the first principle of things; but Anaxamenes afterwards looked upon air, Heraclytus upon fire, and Theracleides on earth, as the primal element. This notion of elements, however, was essentially distinct

1 Quoted from the translation by the Rev. Dr. Legge. In that most obscure classic, the *Yi-King*, fire and water, wind and thunder, the ocean and the mountains, appear to be recognized as the elements.

2 Students of the Apocrypha will remember the expression in the "Book of Wisdom," xi., 17, * * * * * * * ("Thy Almighty hand, that made the world of matter without form"). The same book contains two allusions to the ordinary elements, vii., 17, and xix., 18 to 20. The word elements is used in the New Testament only in a general sense (2 Peter, iii., 10), or in its more popular meaning of the first steps in knowledge.

from our own. It was always associated with the idea of the genesis of matter rather than with its ultimate analysis, and the idea of *simple* as contrasted with *compound* bodies probably never entered into the thoughts of the contending philosophers.

The modern idea appears to have had a totally different origin, and we must again travel back to China. There, also in the sixth century B. C., the great philosopher Lao-tse was meditating on the mysteries of the world and the soul, and his disciples founded the religion of Taou. They were materialists; nevertheless they believed in a "finer essence," or spirit, that rises from matter, and may become a star; thus they held that the souls of the five elements, water, metal, fire, wood, and earth, arose and became the five planets. These speculations naturally led to a search after the sublimated essences of things, and the means by which this immortality might be secured. It seems that at the time of Tsin-she-hwang, the builder of the Great Wall, about two centuries before Christ, many romantic stories were current of immortal men inhabiting islands in the Pacific Ocean. It was supposed that in these magical islands was found the "herb of immortality" growing, and that it gave them exemption from the lot of common mortals. The emperor determined to go in search of these islands, but some untoward event always prevented him.[3]

Some two or three centuries after this a Taouist, named Weipahyang, wrote a remarkable book called "The Uniting Bond." It contains a great deal about the changes of the heavenly bodies, and the mutual relation of heaven and men; and then the author proceeds to explain some transformations of silver and water. About elixir he tells us, "What is white when first obtained becomes red after manipulation on being formed into the elixir tan," (meaning red or elixir). "That substance, an inch in diameter, consists of the black and the white, that is, water and metal combined. It is older than heaven and earth. It is most honorable and excellent. Around it, like a wall, are the sides of the cauldron. It is closed up and sealed on every side, and carefully watched. The thoughts must be undisturbed, and the temper calm, and the hour of its perfection anxiously waited for. The false chemist passes through various operations in vain. He who is enlightened expels his evil passions, is delighted morning and night, forgets fame and wealth, comprehends the true objects of life, and gains supernatural powers. He cannot then be scorched by fire, nor drowned in water, etc., etc. * * * The cauldron is round like the full moon, and the stove beneath is shaped like the half moon. The lead ore is symbolised by the White Tiger; and it, like metal amongst the elements, belongs to the West. Mercury resembles the Sun, and forms itself into sparkling globes; it is symbolised by the Blue Dragon belonging to the East, and it is assigned to the element wood. Gold is imperishable. Fire does not injure its lustre. Like the Sun and Moon it is unaffected by time. Therefore the elixir is called 'the Golden Elixir.' Life can be lengthened

3. Nearly all the above statements relating to this Taouist alchemy are derived from the writings of the Rev. Joseph Edkins, of Pekin, and the matter is treated in greater detail in an article on the "Birth of Alchemy," in the *Argonaut*. Vol. iii., p. 1.

by eating the herb called Hu ma; how much more by taking the elixir, which is the essence of gold, the most imperishable of all things! The influence of the elixir, when partaken of, will extend to the four limbs; the countenance will become joyful; white hair will be turned black; new teeth will grow in the place of old ones, and age at once become youth. * * * Lead ore and mercury are the bases of the process by which the elixir is prepared; they are the hinge upon which the principles of light and darkness revolve."

This description suggests the idea that the elixir of the Taouists was the red sulphide of mercury—vermilion—for the preparation of which the Chinese are still famous. That Weipahyang believed in his own philosophy is testified by a writer named Ko-hung, who, about a century afterwards, wrote the lives of celebrated Taouists. He tells how the philosopher, after preparing the elixir, took it, with his disciples, into a wood, and gave it first to his dog, then took it himself, and was followed by one of his pupils. They all three died, but, it appears, rose to life again, and to immortality. This brilliant example did not remain without imitators; indeed, two emperors of the Tang family are said to have died from partaking of the elixir. This circumstance diminished its popularity, and alchemy ceased to be practiced in the Celestial Empire.

At the beginning of the seventh century the doctrine of Lao-tse was in great favor at the Chinese court; learning was encouraged, and there was much enterprise. At the same time the disciples of Mohammed carried their arms and his doctrines over a large portion of Asia, and even to the Flowery Land. Throughout the eighth century there were frequent embassies between eastern and western Asia, wars with the Caliphs, and even a matrimonial alliance. We need not wonder, therefore, that the teachings of the Taouist alchemists penetrated westward to the Arabian philosophers. It was at this period that Yeber-Abou-Moussah-Djafer-al-Sofé, commonly called Geber, a Sabæan of great knowledge, started what to the West was a new philosophy about the Transmutation of metals, the Philosopher's Stone, and the Elixir of Life; and this teaching was couched in highly poetic language, mixed with astrology and accompanied by religious directions and rites. He held that all metals were composed of mercury, sulphur, and arsenic, in various proportions, and that the noblest metal could be procured only by a very lengthy purification. It was in the salts of gold and silver that he looked for the Universal Medicine. Geber himself was an experimental philosopher, and the belief in transmutation, led to the acquirement of a considerable amount of chemical knowledge amongst the alchemists of Arabia and Europe. This gradually brought about a conviction that the three reputed elementary bodies, mercury, sulphur, and salt or acid, were not really the originators of all things. There was a transition period, during which the notion was itself suffering transmutation. The idea became gradually clearer that all material bodies were made up of certain constituents, which could not be decomposed any further, and which, therefore, should be considered as elementary. The introduction of quantitative methods compelled the overflow of mediæval chemistry, and led to the placing of the conception of simple and compound bodies upon the foundation of scientific facts. Lavoisier, perhaps, deserves the greatest credit in this matter, while the labors of the other great chemists of the eighteenth and the beginning of the nineteenth centuries were in a great measure directed to the analysis of every conceivable material, whether solid, liquid, or gaseous. These have resulted in the table of so-called elements, now nearly seventy in number, to which fresh additions are constantly being made.

Of this ever-growing list of elements not one has been resolved into simpler bodies for three-quarters of a century; and we, who are removed by two or three generations from the great builders of our science, are tempted to look upon these bodies as though they were really simple forms of matter, not only unresolved, but unresolvable. The notation we employ favors this view and stamps it upon our minds. * * * * —*Chemical News.*

ARTIFICIAL STONE AS A BUILDING MATERIAL.

The high antiquity of prehistoric remains is frequently authenticated by the presence of the "sun-baked bricks" found among them. The *Encyclopædia Britannica*, in an article on St. Jean d'Acre (a town and seaport in Syria, and in ancient times a place of some celebrity), says: "Its great antiquity is proved by fragments of houses that have been found, consisting of that highly sunburnt brick with a mixture of cement and sand, which was only used in erections of the remotest ages."

In Scotland, Ireland, and Wales it has been found that the most durable material of those old "castles of the gallant clans" is concrete, in which small cobble stones were embedded to form a solid piece of masonry.

The Moors have left samples of their artificial stone inwrought upon the rock of Gibraltar, which have withstood successfully the storms of ten centuries. The Colosseum at Rome presents further examples which have nobly resisted the tests of time; the cisterns of Solomon, near the city of Tyre, which are of still higher antiquity, are almost complete in their preservation; and at Jerusalem there are to be seen five immense courses of Cyclopean masonry, the base of the wall of the city (now inclosing the Mosque of Omar), supposed to be a remnant of the wall of the Temple of Solomon, which, as the record tells us, was "set in its place *without the noise of the hammer and the ax.*"

Scientists have suggested that the Pyramids were mainly built of artificial blocks, manufactured upon the spot, from the sands of the surrounding plain, by some cunning process which has perished with the builders; and travelers have claimed that the Diocletian or "Pompey's" Pillar, and the ruins of Baalbec and Palmyra, are mainly of artificial stone. Whatever may be said of these, we have in the actual measurements of the enigmatical "coffer" in the king's chamber of the Great Pyramid indubitable evidence of its original plasticity. In the first place, we find it depressed upon all its sides, from the corners toward the center, and *unequally* so. The east side of the coffer has been sadly mutilated by tourists, the southern corner being chipped away about two-fifths its height. The mean depressions are at the north end 0.26 inch, at south end 0.19 inch, at west side 0.20 inch, and at east side 0.01 inch. They are observable vertically as well as horizontally. At the south end of the west side there is no depression perceptible; while at the north end of the same side the depression is 0.20 inch, and on the south end, at different distances from east to west, the depressions are 0.08, 0.12 and 0.14 inch. Upon all sides the coffer is highly polished over all these inequalities. Now, no one acquainted with the simplest means of working natural stone would look for these inequalities, and for the corresponding *bulging out upon the inner surfaces* which we find to exist.

The square, the plummet, and the rule would have done their perfect work before the polishing, and if the depressions had been *intentional*, they would have been *regular*. Again, if we take the superficial outside measurements of the coffer, we find the same irregularity. On the east side near the bottom we have a length of 90.5; ten inches below the top, 90.15; on the top, 90.20. On the west side near the bottom, 89.2; near the top, 89.95; at the top, 90.05; mean length, 90.01. At the north end near the bottom, 39.05; near the top, 38.7; at the top, 38.67. At south end near bottom, 38.8; near top, 38.6; at top, 38.5; mean width, 38.72. From all which we argue that the coffer was moulded in its present position from plastic material, but that it became thus slightly warped, or shrunken, as it dried —in short, that it is of artificial stone, and not of "porphyry," of "black marble," or of "a darkish variety of red and possibly syenitic granite," as has been variously asserted.

Coming down to a later period and a little nearer home, we have in the city of Santo Domingo some of the most interesting historical monuments of this material. This is the oldest existing settlement by white men in the New World, being founded by Bartolommeo Columbus in 1494. Although built on a solid limestone formation, the city is surrounded by a wall of artificial stone, eight feet thick, built (in 1506) of *mamposteria*, "a composition of earth, powdered stone, and lime." Many of the more ancient houses and public buildings of the city, constructed of this material, are still standing and are remarkable for their solidity; the cathedral, especially, in which the remains of Columbus and his brother Bartolommeo reposed for two and a half centuries, which was begun in 1512 and finished in 1540; while on the opposite bank of the river the so-called "Castle of of Columbus," a fortified stone house subsequently built by Diego Columbus, the son of the great admiral, is in ruins.

The Vanne Aqueduct, in France, is another example. Gen. Gillmore characterizes this as "the most important and costly work that has yet been undertaken in this material," being thirty-seven miles in length. This aqueduct, which supplies the city of Paris with water, traversing the forest of Fontainbleau its entire length, comprises two and a half to three miles of arches (some of them as much as fifty feet in height), eleven miles of tunnels, and eight or ten bridges (from seventy-five to one hundred and twenty-five feet span) for the bridging of rivers, canals, and highways. The smaller arches are half circles, and are generally of a uniform span of thirty-nine feet four inches, with a thickness at the crown of fifteen and three-fourths inches. Their construction was carried on without interruption through the winter of 1868–69 and the following summer, and the character of the work was not affected by either extreme of temperature. The spandrels were carried up in open work to the level of the crown, and upon the arcade thus prepared the aqueduct pipe was moulded of the same material, the whole becoming firmly knit together into a perfect monolith. The construction of the arches was carried on about two weeks in advance of work on the pipe, and the centres struck about a week later.

The lighthouse at Port Said, in Egypt, is another interesting structure of this material. It is one hundred and eighty feet high, without joints, and rests upon a monolithic block of the same material containing nearly four hundred cubic yards.

An entire Gothic Church, with its foundation, walls and steeple in a single piece, has been built of this material at Vesinet, near Paris. The steeple is one hundred and thirty feet high, and shows no cracks or other evidences of weakness. M. Pallu, the founder, says that "during the two years consumed by M. Coignet in the building of this church, the material in all its stages was exposed to rain and frost, and it has perfectly resisted all variations of temperatures."

But we have upon our own shores a building antedating these structures nearly thirty years. This is the residence of the late George A. Ward, Esq., at New Brighton, Staten Island, familiarly known as "the cement house," built in 1837, and ten times more solid to-day than the day it was erected. There is no more exposed place to test the stability of this material than the north shore of Staten Island, where this building stands. We confess to some misgivings as we approached it last summer, not having seen it for about thirty years, but we left it more than satisfied, and to such of our readers as require the test of Thomas the doubter, we commend a pleasant trip over the Bay of New York, and a personal inspection.

Another building is the residence of Wm. E. Ward, Esq., at Portchester, N. Y. This is beyond doubt the most expensive private residence of the kind yet erected in this country. It is a perfect monolith, from the lowest line of the cellar wall to the top course of its towers, and is a monument at once of the enterprise, taste, and munificence of its proprietor, a monument, too, which is likely to endure when some other monuments have crumbled in decay. A full description of this building was given in the *American Architect* of August 17, 1877, and a further description was read before the American Society of Mechanical Engineers, at their recent meeting in the city of Cleveland. Perhaps the severest tests to which the material has ever been subjected were in the great Chicago fire of 1871. While granite was chipped and splintered into fragments, while limestone was reduced to powder, while sandstone was disintegrated, and iron twisted into fantastic shapes, artificial stone alone remained intact, and was in shape to be immediately relaid. Several instances could be given, conspicuous among which, however, is the front of the store 114 Monroe Street, which, although thrown down by the failure of its iron supports, was taken up, stone by stone, and relaid. Many of the stones were placed in their original positions; some few were fractured by the fall, and had to be replaced by fresh ones, but none were disintegrated or fractured by the fire, and all were utilized. The front stands to-day exactly as it did before the fire.

The architect is often required to manage a sea wall or a cellar wall where the action of water is to be considered in connection with the safety of his superstructure. And here we claim the vast superiority of this material. In basements it will be found not only waterproof, but *rat proof*. The United States Government has recently employed it as the base of a lighthouse in the Chesapeake, where heavy masonry had proved inadequate, and they would have done better if they had followed the example of the French Government in the construction of the lighthouse at Port Said, and constructed the whole building of the same material. As a sea wall, the jetties of the Mississippi are perhaps the best example we have in this country. When we consider that this great river is the outlet of twenty of our States and Territories, covering an area of 750,000,000 acres —the granary and the principal cotton producing region of the world—the importance of these jetties cannot be overestimated. And hand in hand with their far-reaching commercial value is the triumph they have so signally achieved for artificial stone; for it must be conceded that without this element of success, the jetties would have been a failure. Indeed, they had already proved so, and in less energetic hands they might have been abandoned. The jetties themselves, primarily jets or projections of wicker work, anchored in place and secured in position by rubble and heavy stone, proved inadequate to resist the easterly storms that sometimes prevail, and it became evident that some further protection of the work was required. Heavier stones, some of them weighing three thousand pounds, were accordingly and with great difficulty anchored upon the jetties; but these proved also insufficient. Resort was now had to monolithic masses of artificial stone, and they have proved successful where nothing else could; some of the blocks being thirteen feet in width, five feet thick, and fifty-five feet long, and weighing more than two hundred and sixty tons. One mile of the east jetty and half a mile of the west were thus effectually protected, and so complete were the appliances employed upon the work that it required only the hands of two men to mould them and place them in position.

The jetties at the mouth of the Suez Canal are of a cheaper quality of beton, and are not monolithic, the blocks weighing only about twenty tons; but they are sufficient for the purpose, eighteen thousand of them being employed in the work.

From the description we have given, the far-reaching utility of this material is quite palpable. Its durability is established beyond cavil, and it has the approval of the most eminent architects and engineers of both hemispheres. While other material is constantly undergoing disintegration and decay, this as constantly improves by age. In the air, in the water, in the fire, and in fact under all imaginable circumstances, the certainty of using it with success is one of the greatest of its recommendations.—H. in *American Architect.*

MEDICINE AND HYGIENE.

CLIMATE IN THE CURE OF CONSUMPTION.

SAMUEL AUG. FISK, M. D.

HUMIDITY.—There is a unanimity of opinion amongst authorities in regard to the relation of moisture to the production of phthisis. The seventh annual report of the registrar-general of Scotland showed that the death-rate from phthisis diminished in proportion to the dryness of the location. Dr. H. I. Bowditch, of Boston, has shown that phthisis is prevalent in damp soils in the United States. "It is also common in Holland, and other countries liable to damp fogs and an atmosphere saturated with moisture" (Reynold's System of Medicine, III. 548). Ruehle, in Ziemssen, says, "It appears that moist air favors consumption." Dr. Austin Flint says, "It may be stated that the prevalence of the disease is less in climates either uniformly warm and dry or uniformly cold and dry." And Dr. C. T. Williams writes, "As to the desirability of moist climates for consumptive patients, the evidence is decidedly against their use in the treatment of ordinary chronic phthisis."

If we attempt to explain why it is that phthisis is more prevalent in moist climates than in dry, we might assign as a cause the prevalence of germs, or the impurity of the air, containing the effluvia of decay, or perhaps the greater susceptibility of the system to cold in moist climates; or it may be that the air, being so near saturation, cannot take up the requisite amount of the aqueous vapor exhaled from the lungs. *Causa latet vis est nota* may adequately express the state of our knowledge in regard to this point. A moist climate is acknowledged to be a breeder of phthisis; and, *au contraire*, a dry climate is known to afford a certain exemption from the disease. This shown by the fact that the disease is rare in Iceland, in the island of Morstrand, on the steppes of Kirghis, and in the interior of Egypt; in all of which places the element of elevation is wanting. It may, then, be conceded, that dryness of the air is an important element in the prophylaxis and cure of phthisis.

The method of determining the humidity of the air is that introduced by Regnault, known as the wet- and dry-bulb test. It can easily be seen that the results obtained will depend on the exposure of the thermometers, and on the accuracy of the readings. Moreover, the amount of moisture that the air is capable of holding varies with the atmospheric pressure and temperature.

While it seems to us that a table showing the relative humidity, *i. e.*, the percentage of saturation of the air, would be sufficiently accurate as a basis of comparison, yet, as it might be objected that such a table would be subject to error, we have appended another table, giving the absolute moisture, or the number of grains of vapor to the cubic foot of air. This second table we have computed from Glaisher's Tables.[1]

Consulting these tables it is seen that Denver and Santa Fe afford a very low relative and absolute amount of atmospheric moisture,—a relative amount, which, as between Denver and Jacksonville, is as 1 to 3, and, as between Denver and Los Angeles, is as 1 to 2.

This proves, that, on the eastern slopes of the Rocky Mountains, we have, in addition to the favorable element of elevation, a second, that of dry air, as an element of climatic influence in the cure of phthisis.

PRECIPITATION.—Closely related to the foregoing, is a consideration of the mean annual precipitation, or the mean annual amount (in inches) of rain and melted snow. Its bearing on our subject is apparent in several ways.

1. Of the precipitation, a certain part is lost by evaporation, and tends to increase the humidity of the air. This amount will depend upon the amount of moisture in the air, or its degree of saturation, and also upon the amount of the precipitation left upon the surface of the ground to be evaporated. It is evident that the greater the porosity of the soil, the greater will be its absorptive power, and the less the evaporation from it. Such a porous soil is found on the eastern slopes of the Rocky Mountains. Loose, sandy, and gravelly, it eagerly drinks up all the rainfall; and such a thing as mud is rarely seen.

2. It is well known that pulmonary troubles are most prevalent during "thaws," in those places where the snow lies upon the ground in winter. Now, in the district of the Rocky Mountains under consideration, there is, in the first place, only a slight amount of snowfall, so that sleighing is exceptional, and, in addition, the warm sun soon melts the snow, and the thirsty, porous soil drinks it up; so that the annual "spring thaw" of our Eastern States is a *res incognita* in this country. The writer remembers very distinctly several snowfalls of fourteen to twenty-two inches on a level, of which there was not a vestige left in ten days; and during that time the air was not chill and raw, and there was but little slush.

3. Further than this, the amount of the precipitation has a bearing upon our subject, as indicating approximately the ability of the invalid to lead an out-of-door life. We shall defer our discussion of this point to a later part of this paper.

Turning now to the tables we see that in Denver the mean annual precipitation for a period of ten years is only 14.77 inches in rain and melted snow,—an amount which is only one-fourth of that at Jacksonville, and which, with Santa Fe, gives the smallest showing in our range.

We can, therefore, add this element of climate to the other two of elevation and dry air as a point in favor of the Rocky Mountains in the cure of phthisis.

1 Omitted.

TEMPERATURE.—The writer in Reynold's System (*op. cit.*) says of this matter of the relation of the temperature of climate to the cure of phthisis, "It was formerly supposed that warm climates were beneficial for consumptive patients. * * * But it will be invariably observed that unaccustomed warmth is injurious. * * * What is really required, is a cool, temperate climate, free from great alterations of temperature." Dr. Austin Flint (*op. cit.*) calls attention to the fact, that "the disease is oftener developed during the spring months and hot months of summer," when either there is a great deal of moisture in the air, or the debilitating effects of heat are present as factors. On the other hand, Ruehle says that the temperature has "nothing to do with the prevalence of consumption."

It is known that the effect of heat is to raise the body temperature, to lessen the number of respirations, to quicken the pulse, to lessen the digestive powers and the appetite, to diminish the excretion of urea because of the diminishing of the ingesta, and to depress the nervous system, especially if the heat be accompanied with excessive moisture. It seems, then, that it can be stated as a fair inference from the foregoing, that a dry, temperate climate is to be sought by the phthisical invalid. The Rocky Mountains furnish a dry climate. The table shows that the mean temperature is only a mean between the extremes in our range. The question will, however, be presented in a better form farther on.

WINDS.—The points of importance in regard to the winds are their velocity and direction. It is well known that they are regulated somewhat by changes in atmospheric pressure and temperature.

Velocity.—It is known that a cold wind abstracts body-heat, and in proportion to its velocity. By consulting our tables it will be seen that the mean daily velocity of the winds at Denver is less than it is in the Eastern States; and that as a consequence, while the mean temperature is nearly the same, the chilling effect will be much less. On the other hand, as it has a considerably greater velocity, and as there are fewer calms than at either Augusta or Los Angeles, it has a proportionately greater purifying power in bringing fresh ozone, and in blowing away the products of decomposition.

Direction.—Of more importance than the velocity, is the direction of the winds. The favorable and unfavorable directions vary for different places, according to their geographical location. The east and north winds are known to be the trying ones along the Atlantic coast; and our table shows that the northeast wind is the prevailing one at both Augusta and Jacksonville. The west wind, blowing from the Pacific Ocean, and bringing fogs, is the trying one on the California shore; and the table shows that this is the prevailing one at Los Angeles. The south wind is the salubrious one for the eastern slope of the Rocky Mountains, in Colorado; and our table shows that this is the wind that blows there most frequently.

We can therefore add this element to the others,—of elevation, dryness of air, small amount of precipitation, and mean temperature,—as favorable to the Rocky Mountains as a place for phthisical patients to resort.

Clear, Fair, and Cloudy Days.—We now come to the consideration of our last general point, that is, to an investigation of the number of clear, fair, and cloudy days; or, in other words, to a consideration of the amount of sunshine.

As to the direct effect upon health produced by light and sunshine, we are still in ignorance. Whether the blood is made to course more rapidly, and the nerves transmit impulses more readily, under the influence of the solar ray is not known. It is well known that the actinic rays have a powerful chemical effect upon vegetation; but whether or not they have a like influence upon the human economy is unknown.

Without attempting to refine, there are certain broad and positive effects in the cure of phthisis attributable to sunshine. The experience of the profession is fittingly expressed by the words of Dr. Austin Flint: "I would rank exercise and out-of-door life far above any known remedies for the cure of the disease."

In the table which we present, and which is a mean of daily observations for a period of five years, a cloudy day is one in which the heavens are from seven-tenths to entirely obscured by clouds; a fair day is one in which the heavens are from four to seven-tenths clouded; all else are classed as clear days. From this it will be seen, that for our purposes clear and fair days may be classed as one, and may be put into juxtaposition with the cloudy days. Consulting these tables, it will be seen, that in Denver the mean number of cloudy days in a year is only one-half of what it is in either Augusta or Jacksonville, that it is less than a half of what it is in St. Paul, and that it is slightly less than what it is in Los Angeles.

To put this fact in another way, it is seen, that in Denver there is only about one-eighth of the entire year when an invalid would be kept in the house on account of the weather; in Jacksonville and Augusta he would be confined to the house, for the same reason, one quarter of the year; in St. Paul he would be kept in-doors between a third and a quarter of the time; while in Boston he would have to be housed a good third of the time.

Admitting, then, the force of Dr. Flint's statement, our tables show that there is no place in this whole country, where it is possible for the invalid to enjoy so much fresh air and sunshine, as in the Rocky Mountains. For three hundred and twenty days out of every three hundred and sixty-five it is possible to roam at large, and to breathe in health.

We feel, that, so far, our tables have shown that the Rocky Mountains furnish climatic conditions of elevation, humidity, precipitation, temperature, winds, and sunshine, which recommend them as a resort for phthisical invalids superior to anything to be found in this country.

Observations by Seasons.—Having arrived at these general conclusions, the writer wishes to call attention very briefly to their accuracy and importance as applied to the different seasons of the year. He wishes to lay stress upon the evidence which goes to show that Colorado and New Mexico furnish favorable resorts for phthisical invalids during the winter and spring,—the very seasons that are most trying in the east, the seasons that they are obliged to avoid, and to seek new abodes at the resorts. The elements of elevation and barometric pressure will remain nearly constant the year round. But how is it in regard to the *humidity* of the air in Colorado during the winter and spring? The writer has selected at random, and without reference to whether the showings would be favorable or unfavorable for a given place, the year 1880 as his basis for comparison. Both the relative and absolute humidity for Denver during the winter and spring is absolutely, and by comparison, very small; that, as compared with Augusta and Jacksonville, it makes a wonderful showing in these respects; and that the ratio of the absolute humidity as between Denver and Los Angeles is as 1 to 3 for these seasons.

When we turn to our tables we learn that the amount of *precipitation* at Denver for these seasons was almost *nil;* that the mean monthly precipitation at Denver for the given time was only a small fraction of an inch in rain and melted snow. Carry out, now, the comparison between Denver and Augusta, Jacksonville and Los Angeles, and see the tremendous difference in this particular between these places,—showing immensely in favor of Denver. It will be seen that our general conclusions are very much strengthened by this particular application, and that we have brought strong additional evidence in favor of Colorado as a resort for persons affected with phthisis pulmonalis.

When we turn to our tables to learn in regard to the *winds* at these places for the given seasons, we see that the conclusions previously reached in regard to Denver, in this particular, still hold true.

Temperature.—We come now to our last observation, and to a brief discussion of what some may consider the weak point in regard to Colorado as a resort for invalids. It has been seen that most authorities favor a cold climate; but they add the proviso that it should be free from change. The mean monthly range of temperature is larger for Denver than for almost any other point in our scale. It will be seen, further, that the minima of temperature are very nearly the lowest in the scale,—not so low, to be sure, as the minima at St. Paul, but decidedly lower than at Augusta, Jacksonville, and Los Angeles. This state of affairs demands an explanation.

We have seen that the air of Colorado is both dry and rare,—two conditions that favor rapid radiation. We have seen, further, that the soil is of a porous, sandy nature,—a kind that will easily absorb heat, and as easily give it off. Furthermore, there is but little verdure or shade,—another condition, too, which will favor both absorption and radiation of heat. In consequence of these conditions, the soil and air are, on the one hand, rapidly heated in the morning, and they are equally rapidly cooled at night. The nights are always cool in Colorado,—a condition that renders the summer months enjoyable and invigorating. But the question, after all, is, whether this diurnal change of temperature is injurious to Colorado as a resort for invalids. We claim that it is not, and for this reason: it makes but little difference to the invalid how cold the nights are, for at that time he should be in-doors, where he can regulate the temperature; but it is of importance that it should be warm at mid-day, so that he can take his exercise regularly and comfortably. We have seen, that so far as conditions of sunshine, humidity, and rain- and snow-fall are concerned, the invalid can lead an out-of-door life a greater percentage of the time in Colorado than anywhere else in this country; and we claim that he will never find these factors counterbalanced by the element of temperature. An experience of several years warrants the writer in asserting that an invalid can, with perfect comfort and safety, spend several hours in the saddle nearly every day of the three hundred and sixty-five. One has but to read 'H. H.'s' writings to learn how attractive out-of-door life is in Colorado, even in mid-winter; and we can positively assert that we have known of picnics being held day after day, in the open air, in the very heart of the winter, and that there are days and weeks in mid-winter when one can sit with doors and windows open.

In conclusion, the writer would state, that while his personal experience in regard to a desirable climate for the cure of phthisis has been such as to convince him of the great superiority of the climate of the Rocky Mountains over any other in this country, yet in this article he has tried to put aside any personal bias, and he desires to carry conviction only in so far as he has been able to adduce facts, and to interpret them rationally and logically. He would state, further, that, if the reader should take exception to any interpretation given to the facts, the tables still stand as the best and most reliable data of these facts attainable, and they are not to be controverted. —*Science.*

CORRESPONDENCE.

LETTER FROM WEST CHESTER, PA.

West Chester, Pa., October, 1883.

Editor Review:—Of the numerous scientific papers received, none is more welcome than your Kansas City Review, from the far west. Coming from a section from which we have not been looking for enlightened information, we are surprised to find it so rich in interesting original matter, and so well sustained by local talent.

Perhaps I appreciate it the more highly because of its treating of subjects in which I have long been deeply interested.

For a few years past I have been engaged in collecting relics of the stone age in this section of Pennsylvania (the southeastern corner), and now presume that I have one of the best collections in it. Thinking that a few remarks upon these remains of the aborigines might interest you I take the liberty of sending you the results of so e of my observations.

In the first place we have no mounds here, or known evidence of the mound-builders ever having reached so far east. A very few copper implements have been found, but they had evidently been transported from the Lake Superior region, and are only masses of native copper that have been beaten into desired shapes.

Our country is well watered. Springs of good water are to be found in every section. Near these springs, on any piece of level upland that would be rapidly drained after a rain, are to be found the camping grounds of the ancient inhabitants. They are easily traced when plowed up, by the chips and spalls of white quartz left in making their arrow-heads, this being the most common material used here. We also find larger camping grounds on some slight elevations near what in early ages have been good fishing places on our streams.

In the Susquehanna River near where it crosses the line between Pennsylvania and Maryland is an island containing about sixty acres. The river is here broad and shallow. In early times the fish in the spring of the year must here have been innumerable, and have been easily captured, affording food for vast numbers The island seems to have been common grounds where numerous tribes could meet in peace. Food being plenty, there would be less incitement to war.

The want of food I believe has ever been the principal cause of wars between savage tribes. An overgrown tribe would use up its supply of game and then be forced to trespass upon the preserves of their neighbors, when this would, of course, bring on a contest which would end in the decimation of one or both tribes. The game would again have a chance to recuperate, and for a time peace would reign.

The island spoken of, when I first saw it, was literally covered with relics, and, I might safely say, that cart-loads of arrow-heads, stone axes, pestles, and mortars, have been carried away from this place, showing that it must have been the resort of vast numbers at a time, or had been a noted place through many ages. I have been unable to trace out any burial place on or near the island. A few miles below this place are to be found many sculptured or figured rocks in the bed of the river. The rocks are of serpentine, and the figures are roughly made. These are the only attempts at this kind of work that I know of in this section.

All burial places that I have seen opened here, have contained more or less of modern European relics, such as beads and iron tomahawks.

Yours, etc , A. SHARPLESS.

LETTER FROM PLEASANT HILL, MO.

PLEASANT HILL, MO., October 8, 1883.

The REVIEW for October promptly came to hand. It is an interesting number. Several very excellent articles. I was particularly interested in that relating to the manner the ancient Egyptians quarried and worked rock. Strange Rawlinson, in his otherwise interesting book, says nothing of this. If they had not the diamond drill they possessed a drill of the same principle. The stone used in the sets of their drills and saws must have been corundum. The emery of Turkey in Asia is celebrated the world over. Its hardness and composition is about the same as corundum and they belong to the sapphire group,—No. 9, scale of hardness; diamond being 10.

Yours truly, G. C. BROADHEAD.

ASTRONOMY.

SUN AND PLANETS FOR NOVEMBER, 1883.

W. DAWSON, SPICELAND, IND.

On the 1st of November the Sun's R. A. is 14 h. 26m.; and his declination 14° 29′ S. On 30th his R. A. is 16h. 26m, and declination S. 21° 41′. The days are thus approaching their shortest; and the winter constellations are coming into view from the east. Sun-spots have been unexpectedly numerous thus far (18th) during October: fifty to nearly one hundred spots having been counted several times and one hundred and thirty-five were visible through my 4.6 inch telescope on the 9th, and one hundred and fifty on the 15th. One spot was visible to the naked eye on the latter date. Mercury will be too near the Sun for observation during November. It will be in superior conjunction with the Sun about midnight of the 25th. Venus is evening star; but will scarcely repay an effort for observation till toward the close of the month; and not very good then, being so far south. Mars is wending its way eastward from Jupiter, toward opposition. It is getting nearer the earth and better for observation, though it is yet a morning star. It will rise about 10 P. M. the last of November.

Jupiter is stationary near the Bee-Hive cluster on the 21st, and is very near there all the month—changing place among the stars but very little. On the 1st it passes the meridian at 5:40 A. M., 20° south of Zenith; and at 3:40 A. M., on the 30th, at about the same declination. On the 1st of November Jupiter rises a little before 11 P. M., and on the last of the month about 9 P. M.

Saturn will be an object of interest all the month; rising on the 1st at 6:30 P. M. and two hours earlier on the 30. It will be at its nearest point to Aldebaran, 3½° north, at midnight, November 1st, and will be in opposition to the Sun on the 28th. The oval ring of Saturn may be nicely seen with a spy-glass two and a quarter inches in diameter, magnifiying fifty times. Uranus is about 1° east of Beta in Virgo. Neptune occupies a blank region in Taurus, about 8° SW. of the Seven Stars.

New Moon occurs about six hours before the beginning of November; and also about 1 P. M., November 29th. The Moon passes near Saturn at noon on the 15th and Jupiter four days and two hours later.

KEPLER'S THIRD LAW.

EDGAR L. LARKIN.

This law is one of the corner-stones of modern astronomy; and its discovery a turning-point in the history of the science. Its first presentation to students is usually attended with more or less difficulty, and with the hope of aiding such we endeavor to give a simple exposition of the great law. It is given in different words by astronomers; and here are several versions:

I. "The square of the time of revolution of each planet is proportional to the cube of its mean distance from the sun." Newcomb and Holden's Astronomy, p. 125.

II. "The squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the sun." Herschel's Outlines of Astronomy, p. 259.

III. "The squares of the times are as the cubes of the mean distances from the sun." Ray's Elementary Astronomy.

IV. "The squares of times of revolutions are to each other as the cubes of the distances from the sun." Robinson's University Astronomy.

V. "The squares of the times of revolution of the planets around the sun are proportional to the cubes of the major axis of their orbits." Guillemin's The Heavens.

VI. "The squares of the periodical times are as the cubes of the major axes of the orbits." Olmstead's Astronomy, p. 99.

It seems that matters might be simplified by using the word equal, thus:—

VII. The squares of the times are equal to the cubes of distances.

It follows then that if we square the periodic time of any planet, we know that the square is equal to the cube of its distance from the Sun, and to find the distance we extract its cube root.

Table I gives the periodic times of all the planets, and their squares. Column I gives the times of revolutions around the sun, and II the squares of these numbers:

TABLE I.

Names of Planets.	Periodic Times.	Periodic Times Squared.
Mercury	.24084	.058039
Venus	.61519	.378458
The Earth	1.	1.
Mars	1.880819	3.53748
Jupiter	11.8617	140.7
Saturn	29.456626	867.516
Uranus	84.01447	7058.4311
Neptune	164.615	27098.

But the squares of the times are equal to cubes of distances; whence the cube roots of the numbers in the second column, (Table 1,) are equal to all planetary distances from the Sun. In Table II we give the squares of the times in the first column, and their cube roots in the second; which roots are the distances of all the planets from the solar globe.

TABLE II.

Names of Planets.	Squares of their Periodic Times.	Cube Roots of Squares of Times, or Mean Distances.
Mercury	.058039	.3872
Venus	.378458	.7233322
The Earth	1.	1.
Mars	3.53748	1.5238
Jupiter	140.7	5.2016
Saturn	867.516	9.5371
Uranus	7058.4311	19 182
Neptune	27098.	30.036

The relations of the numbers in both tables can be easily seen; thus: Neptune revolves around the Sun in 164.615 years, whose square is 27098, the cube root of which is 30.036; hence we know that this distant world is 30.036 times farther from the Sun than is the earth.

The truth of the law is demonstrated by elongations of Mercury and Venus, without knowing their, or the earth's distance from the Sun. Kepler did not know the distance from the earth to the Sun; but he knew ratios. He was aware that the distance from the Sun to Mercury is .3872; to Venus .723 and .1 to the earth; and from these facts detected the third law. This law of nature is one of the most important elements of knowledge, and is capable of wide generalization. Not only do planets and satellites obey it,—bodies moving on orbits of small eccentricity,—but likewise comets, which traverse paths of the greatest possible elongation. All bodies whatever, that revolve around one another in cosmic space, must obey this inexorable rule. If suns wheel about their common centres of gravity, then the squares of their periods of revolution must be equal to the cubes of their distances apart; but the units of measures for times and spaces are peculiar to each system of revolving bodies, only determined by their masses. When we observe a fact in nature, we know that it depends on another immediately preceding it; law stands on law; every law has an antecedent and exists as a consequent. Now what great law of nature is next preceding the third of Kepler? What makes it follow of necessity? What is the cause of the fact that squares of times equal cubes of spaces? We are almost on metaphysical ground, since we are dealing with such abstractions as time, space, and motion. The reason why the law of Kepler exists is because every particle of matter attracts every other with an intensity which is directly proportional to the quantity of matter they contain, and inversely proportional to the square of the distance between them.

In this law we come upon square of distance, but in Kepler's we found square of time ; let us see if there is any relation.

It is proven in the higher analysis, that spheres attract matter that is upon their surfaces with a force that can be found by dividing the mass of the sphere by the square of the radius. It follows from this, that the intensity of attraction of a sphere at at any distance from it can be determined by dividing gravity on its surface by the square of the desired distance. This is simply another way of stating the law of gravity as given above. Now, the force of gravity exerted upon the earth by the mass of the Sun is equal to 1, how great is it at Mercury? The distance of Mercury from the Sun is .3872 whose square is .15022384; whence 1 divided by .15022384 eqnals 6.66; therefore solar gravity exerted on Mercury is 6.66 times stronger than on the earth. In this method, we divided gravity at the earth's distance by the square of Mercury's distance, that is: we made use of square of *space;* but singularly enough, the same result can be reached by using square of *time.* Thus, if we divide Mercury's distance from the Sun, by the square of its periodic time, we will have .3872 divided by .058039=6.66 as before.

The law of gravity might be given in this manner: the attraction of the Sun on each planet is equal to its distance divided by the cube of its distance. Thus:—the distance of Jupiter from the Sun is 5.2016 whose cube is 140.7; and 5.2016 divided by 140.7=.037229, which is the intensity of gravity exerted on Jupiter by the Sun, that on the earth being 1. But we have arrived at the same point whence we started at the beginning of this note, because, since 140.7 is the cube of the distance of Jupiter, it is also by the law,—the square of the time of its revolution. Here is a table of intensities of solar attraction exerted on all the planets, found by dividing their mean distances by the squares of periodic *times*, instead of the usual way of dividing gravity on the Sun's surface by squares of planetary distances. We made use of time in place of space. The first column gives the mean distances of planets; the second, the squares of their periodic times, and the third,—quotients of the first divided by the second, which are the intensities of solar attraction, light and heat, on all the planets, and also the centrifugal tendencies developed by planetary motions.

TABLE III.

Names of Planets.	Distances of Planets.		Squares of their Periodic Times.	Solar Gravity Heat and Light, and Centrifugal Tendencies.
Mercury . . .	.3872	÷	.058039	=6.66
Venus	.7233322	÷	.378458	=1.9135
The Earth . .	1.	÷	1.	=1.
Mars	1.5238	÷	3.53748	= .4306
Jupiter	5.2016	÷	140.7	= .037229
Saturn	9.5371	÷	867.516	= .0109737
Uranus . . .	19.182	÷	7058.4311	= .0027177
Neptune . . .	30.036	÷	27098.	= .001108

In the mechanism of the solar system, therefore, we find mutual relation of forces depending on squares of time, space and velocity, a portion of which being given the others may be found. And Kepler's law is a beautiful generalization of them all. Indeed, the movements of the great machine are more majestic than it is possible for the mind of man to fully realize.

NEW WINDSOR, ILL., October 13, 1883.

ASTRONOMICAL NOTES FOR NOVEMBER, 1883.

W. W. ALEXANDER, KANSAS CITY, MO.

THE SUN'S apparent R. A. on the 1st will be 14h. 26m.; the Earth's annual motion will increase his R. A. by the 30th to 16h. 25m. His south declination on the 1st will be 14° 29′; this will be 21° 41′ by the last of the month.

VENUS—will be Evening Star, and by the end of the month may be seen low down in the southwest for about thirty minutes after sunset. Its apparent diameter is slowly increasing. The apparent R. A. will increase from 15h. 9m. to 17h. 42m.

JUPITER—will be in R. A. on the 1st 8h. 25m., this will only increase two minutes during the entire month; its declination will be 19° 35′ on the 1st, and the same on the last of the month; the apparent diameter is rapidly increasing caused by its reaching the stationary point on the 20th. At this time the Earth's annual motion will be bearing us in a direct line towards this planet; He will then be near Præsepe, the beautiful group, or cluster of stars in Cancer; it will rise about 8:30 P. M. at a point 19° north of east.

SATURN—will be in the best possible position for telescopic observation; being in opposition or 180° from the Sun on the 28th; the beautiful rings of this planet are opened full to the view, and will present a magnificent sight. It will be in the constellation Taurus, and on the 1st will be in conjunction with Alpha Tauri, better known as Aldebaran; the star will be 3° 30′ south of the planet.

URANUS—will not be in a favorable position for observers this month, being too near the Sun.

NEPTUNE—will be in the best possible position, being in opposition with the Sun on the 12th; it will then rise just at sunset at a point 15° north of east; the apparent R. A. on the 1st will be 3h. 12m., on the 30th 3h. 8m. No person need spend time trying to see this planet without a good telescope and proper appliances for pointing to its place in the heavens; all the light we receive from this brother world is only equal to an eighth magnitude star.

GEOLOGY.

THE U. S. GEOLOGICAL SURVEY, 1883.

Secretary Teller has just received the annual report of Major J. W. Powell, Director of the geological survey for the fiscal year ended June 30, 1883. The report states that the principal work accomplished by the bureau during the year was in the preparation of the large geological map of the United States authorized by a recent act of Congress. It is estimated that a scale of four miles to the inch will be necessary for this map, which it is proposed to publish in atlas sheets, each comprising one degree of longitude by one of latitude, in areas bounded by parallels and meridians. In the progress of this work the bureau has necessarily availed itself of the results of all surveys accurate enough to fulfill the requirements of the map, and during the past fiscal year has been engaged in collecting, compiling, and adjusting the materials. Field operations have been carried on to a limited extent. An area of 8,700 square miles was surveyed in the southern Atlantic region, and good progress was made in the Rocky Mountain district by surveys in the plateau region of Utah, Arizona, and New Mexico. In the Pacific district the work outlined includes the survey of the Cascade Mountains in Oregon, northern California, and probably in Washington Territory.

Director Powell says that this region is believed to contain the grandest and most extensive display of natural phenomena now known in any part of the world, and the investigation of it promises to supply matter of great importance to geologic science. In California about 2,000 square miles of country have been surveyed, a work of great difficulty. A large part of the report is devoted to subsidiary reports of special investigations, which may be briefly summarized as follows: The study of glacial phenomena, which are described as among the most important and interesting subjects for investigation in the geology of this county, was intrusted to Mr. Chamberlain, and he has been engaged in collecting and grouping evidences of the former existence of a continental placier similar to that which is believed to cover the greater part of Greenland. His purpose was to ascertain its former extent and distribution of its lines of movement, and the part it has played in shaped the physical features of the country.

Prof. Irving has been laboring with great energy in the study of the metamorphic rocks in the Lake Superior region, and has made satisfactory progress.

Mr. G. K. Gilbert has investigated the traces of the former existence of a large fresh water lake in western Nevada; its relations to changes in climate, its former extent, and its general history. His study has brought to light many interesting and instructive facts.

The geologic work in the Cascade range was not begun during the last fiscal year, and Capt. Dutton, to whom it had been intrusted, occupied himself with an investigation of the volcanoes of the Hawaiian Islands.

Researches in the mining districts of Colorado have been made by Mr. S. F. Emmons, and promise to throw much light on the theory of veins and their relations to the eruptive rocks with which they are associated. In the Gunnison district valuable beds of both anthracite and bituminous coal, of a quality unsurpassed in Colorado, have been found, and promise to make that locality one of the most important in the State. The ore bodies of the district also appear to be much of importance. The results of the investigations of minerals collected in Colorado have proved to be of great value to geology, so much so as to have elicited commendations from investigators, both in this country and in Europe.

A reconnaissance of the California quick-silver districts has been begun by Mr. Becker, and the work will be energetically prosecuted.

The search for extinct vertebrate remains has been continued under the direction of Prof. Marsh, and its results have proved to be of the greatest interest.

Special examination of the so-called Laramie beds which prevail over a large portion of the west, and constitute the most important part of the western coal bearing horizons, have been made by Dr. C. A. White. Other specialists have been engaged in the collection of fossils.

In the physical laboratory at New Haven much time has been spent in the adjustment of instruments of precision, chief stress being laid upon investigations relating to the exact measurement of high temperatures.

Very interesting results have also been attained by experiments to ascertain the physical properties of steel—experiments which throw much light upon the exact nature of the differences between that metal and other forms of iron.—*National Republican.*

ASBESTOS AND ITS APPLICATIONS.

Asbestos, a peculiar variety of the amphibole or hornblende family of minerals, is most largely found in Canada and Italy. It occurs in regular layers or veins, generally as a grayish-green rock made up of innumerable fine crystaline fibres which become soft, white, and of a silky lustre when separated from each other by slight pressure. The thickness of the veins varies considerably in different localities, from a thin sheet, in the case of the variety known as mountain-leather, to several inches in the deposits of the delicate amianthus found in the older crystalline rocks, in the Pyrenees, the Alps of Dauphiny, the St. Gothard, the Savoy, and Corsica. A single fibre of asbestos, heated in the flame of a blow-pipe, readily fuses to a white enamel, the varieties containing most iron being most easily fused, but in the mass it resists the heat of an ordinary flame, and for this reason it has recently begun to attract considerable attention. Unfortunately, the fibres of asbestos differ from all other known fibres in having a perfectly smooth surface and in being much less elastic than those of either animal or vegetable origin, in consequence of which all efforts to spin and weave them by modern machinery have until very recently entirely failed. In addition to amianthus and mountain-leather, there are several other varieties of asbestos, for instance, mountain-cork, which is a brownish or dirty-white deposit, less flexible and less regular than amianthus and mountain-leather, and so light as to float on water; mountain-wood, a soft, opaque, brownish colored variety, which melts to a black slag before the blow-pipe; and lastly, the common asbestos, which has recently been descovered in large quantities in Canada, in veins from one inch to two inches thick, and which is the kind most generally used for manufacturing the various articles to which we shall have occasion to refer.

The introduction of asbestos for such purposes as engine-packing and jointing for pipes has been attended with very considerable difficulty. Of all materials, it is perhaps that which requires the most careful manufacture and intelligence in adapting it to its special purposes; and when these have not been sufficiently exercised, users have been disappointed, and have not unfrequently given up the trial in disgust. As already stated, the peculiarity incidental to asbestos fiber for a long time baffled all attempts to spin it into yarn without the intermixture of a certain proportion of flax or other vegetable fiber. Within the last few years, however, the difficulty has been overcome, and yarns capable of withstanding great tensile stresses can now be readily produced by machinery specially constructed for the purpose. One of the most important applications of this yarn is for the manufacture of steam-packings. In making packing, it was at first not sufficiently recognized that the fibers of asbestos were apt to be largely charged with minute particles of pyrites; and until this fact was appreciated, it was often found that the piston-rods were scored, the damage being attributed to the action of the asbestos itself, instead of to the impurities it contained. To obviate this defect, it therefore became necessary to thoroughly cleanse the asbestos from all stone and grit before spinning, for which duty machinery had to be adapted. The yarn now produced is quite pure, and is capable of being woven into almost any kind of fabric. But it was soon ascertained that special cases required special treatment, and though the plaited packing was generally satisfactory, it became evident that something else was wanted in the case of steam-engines with extremely high piston speeds. To meet this demand, the yarn was first woven into a cloth, which, being slightly water-proofed with vulcanized India-rubber, was rolled up into a rope in much the same way as the canvas is treated in what is known as Tuck's packing, only without the rubber core. This packing answered admirably, and is much used in cases where the rapid destruction of ordinary packings gave rise to most serious inconvenience. The enduring powers of this asbestos block-packing are quite remarkable. In one place, on being taken out after twelve months' working with steam of seventy pounds pressure, it was found to be perfectly good, and was accordingly replaced. It has often been erroneously stated that asbestos packing could be used without lubrication. No greater mistake could exist. It not only requires a good supply of oil, but demands careful attention on the part of the engineer in charge. If carefully manufactured and properly used, asbestos is the best material for packing the glands of steam-engines; but if ignorantly made up and carelessly used, it is probably the worst.

A great deal of yarn is woven into cloth, and is adapted for a great variety of purposes. One noteworthy application is for fire-proof curtains, and several of these have been supplied by Mr. Bell for theatres in Great Britain, the United States, and elsewhere. So important is this material considered in regard to the prevention of the spread of conflagrations that a company has been formed in New York with the sole object of extending its use in the shape of protective shields, either permanently fixed or applied in case of a sudden emergency. In relation to this application, a fire-shield was recently exhibited at a meeting of the Firemen's Convention held at Rochester, N. Y., and attracted very great attention. The shield consisted of a piece of pure asbestos cloth about twenty feet square, and supported on an iron frame. A pile of pine wood saturated with petroleum and tar was built on the windward side of the curtain, and set on fire. The blaze was tremendous, and the heat so intense that persons could not stand within fifty feet of the burning mass on the exposed side. On the side protected by the shield, however, the heat was scarcely felt, and a dummy erection of wood and glass, which was placed close beside it, was not in any way injured. The curtain, of course, did not suffer, and was as good after the experiment as it was before.

For forming the joints of pipes exposed to the action of moisture, and for man and mud-hole doors requiring frequent removal, asbestos woven cloth is very largely in demand. In these cases, asbestos millboard, which is the cheapest form of jointing material, is comparatively worthless, if, indeed, it is not absolutely objectionable, from its permeability to water, which soaks through and attacks the iron of the bolts, and it was therefore necessary to devise a combination which would effectually resist the heat and damp. This is provided in what is known as asbestos and India rubber woven sheeting, which is made in any thickness, and is supplied either in sheets to cut to the required shape, or in a tape from one to two inches wide, which can be cut to lengths and bent to circle or oval without puckering. When all other materials have failed to give satisfaction, this has answered admirably, and in the case of man-hole and mud-hole doors and feed-water pipes, the joint can be broken twenty times without requiring renewal of the strip.

The last application of the yarn which we shall mention is the manufacture of rope and cord. Having great tensile strength, and being unaffected by heat and damp, this material is in course of introduction for sash-lines and for ropes of fire-escapes. It is also adopted for covering rollers in print-works, especially when aniline dyes are used, and in cases when it is exposed to great heat and to the action of hydrochloric acid. Asbestos cord has also been found to be the most effectual material for making the joints of the hot-air pipes for blast-furnaces, which are exposed to an exceedingly high temperature. The jointing consists of an iron ring wrapped with the cord, which is simply put in place and nipped between two flanges, and, being unaffected by heat, lasts a very long time.

We now come to an entirely different manufacture of asbestos, in which the rock, after being broken down and reduced to fluff, is pulped and formed by pressure into sheets from one-sixty-fourth to one-half inch in thickness. This mill-board, as it is called, is used for making joints not exposed to the action of moisture, such as for dry steam, air, and gas. When properly made and used with faced surfaces, this material affords the easiest and most cleanly method of making a joint, while, if the faces are previously painted over with boiled oil, the danger of having a troublesome leaky joint is reduced to a minimum. The board is easily cut to the desired size, and as no time is required for drying and setting, steam can be turned on as soon as the bolts are screwed up. A much commoner and cheaper description, though it still possesses most of the essential qualities, is manufactured for fire-proofing floors and ceilings. It is made in sheets about one-thirty-second of an inch thick, and is applied in the simplest possible way, either above or below the joists. It is also used for lining the walls of wooden buildings, where, from its non-conducting and fire-proof qualities, it affords an immense protection in case of the outbreak of fire. As an insulator of electricity, asbestos in one form or another is greatly sought after. Millboard has for some time been used in the construction of dynamos, while cables and leads covered with plaited yarn have been adopted in many installations. The remaining uses of asbestos which we have to notice appear to be mainly in the production of fire-proof cement and putty, for which there is considerable demand for certain kinds of joints, and in the manufacture of fire- and acid-proof lumps, blocks, and bricks. The ordinary gas fire is familiar to everyone, and it will suffice to point out that asbestos enters largely into the composition of the artificial fuel upon which the success of the fire in a great measure depends.—*Engineering and Mining Journal.*

GUNNISON, THE BONANZA COUNTY OF COLORADO.

JOHN K. HALLOWELL.

Mr. Hallowell closes his account of this county in the following enthusiastic terms:

The foregoing represents as succinctly as possible a resumé of what is the general characteristics in mineral wealth of this country, so that I have found in brief, that within a radius of seventy-five miles of Gunnison City, there are 2,000 square miles of mineral lands, with more ore per square mile than was ever seen before in the world to know it. That the drainage of all but three points is towards a common center meeting at Gunnison; that the whole country is readily accessible, having two competing railroads, narrow gauge, with a prospect of a third and broad gauge road within three years; that branch lines have been or will be extended to both coal sections; that Gunnison County has expended this year (1882) $100,000 in making good wagon roads from railroad points to all of the most developed mining camps. That, although this county is barely three years old, work enough has been done to prove that these mineral sections are permanent and productive. That Gunnison City is located in the centre of the largest mineral belt now known; with coal fuel the nearest by of the very best quality, and in quantity sufficient to smelt the ores produced. That this season saw one of the most successful concentrating mills in the State, built in this part of the country, viz: at Elko on Rock Creek. That, personally, I have not visited a single mining camp but that is capable, in time, of furnishing forty to 1,000 tons per twenty-four hours, of concentrating ore for just such mills, and which are the practical mills for all mining districts.

That, at Gunnison City there is now a smelting furnace building by one of the most successful men, connected with ore reduction (lead ores) in the United States. That, I have seen, personally, enough gold and silver districts, in this described territory, to produce more of those values per annum, after the next five years' development, than was the output of the whole State of Colorado in the year 1882. That, I have seen lead ore enough, and indications of it sufficient to warrant the statement, that the product will in time compare favorably with the output of the State of Missouri.

That I have examined more iron ores than are now known in either of the States of Pennsylvania or Missouri.

That I have seen districts enough, with copper sulphides in their veins, to run a smelter plant on the Copper-Matte basis, ten times as large as the present works at Argo, Colo. (Hill's works).

That within this territory I have found Tellurium ores. That I have been over more than eight square miles of territory containing nickel and cobalt—more than was ever seen before in paying quantities. That there are 350 square miles of gold territory, almost wholly unimproved, in which it may be possible to find Iridium, Palladium and Platinum. That I have found traces of tin, but have not proved its existence in paying quantities. That there is building stone of unsurpassed quality and inexhaustible quantity; that limestones, gypsum and marbles exist in large quantities. That I have found that rare mineral Uranium to exist in paying quantities. That while I did not find fire-clay at all, I found immense quantities of ordinary clay for building brick.

Last, but not least, the climate is unsurpassed, elevation not too great, nor winters too severe, but that work in the mines can be carried on the whole year through with a proper preparation; that the valleys are mild, well watered, and the finest stock country in Colorado.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

Temperature of the Air.	Sept. 20th to 30th.	Oct. 1st to 10th.	Oct. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	. .	. .	. .	. .
Max	. .	. .	. .	. .
Min. and Max	. .	. .	. .	. .
Range	. .	. .	. .	. .
Tri-Daily Observations.				
7 a. m.	52.3	52.00	43 4	49.2
2 p. m.	71.7	78.70	59.0	69.5
9 p. m.	56.7	65.20	47.6	59.8
Mean	60.6	65.30	49.1	59.5
Relative Humidity.				
7 a. m.	.88	.94	.88	.90
2 p. m.	.60	.66	.60	.63
9 p. m.	.80	.68	.89	.79
Mean	.75	.76	.79	.77
Pressure as Observed.				
7 a. m.	28.98	28.98	29.14	29.06
2 p. m.	28.97	29.14	29.12	29.07
9 p. m.	28.98	29.01	29.22	29.07
Mean	28.98	29 03	29.14	29.07
Miles per Hour of Wind.				
7 a. m.	. .	. .	. .	. .
2 p. m.	.	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2736	2958	2701	8395
Clouding by Tenths.				
7 a. m.	4.4	6.6	6.4	5.8
2 p. m.	3.8	6.4	7.2	5.8
9 p. m.	1.9	6.7	4.5	4.4
Rain.				
Inches	.33	2.15	2.29	4.77

The first frost of the season at this station occurred October 14th. This was quite a severe white frost, and it killed the sweet potato vines in most situations. There had been, of course abundant time for all crops to mature, and the rainfall has again been considerably above the average.

The lowest temperature was 29° on the morning of the 14th, and the highest September 29th, 91°. Highest pressure on the 15th 29.450 in., reduced 30.429 in. Lowest pressure on the 1st 28.520 in., reduced 29.452 in.,

BOOK NOTICES.

THE MOUNDS OF THE MISSISSIPPI VALLEY, HISTORICALLY CONSIDERED. By Lucien Carr. Quarto, pp. 106.

This essay is reprinted from the second volume of the "Memoirs of the Kentucky Geological Survey," and is divided into three chapters, with an introduction, viz: The Indian as an Agriculturist; The Indian as a Worshiper of the Sun, and The Indian as a Mound-Builder. The object of the paper is to show that, "admitting all that can be reasonably claimed by the most enthusiastic advocate of the superior civilization of the Mound-Builders, there is no reason why the red Indians of the Mississippi Valley, judging from what we know, historically, of their development, could not have thrown up these works."

Taking up the usual argument that the Indians were hunters and hence migratory in their habits, not remaining long enough in one locality to erect such immense works as are found in some portions of the United States, the author devotes a chapter to showing successfully by an extended array of proofs, derived from numerous reliable sources, that they were an agricultural people, cultivating vast crops of corn and other edibles, and that contrary to the usual idea, they were a settled people and had an abundance of time to devote to such structures.

To the argument that the Mound-Builders were sun-worshipers, and hence of a different race from the red Indian of modern times, he opposes a chapter of indubitable proofs that even to a very recent period all the tribes of Indians were given to the same form of worship.

In his final chapter Mr. Carr shows that all North American tribes have been mound-builders and that it was comparatively easy, even with the primitive tools and baskets used in excavating and transporting the earth used in their construction, for these Indians to have erected any of the mounds yet discovered in the Mississippi Valley. As he says in conclusion, "Summing up the results that have been attained, it may be safely said that so far from there being an *a priori* reason why the red Indians could not have erected these works, the evidence shows conclusively that in New York and the Gulf States they did build mounds and embankments that are essentially of the same character as those found in Ohio," "and that one of the more elaborate of them, viz: the mound at Circleville, in which were found articles of iron and silver, was built after contact with the whites, and therefore by recent Indians." He further claims "in view of these results and of the additional fact that these same Indians are the only people, except the whites, so far as we know, who have ever held the region over which these works are scattered," that the mounds and inclosure of Ohio, like those in New York and the Gulf States, were the work of the red Indians of historic times or of their immediate ancestors.

It is a valuable work, full of suggestive points fortified by proofs collected from a multiplicity of sources.

EIGHTH ANNUAL REPORT OF THE RAILROAD COMMISSIONERS OF MISSOURI. 8vo., pp. 193. State Journal Co., Jefferson City, Mo., 1883.

This is the report for 1882, made by the Commissioners, Messrs. A. M. Sevier, Geo. C. Pratt, and James Harding, who seem to have covered the ground very thoroughly.

When Missouri created this Board only eleven of the States had them; now there are twenty-two such boards, showing that their services have been found beneficial. The number of miles of railroad constructed in the State during 1882 was 260.97, giving a total of 4501.58 in operation at the close of that year. Out of 115 counties in Missouri only seventeen were without railroad facilities within their borders, and we presume that by this time even that number has been reduced by the construction of the Kansas City & Memphis Road through the south-eastern portion of the State. There are over eighty main lines and branch roads in the State, operated by twenty-six companies. The net earnings of these roads for 1882 were $2,198 per mile of road, or thirty-five per cent of the gross earnings.

This report is very full and statistical, and closes with a compilation of the laws of the State governing railroads.

ANNUAL REPORT OF THE REGENTS OF THE SMITHSONIAN INSTITUTION FOR 1881: Octavo, pp. 839. Government Printing Office, 1883.

This volume, as usual, consists of the Proceedings of the Board of Regents, the Annual Report of the Secretary, Prof. S. F. Baird, the Report of the Executive Committee and the General Appendix, comprising a record of recent progress in the principal departments of science, and special memoirs, original and selected, of interest to collaborators and correspondents of the Institution, teachers, and others engaged in the promotion of knowledge.

The Astronomical Report is made by Prof. E. S. Holden, Director of the Washburn Observatory, Madison, Wisconsin; that upon Meteorology, by Cleveland Abbe; Physics and Chemistry, by Prof. George F. Barker, of the University of Pennsylvania; Botany, by Prof. Wm. G. Farlow; Zoölogy, by Theodore Gill; Anthropology, by Prof. Otis T. Mason, of Columbian College; History of Smithsonian Institution Exchanges, by Geo. H. Boehmer.

The feature of including these reports is an admirable one and gives great additional value to the volume. If it could be made possible to publish the Report near the close of the same year, instead of two years afterward, it would be an improvement that would be most highly appreciated. The Smithsonian Report is always looked for with eager anticipation and received with warm welcome; more so than almost any other: hence its publication, especially in view of this new feature, should be expedited as much as possible.

QUESTIONS OF BELIEF: Edited by Titus Munson Coan. 12mo., pp. 204. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; paper 25c, cloth 60c.

This is Number V of Volume I of the "Topics of the Times" series, and contains the following timely and able articles: The Responsibilities of Unbelief, by Vernon Lee, from the *Contemporary Review*, May, 1883. Agnostic Morality, by Francis Power Cobbe, from the *Contemporary Review*, June, 1883. Natural Religion, by Edmund Gurney, from *Mind*, April, 1883. The Suppression of Poisonous Opinions, by Leslie Stephens, *Nineteenth Century*, March and April, 1883. Modern Miracles, by E. S. Shuckburgh, from the *Nineteenth Century*, January, 1883.

Number VI of this popular series will be entitled "Art and Literature," and will be ably represented.

CONSTITUTIONAL AMENDMENT MANUAL: By J. Ellen Foster. 12mo., pp. 100. New York. National Temperance and Publication House.

The authoress of this work is a lawyer of prominence in the State of Iowa, who has given much of her time to the temperance cause, and this little volume is prepared as a contribution on her part in aid of "the temperance workers in the various States who desire to join the movement for Constitutional Prohibition with enforcing statutes in both State and Nation."

It contains arguments, appeals, petitions, forms of constitution, catechism, and general directions for organized work for constitutional prohibition. Many of our western readers will remember Mrs. Foster's earnestness, eloquence, and ability in the lecture field when here a few months since.

THE LIFE OF WASHINGTON: By Washington Irving. Two volumes; Quarto, pp. 226. G. P. Putnam's Sons, New York; paper 60c. For sale by M. H. Dickinson.

This is known as the Centennial Edition and is complete in two parts with many illustrations. Of the work itself it is unnecessary to speak, as every reader knows that the life of Washington includes, necessarily, the history of the American Revolution, and that no writer has ever presented the same amount of carefully compiled history in the same elegant, perspicuous and attractive style. The cheapness of this edition, the agreeable size of the print and the beauty of the illustrations will cause it to be sought for on all hands.

WAR SONGS, for Anniversaries and Gatherings of Soldiers: Octavo, pp. 96. Oliver Ditson & Co., Boston. Paper 50c, Boards, 60c, Cloth 75c.

This little volume contains about sixty of the best of the songs so popular among the soldiers during the war of 1861, with piano music and accompaniments, to which is added a selection of songs and hymns for Memorial Day.

We find among the songs many of our old favorites, such as: The Battle Cry of Freedom; Rally 'Round the Flag, Boys; Marching Thro' Georgia; Old Shady; Tenting on the Old Camp Ground; Tramp, Tramp, Tramp, etc. It is dedicated to the Grand Army of the Republic, and is just the thing for them at their post meetings, their camp fires, and their anniversary gatherings.

OTHER PUBLICATIONS RECEIVED.

A Revision of the Lysiopetalidæ, a Family of Chilognath Myriopoda, with a notice of the Genus Cambala, by A. S. Packard, Jr. On the Morphology of the Myriopoda, by A. S. Packard, Jr., read before the American Philosophical Society, June 16, 1883. Old School Medicine and Homeopathy, by J. W. Dowling, M. D., reprinted from the *North American Review*, June, 1882, pp. 26. U. S. Salary List and the Civil Service Law, by Henry N. Copp, Washington, D. C., 35c. Glaucoma, a paper read before Missouri State Medical Society, at Jefferson City, Mo., by Flavel B. Tiffany, M. D., of Kansas City, pp. 16. The *Irving Library*, Vol. I, No. 1, weekly, $25.00 a year, John B. Alden, New York. Remarks upon Hydrophobia, by Chas. W. Dulles, M. D., pp. 12. The *American Medical Journal*, Vol. XI, No. 10, edited by Geo. C Pitzer, M. D., St. Louis, Mo , monthly, $2.00. Variations in Nature, by Prof. Thos. Meehan, Philadelphia, Pa., pp. 14, read at the Montreal Meeting of the A. A. A. S., August, 1882. Iron from the Ohio Mounds, a Review of the Statements and Misconceptions of two writers of over sixty years ago, by F. W. Putnam, pp. 15, illustrated. Inaugural Address of President Charles O. Thompson, Rose Polytechnic Institute, Terre Haute, Indiana, pp. 27. Memoir on the Use of Homing Pigeons for Military Purposes, by Lieut. Wm. E. Birkhimer, Acting Signal Officer. To Foretell Frost, by Lieut. James Allen, Acting Signal Officer. The use of the Spectroscope in Meteorological Observations, by Winslow Upton, A. M. The *Continental*, Vol. I, Nos. 1 to 10, Baltimore, Md., monthly, 50c per annum. The *Canada Lancet*, Vol. XVI, No. 2, Toronto, October, 1883, $3.00 per annum. The *American Psychological Journal*, Joseph Parrish, M. D., editor, quarterly, P. Blakiston & Son, Philadelphia, $2.00.

SCIENTIFIC MISCELLANY.

EMULSIONS OF PETROLEUM AND THEIR VALUE AS INSECTICIDES.

C. V. RILEY, PH.D., WASHINGTON, D. C.

[*Abstract.*]

The value of petroleum for the destruction of insects has long been recognised, and I have for years been endeavoring to solve the question of its safe and ready use for this purpose without injury to plants. The paper contains the results of extended experiments carried on under my direction, by several of my assistants and particularly by Prof. W. S. Barnard, Mr. Joseph Voyle, of Gainesville, Fla., Mr. Clifford Richardson, assistant chemist of the Department of Agriculture, and Mr. H. G. Hubbard, who has for over a year been devoting his time to practical tests in orange groves at Crescent City, Fla.

Passing over the ordinary methods of oil emulsions by phosphates, lactophosphates and hypophosphites of lime and various mucilaginous substances, experience shows that, for the ordinary practical purposes of the farmer and fruit-grower, soap and milk are among the most available substances for the production of petroleum emulsions.

Ordinary bar soap scraped and rubbed into paste at the rate of 20 parts soap, 10 parts water, 30 parts kerosene and 1 part of fir balsam, will make, when diluted with water, an emulsion stable enough for all practical purposes, as the slight cream which in time rises to the surface, or the flakiness that often follows, is easily dissipated by a little shaking. Soap emulsions are, however, less satisfactory and efficient than those made with milk. Emulsions with milk may be made of varying strength, but one of the most satisfactory proportions is 2 parts of refined kerosene to 1 part of sour milk. This must be thoroughly churned (not merely shaken) until a butter is formed, which is thoroughly stable and will keep indefinitely in closed vessels and may be diluted *ad libitum* with water when needed for use. The time required to bring the butter varies with the temperature, and both soap and milk emulsions are facilitated by heating the ingredients. Ordinary condensed milk may also be used by thoroughly stirring and beating it in an equal or varying quantity of kerosene.

The diluted emulsion when prepared for use should be finely sprayed upon the insects to be killed, its strength varying for different insects or plants and its effect being enhanced when brought forcibly in contact with the insects.

Of mucilaginous substances, that obtained from the root of *Zamia integrifolia*, a plant quite common in parts of Florida, and from the stems of which the Florida arrowroot is obtained, has proved useful as an emulsifier.

These petroleum emulsions have been used with success by Dr. J. C. Neal, of Archer, Fla., against the Cotton Worm, without injury to the plant, but their chief value depends on their efficacy against the different scale-insects which affect Citrus plants. Experience so far shows that such plants do not suffer from its judicious use, but that it must be applied with much more care to most deciduous fruit trees in order not to injure them.

GAS FROM SAW-DUST.

"So far as we are aware," says the London *Timber Trade Journal*, "the making of illuminating-gas from saw-dust is a new branch of trade; certainly it is one of considerable importance, from the fact that it deals with what, in the majority of cases, is a waste product. We are advised that Mr. R. Tomlinson, late manager of the Cottingham Gas-Works, near Hull, has just completed the erection of the gas-works and lighting the town of Deseronto, Ontario, Can., the works being erected for the purpose of making gas from fine saw-dust. The gas produced is said to be far superior to that made from the best Silkstone coal, and to be equal to that made from the best cannel coal. It would appear that Mr. Tomlinson is especially commissioned in the above matter, for we learn that upon the completion of some water mains, which he has also in hand, he intends returning to England. As a basis for the manufacture of illuminating gas, saw-dust lays claim to many specialties, more so in the wood-producing countries of northern Europe and America, where coal has to be obtained at great cost, and where saw-dust is a greater drug and nuisance than in our own country. As saw-dust can be practically applied to the manufacture of illuminating-gas, it is clear, where the supply is at hand, towns may be illuminated by it; but it strikes us as being applicable, in a smaller and more general degree, in the case of illuminating saw-mills, joinery works and other establishments where saw-dust is produced."

THE MACKAY-BENNETT MARINE CABLES.

Messrs. Siemens, of London, are energetically pushing the work on the new Mackay-Bennett cables, now being manufactured by them at Charlton Pier, Woolwich. They will form a duplicate line from Ireland to Nova Scotia, continued from Nova Scotia by special cable to Cape Ann, and having a branch line from Ireland to France. The work was definitely begun last week, and though materials are still being prepared and tested, yet it is already possible to determine the character of the cables. Their core will contain a strand of eleven copper wires of highest conductivity, weighing 350 pounds per nautical mile, and the dielectric will consist of eight coatings of gutta percha placed upon the wire according to the improved method of Messrs. Siemens, and weighing 300 pounds per nautical mile. The deep sea portion will be covered with galvanized steel wire and manilla hemp. All the intermediate cables are armed with steel wires. The shore ends are of the usual heavy types. Messrs. Siemens are convinced that nothing superior has ever come from their factories. They will introduce all the improvements suggested by years of research and experience. The length of the entire system of cables will be 5,600 miles. They will be laid by the steamer Faraday in the course of next summer. A visit to the works at Woolwich shows that everything is in a forward state of preparation.

SAMBO ON THE "RAIL-BIRD."

"I just whush," says he, "that some of dese fo'ks wat's all de time stud'in' ober bugs an' animals an' thin's wud fin' out wat kind ob a t'ing a rail-bud is, anyhow. Der' arn't nobody yit wat's eber 'now'd whar dey cum from or how dey cum's, whar dey go's, when dey go's, an' how dey go's. You may cum on dese ma'shes one day an' dey arn't no bud's; cum de nex' an' 'nock on you' boat wid you' oar an' dey answe's you f'om all 'round: 'Heah I is! heah I is!' But cum arter de fus' fros' and you doan' fin' 'em. Dey can't fly, dat's sart'in. Dey can't run hun'ered mil's in a nighttim', dat's shuah. Nobody 'nows nawfin' 'bout em. Dey mighty cut', and dey can run, swim an' div' jes' same lik' a wild duck an' a wild tu'key combin'. Ef dey won't fly yo' might as well lef 'em be. Tain't any mo' use in huntin' 'em than any thin' in dis whol' roun' wo'ld."

EDITORIAL NOTES.

THE Sixteenth Annual Meeting of the Kansas Academy of Science will be held at Topeka, Wednesday, Thursday and Friday, November 21, 22 and 23, 1883. The business meeting will be held Wednesday, November 21st, at 3 o'clock P. M. Wednesday and Thursday evenings will be devoted to lectures. Papers will be read and discussed on Thursday and Friday forenoons and afternoons. Friday evening a social meeting and reception will be held at the residence of one of the local members.

A full attendance of the members and of the friends of science generally is desired, as the programme promises to be full of interest, and business of importance is to be transacted, which will tend to increase the efficiency and usefulness of the Academy.

All persons expecting to present papers, or submit specimens, or introduce any scientific subject, are requested to send the titles and names of the same to the Secretary at their earliest convenience, that he may arrange them in the programme in time to distribute before the meeting.

The subject of the retiring President's address will be "The Organization and History of the Academy." The lecture on Thursday evening will be delivered by Dr. R. J. Brown, of Leavenworth; subject, "Deep Sea Fauna."

Reduced rates will be secured at the hotels; and also, from the railroads of the State.

For information address A. H. Thompson, President, Topeka, Kas.; or E. A. Popenoe, Secretary, Manhattan, Kas.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

DURING the fall of 1883 a very large vein of fuller's earth was discovered in Dallas County, this State, which proved to be of excellent quality; equal if not superior to any found either in Germany or England. It is in several colors, yellowish-white, light brown and dark-reddish brown, and is pronounced first-class by both Professor Prescott, of Michigan University, and Carl Wenntrock, a German Mining Engineer of note. Mr. Wm. Jones, a chemist of this city, has analyzed it and finds a higher percentage of silicate of aluminum than is present in the English article. A company has been formed in this city to mine and sell it to manufacturers of woolen cloths, etc.

MR. WALTER G. MELLIER, of this city, brought home with him, from Colorado and New Mexico, some interesting relics of the former civilization of those regions, which he presented to the Kansas City Academy of Science. All such specimens are gladly received by the Academy, and our citizens may be assured that whatever they donate, geological, mineralogical, archæological, etc., will be labeled with the name of the donor, and carefully preserved.

PROF. BAIRD, of the U. S. Fish Commission, thanks the Life Saving Corps for rescuing from the ocean and preserving to science several rare and unique specimens of salt-water fishes.

THE completion of the Kansas City, Springfield & Memphis R. R. is very properly a matter of great self-congratulation among the older citizens of this city, by whom it was planned more than twenty years ago. The immediate execution of the design is due to General Manager Geo. H. Nettleton, of the Kansas City, Ft. Scott & Gulf R. R., who has given all his energies to it for many months. The first freight train over the line consisted of fifty-six cars, all loaded in this city and gaily decorated by the shippers.

TEXAS has decided to abandon the system of letting the labor of its convicts for outside work on railways and farms, and is about to employ 1,000 convicts in the reduction of iron ore at the Rusk penitentiary.

PROFESSOR SNOW, of the Kansas University, has lately received large accessions to his museum in the way of mastodon bones from Kansas, and other fossils from Iowa. He also has our old friend, Judge E. P. West, in the field collecting archæological and geological specimens.

THE noted chemist, Professor J. Lawrence Smith, recently died at his residence in Louisville, Ky. He was an eminent scientist and a very prominently useful citizen, and his loss will be severely felt, both by his scientific associates and by his family, some members of which live in this city.

LIEUT. STONEY, of the Revenue Cutter "Corwin," reports the discovery in northern Alaska of an immense river hitherto unknown to geographers.

DR. EDWIN R. HEATH, the well known South American explorer, was married on Monday, October 15th, to Miss Jennie E. Gregory, of Jersey City, N. J., daughter of Mr. George Gregory, one of Dr. Heath's companions in the wilds of Bolivia.

SEVERAL samples of zinc found a short distance southeast of Butler, Missouri, have been brought in recently and are pronounced fine ore by parties who have had experience in mining this metal.

A paper read by W. M. Bowson at the Colorado Meeting of the American Institute of Mining Engineer seems to show that titanium is destined to become an important addition to the metallurgy of the future.

ON the evening of August 25th the Island of Java, equaling in size New York, Pennsylvania, and Ohio, was shaken from end to end by volcanic action, and so vast a portion of its surface submerged beneath the sea that, as *Harper's Weekly* suggests, the story of the lost Atlantis may be regarded as brought within the range of probability.

PROFESSOR PARKER, formerly of this city, now chaplain in the U. S. Army, has been transferred from Ft. Stockton, Texas, to Ft. Hays, Kansas, much to his satisfaction. He is now in this city enjoying himself among his friends for a short time.

PROF. G. C. BROADHEAD, formerly State Geologist of Missouri, gave us a brief call on the 19th ult. He still insists that the Legislature made a mistake last winter in not providing for the completion of the geological survey of the State.

THE *Western Normal Advocate*, edited by C. L. Gregory and C. F. Holcomb, at Bushnell, Illinois, winds up a complimentary notice of the REVIEW by saying, "*Every teacher should be a subscriber to this truly excellent periodical.*"

MISS FANNIE E. WRIGHT, a well known artist of this city, has recently returned from Europe, where she has spent the past year studying under the very best instructors, and has resumed giving lessons in painting at her home, 1105 Forest Avenue.

A cablegram announces the death of Prof. Wm. Denton, geologist, for the past two years making scientific explorations in Australia, New Zealand, and China. He is supposed to have been in Java at the time of the earthquake, and to have been one of the victims.

THE publisher of the REVIEW has for sale, very low, a large, fine, new parlor organ, suitable also for college chapel, lecture room, or church. It is one of the very best styles, and can be had at a decided bargain.

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY is one of the ablest and best publications of its kind in the country, and has the especial merit of dealing with scientific questions in a manner that can be understood by the lay reader. The great fault of most publications of the sort is that they treat subjects of scientific interest in a manner too profound for the ordinary citizen, but the REVIEW is purely popular, and therefore the more valuable.—*Chicago Inter Ocean.*

PROF. E. B. SEITZ, of the Kirksville State Normal School, died of typhoid fever on the 8th of October. He was regarded as one of the finest mathematicians in the United States and his loss will be greatly felt.

PROF. R. S. G. PATON, late of Chicago, has been elected Professor of Chemistry in the Medical Department of the University of Kansas City, and is now engaged in delivering his winter course of lectures before the students of that Institution.

NEW YORK CITY is now in direct communication with Rio de Janeiro by telegraph, so that dispatches are now received in the Coffee Exchange only two hours after they are written. From Rio the new line has been extended by way of Montevideo and Valparaiso on land wires through South and Central America, crossing the Isthmus of Tehuantepec, and going thence by cable to Galveston, Texas. With improved facilities our trade with south America ought to be materially extended.—*American Grade Journal.*

WE call attention to Dr. Fisk's article upon "Climate in the Cure of Consumption," reprinted from *Science* of October 5th, which number also contains its usual quota of timely and valuable papers, correspondence, etc.

DR. KOCH, of Berlin, who has been investigating the cholera in Egypt, finds that it is due to a "living, thread-like microscopic organism," resembling that seen in cases of phthisis."

I. T. SOULE, of Rochester, N. Y., has arranged with Gilbert Bros., of Spearville, Kan., for digging and operating seventy-five miles of irrigating canal, beginning at available points on the Arkansas River—one above Dodge City, near Cimmeron, and the other near Spearville, and terminating near Vanity. The work is to begin at once, and the canal completed as soon as possible.

THE awards to the United States at the Fisheries Exhibition, number 147, of which forty-five are gold, forty-five silver, and twenty-eight bronze medals, Also nineteen diplomas and ten money prizes. The United States Fish Commission gets eighteen gold and four silver medals, besides two diplomas.

THE reconstruction of Pine St., St. Louis, with asphaltum is completed, making an elegant drive. Locust Street has been begun. No heavy traffic will be permitted on these streets, but will be confined to the street between them, Olive, now being reconstructed with granite.

PROBABLY the earliest patent in this country was that granted by the Commonwealth of Massachusetts, to Samuel Winslow, who had invented a method of manufacturing salt. "None are to make this article," said the patent, "except in a manner different from his, provided he set up his works within a year."

THE Supervising Architect of the Treasury has received a sample of Missouri granite in connection with the bid of a granite company in St. Louis on the Pittsburg public building. This particular variety of stone attracted considerable attention in the architect's office, and Mr Hill pronounces it the finest specimen of building stone he had ever seen. It is deemed chiefly remarkable for its dark, rich color and susceptibitity of polish.

ONE of the most interesting exhibits at the Vienna Electrical Exhibition was Gentilli's Glossograph, a little instrument by which speech is automatically reproduced as soon as it is uttered. A small apparatus is placed in the mouth of the speaker—in contact with the roof of his mouth, his tongue and lips—and on being connected with an electro-magnetic registering apparatus the sounds are committed to paper.

As near as could be ascertained the yield of copper in Arizona, in 1882, was 15,000,000 pounds. The combined value of the silver and copper product for 1883 will be between fifteen and sixteen millions of dollars. This will place Arizona second on the list of bullion producers, and it is believed to be only a question of a few years when she will take the place which naturally belongs to her, and stand at the head of the list.

THE Saverton Lithographic Stone Co., of Ralls County, this State, has received an order from the Government which will amount to $150,000 a year, and henceforth all the postage stamps will be printed on stone taken from Ralls County, it having been fully demonstrated that it is the best in the United States for lithographic purposes.

SEVERAL changes have recently been made in the faculty of the University of Kansas. Thus Professor J. A. Lippincott, late Professor of Mathematics, at Dickinson College, takes the place of the highly esteemed Dr. James Marvin, as Chancellor; Prof. Edward L. Nichols, late of Central University, Richmond, Ky., takes the chair of Astronomy and Physics, in place of Prof. H. S. S. Smith, who has gone to Princeton N. J.; Prof. E. H. S. Bailey, late of Lehigh University, fills the place of Prof. G. E. Patrick, so long Professor of Chemistry. Each of these gentlemen brings with him a high reputation for scholarship and fitness for his special department, and it is to be hoped that these changes will prove profitable to the University of Kansas, though all of its old friends will long miss the familiar faces of the veteran professors.

A ship-canal across the Isthmus of Cornith is now under construction, though but little has ever been heard of it out this way. Work on this historic ground was begun a year and a half ago and considerable progress has been made with it Its length will be between three and four miles, its breadth about sixty-five feet, and depth twenty-five feet. A couple of French companies are making the excavation under a contract which calls for the payment of $4,920,000. At each end the canal traverses a plain. The middle section cuts through a ridge of solid rock from 120 to 240 feet high.

SOME appreciative but unknown correspondent of the Topeka *Capital* makes the following flattering reference to the REVIEW: "Among the productions of the Kansas City press Col. Theo. S. Case's REVIEW OF SCIENCE AND INDUSTRY takes a front rank. It is what its name implies, and is edited by a thorough scholar and scientist. It is a credit to this city, where the pursuit of wealth is such a ruling passion, that business men as well as scholars take time to read and interest themselves in its success. Teachers of Kansas will always find the subscription fund of this magazine a valuable investment."

REV. H. C. HOVEY, of Hartford, Conn., calls attention in the *Scientific American* to a newly discovered cavern in Crawford County, Indiana. It was first explored in September last and found to be wonderfully rich in rooms and halls embellished with fantastic stalactites, columns, drapery, etc. Its trend is southward; it is believed to be not less than two miles in length.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *North American Review* for November, by the liveliness and the sterling worth of the articles it contains, satifies the requirements of the most exacting reader. Senator H. B. Anthony writes of "Limited Suffrage in Rhode Island," giving incidentally a highly interesting sketch of the early constitutional history of that little Commonwealth. Dr. Norvin Green, President of the Western Union Company, in an article entitled "The Government and the Telegraph," cites the provisions of the Federal Constitution and the determinations of the Supreme Court which appear to debar the General Government from assuming the management of the telegraph lines. The Rev. David N. Utter, formerly pastor of the Unitarian Church of this city, brings out from oblivion his view of certain alleged atrocious crimes of "John Brown of Osawatomie." There are two scientific articles, namely, "Solar Physics," by Professor Balfour Stewart, and "Modern Explosives," by Gen. John Newton. W. H. Mallock contributes "Conversations with a Solitary." In "Suggestions in Regard to the Public Service," Green H. Raum offers certain facts going to prove that clerks and other employes of the Government departments at Washington, even before the passage of the Civil Service act, were in the main both faithful and efficient. Finally, "Dr. Hammond's Estimate of Women," as reviewed by Mrs. Lillie Devereux Blake, Miss Nina Morais, Mrs. Sara A. Underwood, and Dr. Clemence S. Lozier. Clubbed with the Kansas City REVIEW at $6.50 for both.

Harper's Monthly concludes its sixty-seventh volume with the November number which as ever, is filled with valuable, timely, and entertaining articles, while the illustrations are finer, if possible, than usual. No magazine published is better adapted in all respects for family reading than this. Subscribers to the REVIEW can obtain it at reduced rates by subscribing through this office, and now is the time to attend to it, as the December (Christmas) number will be the first of the new volume and will be an extra-attractive one.

WE notice an excellent article upon Glaucoma, in the *St. Louis Medical and Surgical Journal* for September, by our fellow citizen, Prof. Flavel B. Tiffany, of the University of Kansas City. It is exhaustively written and fully illustrated.

Psyche, an entomological magazine of high standing in scientific circles, is now in its tenth year, but has never reached the paying basis that its excellence merits. Of the associate editors, four are the State Entomologists respectively of Michigan, Illinois, New York and Kansas. Prof. Trelease is a botanist, Professor in Wisconsin State University. Dr. Dimmock is a graduate of Harvard College and the University of Leipzig; Mr. Mann is Assistant Entomologist of the U. S. Department of Agriculture, and was formerly Entomologist to the Government of Brazil. Mr. Mann has been editor of *Psyche* from the outset. It is published monthly at Cambridge, Mass., at $1.00 per annum.

THE *Atlantic Monthly* for November, 1883, presents the following excellent table of contents: A Roman Singer, IX., X. F. Marian Crawford. Ezra Ripley, D. D., Ralph Waldo Emerson. The Trustworthiness of the Hebrew Traditions, Brooke Herford. Charon's Fee. Newport, X., XI. George Parsons Lathrop. A Noble Lady, Maria Louise Henry. En Province, V, Henry James. Omens, Edith M. Thomas. The Bird of the Morning, Olive Thorne Miller. Random Spanish Notes, Charles Dudley Warner. Recollections of Rome during the Italian Revolution, II., William Chauncy Langdon. An Only Son, Sarah Orne Jewett. Venice, Christopher P. Cranch. The New Departure in Negro Life, O. W. Blacknall. What Instruction should be given in our Colleges? Albert S. Bolles. A Good-Bye to Rip Van Winkle, Gilbert A. Pierce. The Songs that are not Sung, John Boyle O'Reilly. The East and the West in Recent Fiction. James Buchanan. The Contributors' Club. Books of the Month.

THE *Mexican Financier* gives an account of a new fuel invented in the City of Mexico, called "turbato." It consists principally of bog peat, of which there are immense quantities in Mexico, mixed with a proper proportion of bitumen or chapopote. The fuel is made in five different classes: for locomotives, stationary engines, smelting purposes, smiths' fires, and household purposes. It burns freely and without much smoke, giving a higher dynamic equivalent of heat than the same amount of wood, and very nearly as great as the best English coal. It can be manufactured and sold in Mexico at a price considerably below coal or wood.

THE *Educational News*, published at Adrian, Michigan, by Wm. B. Mumford, says of the REVIEW, "Its readers get value received for their investment."

Popular Science Monthly, for November, gives considerable space to the "Greek Question." It contains an article by Professor Josiah P. Cooke, of Harvard College, and an editorial by Professor E. L. Youman in opposition to that of President Porter in the last *North American Review*, and in support of Charles Francis Adams' attack upon the study of this language in colleges.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

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GEOLOGY AND MINERALOGY.

THE TRIASSIC BEDS OF TEXAS.

CHARLES H. STERNBERG.

The Red River and Big Wichita receive their characteristic color from the extensive red clay beds along their valleys. These deposits have been called Triassic by most geologists. Professor Cope claims they are Permian, and that the vertebrate fossils are similar to those found in the Permian shales of Illinois. They have been but little studied and offer a rich field for the stratigrapher and palæontologist. For miles along the Big Wichita are thousands of acres of the rich colored strata exposed. So persistent is the red color that all the surface waters are colored. On examination the water will be found to hold red clay in solution and though on still days the clay is partially settled, the least wind will make the water almost as thick as cream. As there is no other water but that which is impregnated with salts of magnesia we were obliged to drink it, I found that boiling would settle it, as would also the bruised leaves of the prickly pear. Some of the scenery along the Big Wichita is very beautiful. The miniature Bad Lands are made up of pinnacles, ridges, cones, hills, etc., composed of red and green clays interspersed with layers of grey sandstone, some of which has such a fine grit that it can be used for sharpening razors or other fine instruments. I spent several months among these beds in search of fossil vertebrates for Harvard University, in the winter of 1881. The Triassic beds are covered with yellowish sands and clays of quite recent age, containing the remains of the elephant, mastodon, horse, camel, turtle, etc. I discovered one shell that was over three feet long, unfortunately it fell to pieces. I got quite a number of bones and teeth of these animals.

There are large beds of massive gypsum in the Triassic, as well as narrow seams crossing the beds at various angles: some is of the fibrous variety and white as snow. Nearly all the clay beds are filled with concretions of all the shapes imaginable. They cover all the beds.

For many weeks I searched these beds for fossil remains without success: they were remarkably barren. Week after week passed and I was well nigh discouraged when I was so fortunate as to find a large reptile, and thereafter I was very successful. I also found seven Ganoid Fishes; their peculiar enameled scales are quite abundant. Some of the reptiles appear to belong to the Labyrinthodonts. One fine specimen resembled a crocodile, the bones were all beautifully sculptured: it was provided with a row of round teeth. I think it was about twenty feet long and four crocodile-like limbs.

Another species, a land reptile, was of large proportions. The hind limbs were long and powerful, and it had a large tail. The front limbs were provided with claws; so it doubtless walked on its hind feet.

Some of the bones were changed to iron ore and were very heavy. One swimming species had two rows of teeth in each jaw, long and short ones. The bones were all sculptured. I discovered a great many loose teeth, three of them projecting from one root. One large animal I discovered had bi-concave vertebræ and long well preserved limbs, with hoofs on hind feet and claws on front ones. I got a lot of sculptured dermal plates. I passed the winter on these beds, and every week or two we were overtaken by a dreaded "norther," and the ground would soon be covered with sleet and ice. The explorer always suffers a great deal from exposure. He is away from all the comforts of civilization; absent from home and friends. He works with unfailing enthusiasm and is happy if success crowns his efforts. If he discovers new species and adds new facts to science, he is well rewarded. To his work are the recent advances made in palæontology largely due. In the interests of science there is no place on land or sea that he will not explore. Enduring the heat of the tropics or the extreme cold of the north in pursuit of his beloved science, and the glory of the whole is that nature always rewards persistent effort in searching out her hidden treasures, and when they are found there can be no sensation so gratifying as the explorer feels over each new discovery. He is quick to read the mighty volume the Creator has written in the solid rock. Each stratum is a leaf in which he has written in never fading characters its life and history; written so plainly that there can be no mistake. The geography, climate, depth of sea, etc., of each succeeding era in the world's history are carefully inscribed. On the Little Wichita I discovered a great many well preserved specimens of ferns, etc., that closely resemble those of Permian rocks, a strong proof, to my mind, that the beds are Permian. They lie immediately under the old beds. My collections have not as yet been described or I would be able to give a more detailed account of them. I found enough to prove that in the days when these rocks were forming, the land and sea were peopled with animal life on land; great carnivorous and herbivarous reptiles were abundant; the climate was tropical and plant-life luxuriant.

Copper ore is found in this formation and a smelter has been erected at the Narrows to reduce the ores. The Narrows are named from a place where the divide between the Brazos and Big Wichita is so narrow that a wagon can hardly pass. It is difficult traveling along the rivers, as deep drainage canals cut through the valley and have to be headed. I have often travelled fifteen miles in going three in a straight line. The woods were filled with wild turkeys, and our table was well supplied.

The Triassic beds have been thrown up by internal forces into miniature mountains, and their trends can be followed for some distance. The rocks lie at all angles. The color of the beds change so often that it is hard to trace them.

Thanks to a letter from Mr. Lincoln, Secretary of War, to commanders of western forts, I had, thanks to Major Henry, Commander of Fort Sill, placed at my disposal a large government wagon and six mules, with escort of four soldiers and a teamster, with wall-tent, rations, etc. And here I would express my hearty thanks not only to the officers of Fort Sill, to whom I am under many obligations for similar courtesies extended and help rendered, but to all army officers who have always felt great interest in all scientific expeditions, and have done much to make them successful. It is to be hoped that Texas will soon be more thoroughly explored. It offers a most interesting field of research. The landscape artist would also find some beautiful scenery.

GENESIS OF NATIVE COPPER.

JOHN K. HALLOWELL.

Having expressed some ideas relative to the method of occurrence of native copper, and also being requested to make the same public through some journal of standing, I have taken the liberty of sending the REVIEW the following:

In order to express my views clearly I will take the Lake Superior copper occurrences as a final illustration, at the same time I feel how difficult it will be to set the whole upon paper plainly, that any one may understand, especially those who have not much knowledge of rocks and ore formations. There is not much in the books that is at all satisfactory to me; the basis of reasoning there, being, in most instances, theoretical and far fetched, and the simpler things, even though occurring on a very large scale, appear to have been overlooked.

To get at the genesis of native copper let us see what the first form of the ore occurrences is. Mineralogists as well as geologists are agreed that this is in the condition of sulphides, being a deposition, or precipitation from aqueous solutions, known also as copper pyrites, the ore being a mechanical combination of copper, sulphur, and iron. These pyritous ores are known to occur in very large quantities, sometimes is well defined veins, also as deposits, being worked not only for the copper values, but also for the gold and silver occurring with them; this is the case with the Colorado copper ores. They are also extensively worked in Canada, Spain, and other parts of Europe, and I am quite certain also in the Southern States of this country, for sulphuric acid as well as the copper product. Where utilized for the acid, the ores are found to exist in very large (so-called) deposits con bined with a silica gangue; and surprising as it may seem, even where such ores have been worked for centuries in Europe, I know of no record which states that they have ever been worked out.

Having got our copper into this condition, and exposed to atmospheric agencies, the next step in nature is, apparently to undo what she has so laboriously built up. Without taking time into consideration at all, comparatively speaking, copper pyrites are very readily acted upon by meteoric agencies, that is, rains, frosts, and snow waters help the ores to oxidize, the sulphur is set free, washed out, and the residue is oxides of copper and iron; notably the green and blue carbonates of copper.

Now the salts of copper in this condition are much more soluble than the iron oxide, which results in a continual leaching process gradually carried on for ages upon ages, until all of the copper is leached out from amongst the iron, and accumulates further down amongst the vein matter, quartz; this concentrated oxide is generally cuprite, or red oxide of copper, very rich, and giving over fifty per cent metallic copper. With no geological disturbances in the immediate locality this gradual change would keep on until all of our first formed pyritous ores would be changed to concentrated copper oxides; concentrated at times to such a degree as to actually show spots, crystals and other small particles of really metallic copper, as a natural occurrence.

Let some slight geological change now occur, by which the iron ore of the surface is eroded away, exposing the large mass of accumulated copper oxides. We have the illustration of this method of occurrence in New Mexico and Arizona; where the most easily reduced of all copper ores are found in the form of almost mountains, or vast deposits of copper oxides, and the product from these is, to-day, successfully competing with the Lake Superior product.

The metallic copper from the Lake Superior mines is the purest form of native copper now known, and the duplicate of this region has been widely sought for on the American continent for many years, but so far unsuccessfully; or at least if found, there has not been any attention attracted to it, as would naturally be the case if found in fact; but this is digressing somewhat.

Having shown the first two steps of copper occurrence as known, it remains to reason out the Lake Superior copper region from the last explained.

We can rightfully assume, for illustrative purposes, that we have a very large formation of quartz, mineral bearing, originally containing copper pyrites, which through ages of time, under the conditions described, have changed to the condition of copper oxides, and that by surface erosion the iron gossan, or cap, has been removed; the surface quartz from the leaching out of the sulphides is honey-combed, loose and friable. Now let a geological change come, by which in the subsidence of a large area of dry land, our copper deposit is submerged many thousand feet under an ocean.

The weight or pressure of all this water, would act in making our formation more compact. If we could see it then, we would find a vein, or mineral bearing quartz, iron and copper stained, amongst the top layers, packed firmly together, but if taken from under this pressure of water, easily disintegrating; and further down in the gangue we would keep getting a greater proportionate showing of copper, owing to the previous leaching action already described, but it will not do to take our deposit out just yet.

Let us go outside in our reasoning a little; all of the large masses of eruptive rock known, except lava of recent date and pumice stone, have been thrust up, in the form of volcanic pastes, through the earth crust, or floor under an ocean. Now if such were to happen, in near proximity to our copper oxide deposit, the result would be, from the heat and pressure of such an occurrence, that all of our oxides would gradually change to native, or metallic copper. I reason, gradually, as the pressure and presence of such an enormous mass of water would prevent the copper melting as in a furnace. It would produce such changes as would be best described by the word metamorphism. The quartz also would be metamorphosed into a very much harder form and be more homogeneous in texture, but with scales of native copper all through, these of course increasing in quantity as depth in the formation is gained.

If this quartz had cavities in it before the submergence, which could have been filled with the copper oxides during the leaching period, then there would be found in places large masses of native copper, and which are found in Lake Superior regions, the result or product of just such a natural process as I have described.

There, as is well known, we have trachytes, basalts, and porphyries in vast amounts, and it is owing to these being erupted under the conditions described, and in near proximity to what had been, in the past, a duplicate of the Arizona copper formations, that we have the pure form of metallic copper as a natural occurrence upon the shores of Lake Superior.

Now, if ever a duplicate of the formation of this region is found it will also be found that surrounding it, perhaps also on top, (the result of a flow of volcanic paste) will be found some of the varieties, and in very large quantity too, of eruptive rocks; if so, then the copper product will duplicate that of the Lake Superior mines in quality, with perhaps this chance for variation in quantity. That perhaps the quartz did not contain cavities to allow of the accumulation of large masses of copper oxides, hence there will be no large masses of native copper, but the metal will be evenly distributed throughout the whole of the quartz, not varying much in quantity in planes of the same horizon, but rapidly increasing throughout the whole of the mass as depth is gained in the formation.

It might be that the surface quartz would be barren, or that there would be only the smallest scales of copper amongst the surface material; but the quartz, or gangue, would show for itself whether it had been through the course of change I have described; and should such ever be found, it would be, to my mind a very safe thing to go down upon, especially if occurring in a large bed, as then it would have the chance of being as inexhaustible as anything known at Lake Superior.

DENVER, COLORADO, November 7, 1883.

THE PLUTON GEYSERS OF CALIFORNIA.

* * * * * * *

Although only a hundred miles from San Francisco, it is an all day's journey to the Geyser Cañon. One travels by train from eight to eleven o'clock in the morning, first crossing the Bay of San Francisco and the Straits of Carquinez by ferryboats, and then speeding up the famous Napa Valley to that point where the mountain ridges meet and seemingly bar all further progress, the great stage ride of twenty-seven miles from Calistoga to the geysers begins. There is one spring in that narrow little "Devil's Cañon" for every ailment in the doctor's category; the iron, the sulphur, the alum, the magnesia, and the epsom salts, boiling and gurgling away at all temperatures and in all combinations, and as we wound our way up that tortuous cañon the guide continually did tempt us with his cup full of some steaming draught.

The shifting clouds of steam and the cañon walls streaked and daubed with brilliant patches of color make fine pictures to the eye every moment, but no photograph can do justice to it, and only a well executed aquarelle could give an accurate view of this vivid, diabolical and unearthly realm.

Although this group of hot and boiling springs have long been denominated geysers, they are not geysers at all, and there are no eruptions of columns of water or the recurrent bursts of water and steam to great heights, which characterize the geysers of Iceland, New Zealand, and the Yellowstone. One inky pool, of unknown depth and a diameter of seven feet, boils away at a furious rate, but even this witches' caldron does not authorize the ambitious name that designates this collection of boiling springs and steam blow-holes. The heat and steam have so decomposed the rocks through which they find vent, that one can thrust his stick into what appears to be solid rock, and the ground jars and trembles beneath any heavy or emphatic footstep. At the head of the cañon there is the inevitable Devil's Pulpit, from which the ruler is supposed to view his realm. In the early morning and at sunset the cañon is one cloud of steam, and prosaic human figures seen through that misty and shifting medium are suggestive of all the witches, goblins, and demons that haunt the fairy tales and the Brocken; but, at noon, when the hot sun pours straight down into the cañon, the steam rises in faint and fitful gusts, and the wonderful coloring of the cañon walls is seen at its best. Cinnabar streaks the sides with red; magnesia lies in great white masses; sulphur crystals form yellow patches around each little steam-hole, and rocks are covered with blue and green compounds of copper that have condensed from the heavy fumes. Tossed together in the wildest way the rocks show all these vivid tints, while the general effect on the eyes is the endless range of reds and yellows. The puffing, steaming, and sputtering holes in the hillsides culminate in the great tea-kettle's spout, which emits a hoarse blast of steam that makes the guide's cup whirl like a fly-wheel when he hangs it on his stick and holds it across the orifice.

The Indians knew this cañon ages ago, and it is not many years since they tore down the rude tepee that they had built over one of the springs for a sweat bath. The old men were cured of their rheumatic woes by the sulphur steam, and marvelous effects are now produced on the white man who dares to "sulphur the deep damnation" of one of the steam baths provided at the bath house near the hotel. The bath house is built over a collection of boiling sulphur springs, and the patient, or the victim, is first conducted to a box of a room where the steam creeps in at every crack of the floor as hot as it came from the center of the earth. After a thorough parboiling there comes the hot and tepid showers, a plunge into a tank of cold sulphur water, and then a glow and a rapturous and delightful sensation of having grown twenty years younger and spryer.—*Cor. Globe-Democrat.*

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION NOTES.

In a paper read before the Mathematical and Physical Section, Professor Chandler Roberts remarked on the rapid diffusion of molten metals. The two metals chosen were lead and gold enclosed in a U-shaped tube, the lead occupying the lower portion of the tube, and the gold being put in at the top of one limb. After about forty minutes Professor Roberts found that the two metals had been thoroughly mixed. Sir W. Thomson called attention to the extreme importance of this, with reference to metallic alloys, and remarked that it resembled the diffusion of gases or of heat in a gas rather than of a solid in a liquid. Salt would take years to diffuse in a similar manner through water.

A paper was read which had been received from two American gentlemen, Messrs. W. B. Scott and H. F. Osborne, upon the "Origin and Development of the Rhinoceros Group." These gentlemen have made careful researches in the extensive series of tertiary lake deposits in the northwestern United States, in which specimens of very many animals have been discovered, which render it possible satisfactorily to trace the genealogy of several important groups of mammals. These gentlemen have discovered the remains of the ancestor of the rhinoceros group,—an ancestry from which it is found that both the rhinoceros and the tapir groups are descended. This animal has been named Orthocynodon. A somewhat detailed account of the anatomy of the skull and form of dentition was given, bearing out the authors' views.

The committee on Meteoric Dust state that Mr. Pope Hennessy had obtained a quantity of ice and snow from the Himalayas. After being melted and boiled down the residue was sent to England for examination. In most specimens of the dust are a number of small spherical bodies of magnetic matter, the surfaces of which are generally highly polished. Dr. Schuster showed several of these particles, the largest being perhaps one-twentieth of a millimètre in diameter, which had been obtained from a spot in the Himalayas about 3,400 feet high and fourteen miles from any human habitation.

Sir R. W. Rawson stated that, according to the observations of the Anthropometric Committee it appeared that from the top of the social scale to the bottom there was a gradual descent in stature, weight, chest-girth, and all the elements of strength. It was therefore of the utmost importance that by nature and improvement of sanitary conditions the lowest should be raised to the level of the highest.

Dr. Schuster read an interesting paper on the motion of the Swiss glaciers. It has been known for some time that there are long periods of time during which the Swiss glaciers advance down or recede up their beds. Thus, in 1741, they were advancing, but it was reported that in 1700 it was possible to walk from Chamounix to Courmeyer over the Col de Géant without touching ice. They advanced all last century as far as is known and up to 1817, then went back until 1840, advanced till 1859, and have since been receding till the present year, when many, including the Mer de Glace and the Rosenlaui glacier, have begun to advance. Dr. Schuster has made observations this summer on the Glacier des Boissons, at Chamounix, and has arrived at the important conclusion that the rate of motion of the same point on a glacier changes greatly from day to day. Thus he showed that while during the day the hourly rate of motion of one point observed was only .6 centimètres, during the next night it advanced at the rate of 5·5 centimètres per hour. The rate of other points examined varied, but not so greatly. Dr. Schuster also noticed the change occurring at the foot of the glacier when it comes into the valley. The downward motion of this point is determined by the fact that the parts above advanced more quickly than the ice at the foot melts away. He found that on one side of the glacier, where it rested against a boulder, there was no apparent change in the outline of the ice or in the position of the boulder during the day, while at the other side the end had moved in the same time four or five feet.

A paper was read by Mr. E. B. Poulton on heredity in cats with an abnormal number of toes. The peculiarity appeared in the third generation and in succeeding generations. All varieties between the normal four and the extreme seven toes had been observed. The females most frequently possessed the abnormal number of toes. They were very clever at catching mice, and readily learned to shake hands. The President said the importance of such observations lay in their bearing on heredity. Reasons had been advanced to show that man was descended from a six-fingered animal. Miss Buckland said she had seen in Bath a cat with seven toes on each foot. Professor Marshall remarked on the importance of such observations in relation to investigations as to the origin of species.

Mr. Adam Sedgwick gave an account of the Periodatus—a slug-like animal which he found in South Africa, and of which he exhibited specimens. The animal, he said, had only recently been discovered, and he made a special visit to the cape to obtain specimens. Special interest attached to it, as it had no living relations in the animal kingdom. It was a survival of a type of animal which at some ancient time in the world's history was represented by a greater number of forms. The animal lived in the roots of rotten trees, and it had probably survived on account of its habits and the difficulty of finding it. Since its first discovery the animal had been found in New Zealand, South America, and other parts of the world.

Dr. Stone read a paper on the electrical resistance of the human body. He began by observing that the application of this powerful force to the organism in a scientific manner was still in embryo, and that the results had hitherto fallen far below what might be expected. The main difficulty in obtaining this resistance lay, first, in the difficulty of making good contact through the skin of a living man, and, secondly, in the rapid electrolysis which takes place in the tissues when a current passes through them. The resistance of the skin, he thought, had been greatly overstated, and might easily be overcome by very large electrodes saturated with a conducting solution. The electrolysis was checked by alternating contacts and momentary duration of the current. In this way he had obtained very satisfactory results—among others, the interesting physiological observation that a man of 5 feet 6 inches in height, another of 6 feet 3 inches, and the Hungarian giant, who was 8 feet high, nearly all gave from the wrist to the ankle a resistance close upon a thousand Ohms, the larger man being decidedly the better conductor. The influence of temperature and of disease was also adverted to, the body apparently following the law of solid conductors, increasing in resistance with heat and becoming a far better conductor when suffering from paralysis than in the condition of health.

Dr. Stone also read a paper on some effects of brain disturbance on the handwriting. It was not surprising, he said, that affections of the cerebral hemispheres competent to interfere with the complex co-ordination of speech should also show their influence on the similar act of writing. Essentially both functions were acquirements which by practice had become automatic, and were put forth involuntarily. He said, therefore, that as the defect known as aphasia might occur in different parts of the circuit, so might graphic modifications. Three such cases he described, one of which occurred to himself personally. After sustained mental effort, he fell down in partial state of insensibility. During three weeks delirium and delusions predominated over physical depression.

These were broken, however, by lucid intervals. The leading feature of all his aberrations seemed to have been reduplication. He doubled the number of his sisters, his nurses, and his medical attendants. When he returned to himself and could trust his memory and senses he found two things—first, what he had been accustomed to call aphasia; secondly, that he could not write as he intended. The tendency to reduplication, which was obvious in his delusions, was as clear as need be in his writing, and the trick of including otiose letters in familiar words lasted for some time. It was probably the trace either of mental stammering or of diplographia, depending upon want of synchronism between the two hemispheres of the brain. That such a condition of the ocular muscles occurred in drunkenness was well known.

Mr. E. P. Culverwell read a paper on the probable explanation of the effect of oil in calming waves in a storm. He said when the surface of the sea had become smooth after a storm it was very common for long rollers to break on a sand-bar. If there were no wind and the sea was glassy, these would not break until quite close to the shore, even though the ordinary theory pointed to their breaking earlier, unless there was a force directed opposite to that of their motion. When exerted on the waves, such a force might be supplied by the wind; but if it rose in any direction the waves broke much sooner. This result was, therefore, due to some secondary effect produced by the wind pressure, and not directly by the pressure itself, and it was to the ripples produced on the surface, which disturbed the wave motion, that the speedy breaking was to be attributed. It was, however, a direct result of the theory that the ripples depended on surface tension for their propagation, and could not exist in large amount on the oiled surface. It was also evident that the hold of the wind on the wave was greatly decreased by the absence of ripples, and thus the oil acted both to prevent the wind having much effect on the surface, and also to modify the motion of the water in the wave.

Professor Stokes read an important paper by Dr. Huggins on coronal photography without an eclipse. In a paper read before the Royal Society some time back, Dr. Huggins had shown that it was possible by isolating, by means of properly chosen absorbing media, the light of the Sun in the violet part of the spectrum, to obtain photographs of the Sun surrounded by an appearance distinctly coronal in its nature. These researches have been continued, using a reflecting telescope, by the late Mr. Lassell, and a film of silver chloride as the sensitive plate, on which the photograph is taken. These plates are sensitive to the violet light only, and therefore it was unnecessary to use absorbing media, which had proved a source of difficulty, to sift the light. Fifty photographs in all were taken and examined afterwards by Mr. Wesley, who made drawings of them for the paper. The details shown agree well with the photographs of the corona made during the late solar eclipse, the agreement being specially marked in two cases, dated April 3d and June 5th. The photographs have been seen by the observers sent to Caroline Island to observe the eclipse, and one of these writes that Dr. Huggins's coronas are certainly genuine up to 8′ from the Sun's limb. Dr. Ball, who was in the chair, examined some of the plates, and spoke of the interest and importance of this communication.

Mr. Litton Forbes stated that the territory of Arizona is now practically opened up for the first time in its history by the completion of the new Atlantic & Pacific railway. The port of Guaymas, on the Gulf of California, probably in the not far distant future will be the port of arrival at least for mails and passengers bound eastward from Australia, China, and Japan. At present Guaymas is a small Mexican town, consisting of adobe houses. Its harbor is excellent—one with deep water up to the very shore, and well sheltered from every wind. It is the only possible mail station on the Gulf of California, and is some 500 miles, or nearly two days' steaming, nearer Australia than San Francisco. Of all the western territories, Arizona has long been the most remote and inaccessible, and, therefore, the least known of all the territories. The aridity of the climate and the presence of hostile Apache Indians have had much to do with this. Arizona is a country of extraordinary mineral wealth. In many parts of its extensive territory it offers large tracts of excellent land to the farmer and stock-raiser. Its chief drawback is a want of water, but this can be supplied by irrigation works and by artesian wells. Coal, salt, and precious metals exist in larger quantities probably than in any of the western mining territories. The copper mines are even now the richest known. The area of the territory is about 114,900 square miles, or approximately 73,000,000 acres—in other words, three times the size of the State of New York. The general topography of the country is that of a plateau, sloping towards the south and west from an altitude of 7,000 feet to the sea-level. The surface of Arizona is much diversified, and contains some of the finest scenery in North America. In no country can the evidences of past geological action be better studied. The cañon of the Colorado is a stupendous waterwork chasm, 400 miles long and from a quarter of a mile to a mile and a quarter in depth, and the scenery in many parts is grand and impressive.

A note on some recent astronomical experiments at high elevations on the Andes was contributed by Mr. Ralph Copeland. At La Paz (elevation 12,000 feet), he saw stars with the naked eye, when the Moon was full, that are with difficulty seen in Europe without artificial aid. At Puno (12,500 feet), Canopus, Sirius, and Jupiter were visible to unaided vision from one to twenty-five minutes before sunset. A number of small planetary nebulæ and stars, with very remarkable spectra, were found in the southern part of the Milky-Way, by searching with a prism attached to a 6-inch telescope, on Professor Pickering's plan. The most remarkable stars showed spectra of little more than two bright lines, one near D, and one beyond F, with a wave length of 467 mmm., which the author, in conjunction with Mr. Lohse, had observed in the spectra of various nebulæ; γ Argûs is a star of this type, with the addition that the line near D is threefold. Several close double stars were discovered. At Vincocaya (14,360 feet) the solar spectrum was very much increased in brightness at the violet end. The solar prominences were seen with nearly equal ease in C, D_3, F, and Hγ. With ctroscope of lines were visible beyond H and H_2. The solar corona was not seen, nor were any lines discernible in the spectrum of the zodiacal light, although that light was sufficiently bright to be very obvious when the Moon was eight days old.

Dr. Copeland made also several interesting meteorological observations. Black bulb temperatures up to 205·5° F. were recorded, this being the limit of the tube of the instrument, and not the actual *maximum*. With the black-bulb thermometer more than 13° above the local boiling-point, the wet-bulb was below the freezing-point. At Arequipa (7,500 feet), the relative humidity of the air was as low as 20 per cent, and not much higher at other stations. The author believed that an observatory might be maintained with great facility at a height of between 9,000 feet and 12,000 feet, the night temperature being little below the freezing-point at any season. Beyond that height an increased elevation of 150 feet roughly corresponded to a fall of the thermometer of 1° F., and a depression of the barometer of 1-10th inch, so that at 15,000 feet very arduous winter conditions were encountered.

Professor Janssen gave an account of his observations on the solar corona, made at Caroline Island during the recent solar eclipse. He stated that in 1870 he had seen, for the first time, dark lines in the spectrum of the corona—indicating, probably, the existence of matter capable of reflecting the solar light. This observation had been confirmed by some observers, while others had failed to obtain evidence of it. He thought that the failure was due to the fact that the telescopes used by most observers had too small an aperture compared with their focal length, so that the amount of light received by the slit of the spectroscope was very small; the luminosity of the corona being very feeble. Dr. Janssen used a lens of 50 centimètres aperture, with a focal length of 150 centimètres to form the image on the slit of the spectroscope, which was one which admitted a large quantity of light. By means of an ingenious arrangement, it was possible to observe with one eye at the spectroscope, while the other noted through the finder the part of the corona examined. Dr. Janssen found a complicated spectrum with many dark lines. In the course of his paper he referred to the measurement by photographic means of the intensity of light, and stated that the corona was about as bright as the full Moon. Dr. Schuster thought that the differences observed at different eclipses, as to the existence of dark lines, might be real, and not due to want of illumination. During the eclipse in Egypt he had succeeded in photographing G as a dark line. He agreed with Dr. Janssen in attributing the reflection of the solar light to meteoric matter, and pointed out that near the Sun there were no lines, so that there the matter was self-luminous. Prof. Stokes was inclined to refer the reflection to the action of small particles of matter shot out from the Sun in the form of vapor, but condensed at a distance from its surface, forming, as it were, clouds of minute particles.—*Knowledge.*

ENGINEERING.

CABLE RAILWAYS IN VARIOUS CITIES.

We find the following account of cable railways in San Francisco, Chicago, and elsewhere in the New York *Tribune*. We append an account of the Kansas City Cable Railway, furnished by Mr. Robert Gillham, Chief Engineer, by which it appears that this line is superior in many points to any yet built.

To the enterprise and mechanical ingenuity of San Francisco are due the origin and practical success of the system of running street cars by means of the endless wire rope or cable, placed beneath the surface of the ground. The first concession for a wire cable road in San Francisco was granted to Gen. Abner Doubleday and Capt. R. L. Ogden, of the army, the originators of the enterprise. Gen. Doubleday's duties taking him from California, all the rights and privileges granted him were sold and transferred to A. S. Hallidie, representing the present Clay Street Railroad Company, to whom the credit is due of perfecting and carrying to complete success the present system of cable roads. Possessed of indomitable energy and great mechanical ability, Mr. Hallidie, under discouraging and disheartening difficulties, persevered until he has brought the system to that point where he is clearly able to establish by actual practice and demonstration its superiority over the general system of horse-power surface roads.

In August, 1873, the Clay Street Hill Railroad Company in San Francisco began business, and since then it has been found to answer all requirements, and to exceed the expectations of engineers and others who had examined the plans previous to the construction of the road. This system is adapted to all metropolitan railroading where the surface of the streets has to be kept free from obstruction and open to ordinary traffic, where locomotive steam engines are not tolerated, or where the streets are so steep as to make the use of horses difficult or impossible.

After the Clay Street Road had been running three years and its practicability had been fully tested, the Sutter Street Railroad Company, whose lines had been for many years unprofitably worked by horses, changed its system from a horse road to a cable road. This company has now over three miles of double tracks operated on this system. The greatest elevation is 167 feet above the starting point. The business of the road was not interrupted for a single hour during the transformation. The saving in expenses, as stated under oath in testmony given in a suit affecting the company, amounted to 30 per cent, and the passenger traffic was increased 962,375 the first year after adopting the cable system. The shares of the Company were selling before the transfer at $24. They are now worth $60.

The next road built on the cable principle was the California Street Road which traverses the steepest street in San Francisco, the grade being 500 feet in 12,000. This has given easy access to property which previously was of little value, but is also the site of the palatial residences of ex-Governor Leland Stanford, Mrs. Mark Hopkins, and Charles Crocker, costing $1,000,000 each. The next street supplied with the cable system was Geary Street, a comparatively level thoroughfare, but one of the most populous in the city. Its length is 13,200 feet, and it possesses two elevations of 350 and 280 feet respectively. The Presidio and Ferries Cable Road has a five-foot gauge, and 10,000 feet of double track ascending one hill 246 feet above its starting point in a distance of 5,000 feet, one portion being an up-grade 78 feet in 412, or 1 in 5 3-10. The grip is the same used on Clay Street, but made heavier. A road has been built under these patents in the City of Dupedin, New Zealand, 3,500 feet long, which ascends 500 feet in that distance. It has a single track line, with two turnouts or sidings, both parts of the rope running in opposite directions in one tube except at turnouts. It has two curves of 215 feet radius forming an 8.

The Chicago City Railroad Company's cable line in State Street is 4 7-10 miles long, with double track five-foot gauge, and runs on a very busy street, almost level. The president of the road says, in reply to the question how the system worked last winter during cold weather and snows: "We have run smoothly and without the loss of a single trip during the entire winter, although the frost, by actual measurement, penetrated the ground five feet six inches, with heavy snows and hard rains, the mercury dropping to 29° below zero."

THE KANSAS CITY CABLE RAILWAY.

This road will be the first duplicate cable railway built and operated in the world. All cable roads that have been built are operated by a single cable, which, if through accident, becomes broken or unsafe, causes a cessation of travel until the damage is repaired. The breaking of cables through carelessness in grip-men unacquainted with exact manipulations of the grip, in Chicago during the first year of its operation, caused many vexatious delays, and until the cable was again repaired travel was entirely stopped. These delays cannot occur with duplicate cables, as there is a duplication of machinery throughout the entire length of the road. One cable remains idle while the other is in motion propelling the cars; if this cable becomes fractured or damaged it is stopped and the other cable is put in motion, which in turn propels the cars, until the damage is repaired or as long as may be desired. The cost too, is very much greater than that of single cable roads.

This road has also another peculiar feature, the westerly portion being an elevated structure built entirely of wrought iron. At or near the Union Depot over Union Avenue an elevated station or waiting-room is to be built, similar in design and construction to to those of the elevated roads in New York City. From the east side of the waiting-room a continuous span, without intermediate supports, of one hundred and eighty-five feet, is made, which crosses over and above the railway tracks that enter Union Depot. This span is supported at Union Avenue upon wrought iron columns, and the opposite end at Bluff Street upon a stone pier. The summit of the road and bluff is attained at Penn Street 189 feet above Union Avenue, or 166 feet above the track level at waiting-room.

From the centre of the main span mentioned the road begins to ascend the bluff on an inclination of 19 feet in 100 feet for a distance of 753 feet; from this point, which is the west line of Jefferson Street, the road continues on an ascending grade of about 12 feet in 100 feet for a distance of about 300 feet, to the summit of the bluff at Penn Street, 166 feet above the track-level at station referred to. From this street the road descends on an inclination of 11.5 feet in 100 feet, distance 300 feet to the engine house, the external dimension being 90x144 feet. The main floor is 141 feet above track-level at Union Avenue and 57 feet above the next lowest point in road at Main Street.

The basement of engine house is divided into three rooms, the east room as a boiler room, having six steel boilers, and also coal vaults. In the middle room are placed two 250-horse power engines and all the driving machinery, and tension apparatus. The west room will be used as a machine and repair shop. The driving machinery is arranged upon a large cast-iron girder bed-plate with two sets of driving-drums, around which the cables pass in propelling cars, either pair of drums can be put in motion at pleasure by means of a patent screw-clutch, which throws the drums into or out of gear. One pair of drums imparts motion to one cable while the other pair remains idle and the cable motionless.

If the cable in motion becomes damaged by accident, it is immediately stopped and the other drums thrown into gear, thus giving motion to the duplicate table. Another feature not the least interesting is a little stationary engine fixed to the bed-plate of the driving machinery, of sufficient power to move slowly either sets of drums and cables without the additional load of cars gripping the cable. One set of drums being in motion thus, propelling cars on the street, the little engine is put in motion and the other cable not in use moves slowly into the house and is carefully inspected and all defects repaired, at will.

On all other roads this inspection must be done between 12 o'clock midnight and 5 o'clock next morning, as the cables move too rapidly while propelling cars to be inspected, and if inspected during the daytime travel would be stopped. This illustrates the advantage of duplicate cables over the single-cable system.

The main floor of the engine house, on a level with the street grade, is used as storage for cars; the next story as a paint and carpenter shop, etc. In front of the engine house the whole roadway of the street is carried on wrought iron ⌶ beams placed proper distances apart for strength and arched between, upon which the paving is placed, there being large vaults beneath the roadway containing machinery pertaining to the road. There are two curves in the road. The changing of cars from one track to the other will be done by gravity, thus dispensing with turn-tables.

The tube will be composed of concrete and cast-iron, there being placed every four feet in length of road of double track, two cast yokes which carry the stringers upon which the rails are laid, and also the slot-rails between the track. These yokes each weigh 300 pounds.

RURAL ENGINEERING.

REV. ALBERT E. WELLS.

But little attention, of late years, has been paid the subjects of the following article, concerning roads, bridges, open drains and water courses. It is true the State Legislature have something to say every session about roads and bridges, and in the interest of sportsmen may enact laws forbidding seining or trapping fish in the smaller rivers and streams.

We hear nothing now of canals, and slack-water navigation, nor is mention made of "the levels" of either streams or roads. The importance of railways, as opening vast areas to settlement and trade, has, for the time being, crowded out of attention the items of use, comfort and beauty, as they might be developed by a careful attention to local needs and facilities. In our want of a way to the great markets, we have slighted the lesser one of a way to the nearest railway station. It is easy to go from there to Chicago, St. Louis, or Kansas City, or to send 1,000 tons of freight to any of these markets; but how about reaching the nearest station either in person or with the 1,000 tons of freight from a farm fifteen miles distant? especially during the annual "mud blockade" that besieges nearly every town. In calling attention to these subjects and the problems lying back of them I am near the interests of every one in our western land.

1st. Of present methods. The General Government devotes a great deal of time and valuable franchises and public domain to great railway corporations; but pays no attention to common roads. It also devotes both time and money to navigable rivers and notably to their banks with a view to the well-being of the people living near them. And though under its command is one of the ablest corps of civil engineers in the world, the attention of that corps is not devoted to the set of subjects here mentioned, though they have no small bearing upon those that have hitherto baffled their skill.

The State relegates the subject of roads and bridges to the county authorities, and also that of drains, with some directions about the election of road-masters, and the legal steps for obtaining and paying for a right of way, and the method of constraining the neighbors to work or pay the road-tax, or of compelling an unwilling farmer to grant a ditch across his farm. In some States it is made the duty of the county clerk to keep a record of these road-grants in a separate book, in others these things are passed into the record book.

The county authorities grant the right for a public road on a petition of citizens resident in the district to be benefitted, who will in the existing order of things have charge of its construction and by tax pay its cost. The authorities say if the people want a road let them have it. So the farmers have such a road as they can make. It would be inconvenient to spoil any one's quarter section, therefore it is rarely a direct road, for the same reason it takes a rough and tumble course over hill and valley along section or quarter-section lines. It is a public road, for the public has consented to its creation. If it become much of thoroughfare, it falls but little short of being a public nuisance, by reason of its heavy grades and want of direction. For instance, it is the route from a town in the northwest of the county to one in the southeast, and traverses two sides of each section in the line. Of streams the county takes no cognizance except to bridge them as cheaply as possible, and regret that the bridging costs so much, and has to be replaced every few years because of a wash-out. So much for the present arrangements. It is expensive, inconvenient, and does not fill the requirements of a good road. The county surveyor has been called on to stake out the road after the "location has been determined." He is the only one connected with the enterprise, whose profession would lead him to know the high order of talent required *to locate a good road.* Dr. Lardner says, "I do not know that I could suggest any one problem to an engineer, which would require a greater exertion of scientific skill and practical knowledge than laying out a road." Our authorities are taking no steps to secure this great skill and knowledge in behalf of the people.

If more were made out of the office of county surveyor, so that that officer should have greater authority in the matter, as the only county officer representing the department of engineering, it might prove a great benefit to the people on the subject of roads. His office should show the position and the profile of every mile of road in the county, and keep statistics from which roads could be classified according to their traffic and expenditures made on them in proportion to their needs.

The necessities of a new country have led to the existing state of things; but it is not necessary to perpetuate it. In behalf of the roads there should be a public officer in every county who should have authority in matters of locating and making roads, and by whom specifications should be made of the cost before it is undertaken as a public charge, even the unit of our population, the road district would obtain a better value for its labor by a competent direction, which now it does not have.

There are some laws on the subjects of rivers, streams, and drains. Of the first and second, these laws have reference for the most part to the preservation of fish, and seem to have emanated from the clubs of sportsmen. While the laws about drains look to compelling owners on the lower level to open ditches across their farms for the passage of the surplus water from the higher level, *i. e.* because A, B and C on the divide have ditched their flat land, D, E and F shall have the best of their land overflowed or crossed by gaping gullies, and the public shall keep in order three bridges, with from eight to twelve foot spans each, when a competent engineer would say that "there ought not to be a ditch or gully on any farm of the six, nor a bridge to be a public charge on the mile and a half of road that passes along the lower side of the lower farms. The true solution of the problem is the placing of large underground drains that should be the mains of a thorough drainage of the farms in question, and provide also the best economy of land and water, in giving a fish pond, that would yield a harvest of ice every winter to every two of the six.

If it be a larger matter, and an undoubted stream is to be handled so that it may cost as little as possible and yield the best return for the money expended on it, there the civil engineer could render great service. So many items are to be thought of in the consideration of any watershed requiring careful surveys and practical knowledge, that no utility is to be expected from our streams until a different regime comes into force. The friend of man, of which Tennyson and Longfellow sing so beautifully, "The Brook," has within our experience neither use nor beauty.

It may be that a small river is the subject of local anxiety. Its bridges are costly, its annual torrent rarely fails to wash out one or two. Its bottom land is very fertile. Its volume of water varies from what a ten-inch pipe could carry to a bulk that overflows its banks, though the channel has a cross-section of 500 square feet. It is the drain of a large water-shed, what can be done with it? Much, if its whole basin be taken in hand under competent skill; but little if its bare channel is treated. 1st. A great and useful water-power now goes to waste. 2d. A slack-water navigation of from ten to thirty miles is lost. 3d. A supply of water to towns on its banks. 4th. The preventing of overflows, and the sure use of the bottom land, probably the best in the county. 5th. The delivery of its water to the larger river clear of silt. Most of these objects are of local utility. I have not yet named the fish and wild duck that may have their pastime therein and delight the heart of sportsmen. Of this we may be assured, there is enough profit to be derived from every stream, twenty miles long, to pay those living on its borders to have its possibilities examined and developed. And if not cared for, it inflicts an annual damage that equals fifty per cent of what it would cost to put it in order.

If a county have thirty miles of river border, it will be a useful outlay of capital to put it in order; in regard to its channel; in regard to that portion of its basin or water-shed lying within the county, and for the utility of a slack-water navigation and milling power that may be developed.

Of canals I have but little to say. They still have their uses for purposes of irrigation on the high plains of the west, and may serve as a connecting links between different levels, giving length to useful navigation. They are to my purpose now as introducing a quotation from DeWitt Clinton, "Every judicious improvement of roads and bridges increases the value of land, enhances the price of commodities, and augments the public wealth." The road he did the most talking about was the New York & Erie Canal. His statesmanship was comprehensive, and embraced our subject. I think the subject worthy of the attention of our public men. The subject of roads and bridges does not now receive the attention which its great importance demands. They should not be left to well meaning farmers and citizens who neither have nor desire the scientific knowledge which their proper construction requires and the neglect of the watercourses is an annual cause of waste and damage. A railroad employs five men under a competent engineer for every six miles of road. This engineer has an office and generally a couple of clerks, and is expected to supervise the work on one hundred and fifty miles of road. The county of thirty townships would have about two hundred miles of roads and about three hundred and fifty miles of watercourses. Here is surely enough to employ one man constantly in directing works upon which the comfort, the advantage, the prosperity of so many people depend. If he be allowed a couple of clerks and six men to every township the entire force could be usefully employed. And the importance of the interests involved demand the outlay We are now beyond the early day of our country life, and are entitled to more than the temporary accomodations that were all we could then afford. The state of the country roads is in a measure the indication of our civilization. From their present condition we do not stand high in the scale.

PHYSICS.

THE FIRST ELECTRIC TELEGRAPH.

The idea of the practical application of the electric telegraph to the transmission of messages, says a writer in *Engineering*, was first suggested by an anonymous correspondent of the *Scots Magazine*, in a letter dated Renfrew, February 1, 1753, signed C. M., and entitled "An Expeditious Method of Conveying Intelligence."

After very considerable trouble, Sir David Brewster identified the writer as Charles Morrison, a native of Greenock, who was bred a surgeon, and experimented so largely in science that he was regarded in Renfrew as a wizard, and eventually found it convenient to leave that town and settle in Virginia, where he died. Mr. Morrison sent an account of his experiments to Sir Hans Sloane, the President of the Royal Society, in addition to publishing them anonymously, as stated above.

The letter set forth a scheme by which a number of wires, equal to the letters of the alphabet, should be extended horizontally, parallel to one another, and about one inch apart, between two places. At every twenty yards they were to be carried on glass supports, and at each end they were to project six inches beyond the last support, and have sufficient strength and elasticity to recover their situation after having been brought into contact with an electric gun-barrel placed at right angles to their length, about an inch below them. Close by the last supporting glass a ball was to be suspended from each wire, and at about a sixth or an eighth of an inch below the balls the letters of the alphabet were to be placed on bits of paper, or any substance light enough to rise to the electrified ball, and so continued that each might resume its proper place when dropped. With an apparatus thus constructed the conversation with the distant end of the wires was carried on by depressing successively the ends of the wires corresponding to the letters of the words, until they made contact with the electric gun-barrel, when immediately the same characters would rise to the electrified balls at the far station. Another method consisted in the substitution of bells in place of the letters; these were sounded by the electric spark breaking against them. According to another plan the wires could be kept constantly charged and the signals sent by discharging them. Mr. Morrison's experiments did not extend over circuits longer than forty yards, but he had every confidence that the range of action could be greatly lengthened if due care were given to the insulation of the wires.—*Electrical Review.*

LIFE ON THE PLANETS.

Prof. McFarland, of the Ohio State University, in the *Sidereal Messenger*, says: Thirty years ago the question of the habitability of the planets was widely and, in some instances, intemperately discussed. Several volumes were written pro and con, the writers mostly seeming to think that they had a direct commission from on high to settle the question or to settle their opponents; which things they proceeded then and there to do. And both sides about equally forgot or disregarded the facts, and with great heat argued on general principles.

An article in the June number of the *Popular Science Monthly*, entitled "The Cost of Life," and which was in part criticized in a late number of the *Messenger*, is a kind of renewal of the useless debate, and is clothed in logic equally conclusive as was that of the original controversy. The points given lately touching the weight of a man on Jupiter and Mars were intended as a part of the proof that these planets are not habitable. To pass in review all the points of error would require an article of too great length for the pages of this journal; so I shall confine myself pretty closely to a few of the more prominent ones.

The same author, speaking of Mercury, says: "With a temperature of boiling water in the frigid zones, and red-hot iron at the equator," etc.—therefore there can be no life on the planet. But there is no proof of any such temperature, and in the nature of the case there can be none. Wherefore the conclusions are of no force. The error consists in virtually assuming that the climate of a place depends solely on its distance from the Sun—whereas this is only one of a hundred causes.

It is well known that even in the Torrid Zone at an elevation of about three and one-half miles, snow does not melt; that century after century "eternal" snow whitens lofty peaks in all latitudes.

The temperature of a place on the earth's surface depends on many influences, any one or several of which may be greatly modified or annulled by the others; so that there is no general rule for climate.

As a part of the multitude of things to be taken into consideration as touching the matter in hand, we may name these, viz: The latitude, the elevation above the sea-level, the ocean currents, the direction of the prevailing winds, the presence and trend of mountain ranges, the amount of vapor usual in the atmosphere, the degree of cloudiness, the quantity of rain and snow-fall, the size of the body of land, the amount of land in close proximity and its surroundings, the nature of the soil, the amount and kind of vegetation, the density and height of the atmosphere, the length of the day, the obliquity of the Sun's rays, and the thousand and and one other things which go to make up the whole temperature and climate. Of the greater part of these—indeed, of almost every one of them—as exhibited on other planets, it is absolutely impossible to know anything at all, and as a matter of course, no one can speak intelligently of the climate on any planet except our own. But should all these items be known, the further question arises whether it is not possible that animated beings could live in an environment totally unlike that which surrounds us. The conclusion of the whole matter, so far as astronomy and physics can now tell, is this: That the four large outer planets have not sufficiently cooled down to allow life on their surface, such as we see on the earth; that Mars gives all telescopic and spectroscopic probabilities of conditions compatible with life as we see it; that the earth certainly for millions of years has been covered with multifarious life; that of Venus and Mercury we have no certain knowledge; and that the satellites are pretty certainly not fitted for such life as is on the earth; that, in particular, our Moon has no water and no atmosphere, consequently no climate or vegetable life. If the Sun and the planets continually lose heat, then there will come a time in the far future when the Sun itself shall go out in everlasting night, and the planets cool down so that the "eternal snow" would be hot compared with the degree of cold throughout all space where everything shall be dead.

SOUND VIBRATIONS PHOTOGRAPHED.

Photography appears to be running a race with electricity in curious developments and novel applications. George G. Rockwood, the well-known photographer, has just achieved the remarkable feat of photographing sound-waves instantaneously. The instrument by which the sound-wave was represented or made visible in its effect is a new telephone, the inventor of which has obtained from Mr. Rockwood a perfect ocular demonstration of its vocal repeating action. The vibrating diaphragm, upon which the voice is projected, has a fine metallic point mounted on the center of its reverse side. This point meets the pointed end of a conducting wire so nearly that when at rest the interval between the two points can be discovered only through a strong lens. The thing to be done was to show in a picture of the instrument, or rather in a series of pictures, the alternate contact and separation of the points from the vibrations imparted to the diaphragm by the voice, involving the closing and opening of the electrical circuit and the consequent reproduction of the same rate of vibration in the receiving instrument at the other end of the line. In considering this problem Mr. Rockwood found himself indebted to his recollection of an experiment by Herschel in photographing (or daguerreotyping) with the electric spark. Herschel caused a four-sided prism of wood, around which a picture was pasted, to revolve at high rate of speed as in a turning lathe. By illuminating this revolving picture with the electric spark (in total darkness otherwise) he obtained a photograph of it as standing still at that instant in its revolution when the spark flashed. In describing his experiment Mr. Rockwood said:

"Wheatstone measured the duration of the electric spark as one-twenty-four thousandth of a second. It would follow that any vibration not quicker than this might be arrested on the photographic plate at any point in its travel. Whereas, according to the investigations of Plateau, the duration of successive impressions on the human eye will average half a second, the electric spark might separate and distinguish photographically waves of which 12.000 impinge on the retina while the first of them is still lingering there; in other words, 12,000 practically all at once. Now the vibrations or waves of air that yield the respective tones or pitches of sound have been accurately measured and counted. Assuming the pitch of the ordinary masculine voice in conversation to be as low as middle C, the number of complete double vibrations imparted by such a voice to the telephonic diaphragm or tympanum would be 256 per second; that is, counting both ways, 512 movements of the diaphragm with its metallic point making or breaking the electrical circuit at each movement. To the eye, which retains every impression for half a second, 256 of these movements would make their impression as one, and would give a stationary, fictitious image, if they were of sufficient depth to produce any visible effect whatever, as they are not. The electric spark, however, would give its illumination and do its photographic work within a little more than one-fiftieth of the time of one of the tympanum movements. A succession of such photographs, therefore, would present fortuitously any position of the vibrating point from that of contact to that of extreme retraction, with an indefinite number of intermediate positions."

To verify these calculations, Mr. Rockwood carefully focused his photographic camera on the points of the telephone by daylight, and a battery of Leyden jars was so adjusted that when discharged it would throw the proper illumination on the points. Mr. Rockwood's instantaneous plates were now to be tested under action five hundred times quicker than a sensible instant and also invisibly minute. Of course it was as yet a practical question whether they could effectively receive as quickly as the electric spark would give this infinitesimal action of light. Waiting until the darkest hour of the night, the plate was uncovered in total darkness, the telephonist began speaking into his instrument, and the illuminating spark was flashed upon the points. This operation was repeated with more than twenty plates in succession. The resulting negatives, on being developed, proved a triumph in two arts and a science. The photographs printed from them showed under the glass, in some, contact of the points, and in others a variety of infinitesimally differenced intervals between them. Not one of the impressions had more than the one-twenty-four thousandth of a second in which to be begun and ended.—*Electrical Review.*

CHEMISTRY AND METALLURGY.

THE SMOKE NUISANCE.

PROF. R. S. G. PATON.

In walking in and around Kansas City I have noticed a considerable amount of smoke emanating from the chimneys of a number of manufacturing establishments. This is by no means necessary, and should be checked at once, especially in such a growing city, as the evil will in nowise become less on the increase of the number of chimneys. Smoke is deleterious to the health of a community and, besides, it is extravagance on the part of the manufacturers to allow of its emission.

Whilst chemist of the Health Department of Chicago, I was given charge of the enforcement of the "Smoke Ordinance," and the following is some of the results of my work.

This ordinance came into effect on the 1st of May, 1881, and I had the honor to be appointed to carry out its provisions on the 1st of July of the same year. From that date until the 16th of July, 1882, I acted alone; since then I have had either one or two assistants.

The number of persons or firms called upon	654
The number of visits made	1821
The number of locomotives observed smoking	94
The number of steam tugs observed smoking	239
The number of elevators observed smoking	18
The number of special trips on locomotives	3
The number of special trips on tugs	2
The number of visits examining devices	63
The number of abatements observed	219
The number of devices for suppression of the nuisance examined	49
The number of suits commenced	111

Of these 52 were fined, 16 took change of venue, and 43 were dismissed.

Number of cases in quasi-criminal court	7
Amount of fines imposed in police court . . .	$2,045 00

Of that $35 were on change of venue cases.

Amount of fine in quasi-criminal court . . .	5 00

Considerable trouble has been gone to in order to persuade the various railroad companies to obey the ordinance, and I am glad to be able to report that some have made endeavors to do so.

With regard to the steam tugs, I have to report that some of the owners—for the benefit of all the owners—have tried various experiments in order to comply with the law. They are at present corresponding with boiler-setters, furnace-builders and patentees of smoke-preventing devices. The number of steam tugs mentioned above represents those of which definite data are preserved.

With regard to the trials for refusal to comply with the smoke ordinance, they represent much more work than might at first be imagined. In the first place dense smoke must be observed coming from a certain chimney stack; the officer then serves a notice, verbal or written, on the owner, occupant or proprietor of the building, preferably the latter. If, within a given space of time, say ten days or two weeks, he finds that no attempt has been made toward abating the nuisance, he must apply to a justice of the peace for a summons against the offender, and see that it is properly served and returned. Then the inspector must procure witnesses who will testify that the smoke from that particular chimney stack is to them a nuisance. This in many instances is an exceedingly difficult task. It is, however, very easy if the officer commences work at the instigation of a written complaint from some of the neighbors. When the day of trial arrives it is necessary to see that all the witnesses, attorney, etc., are in place, prepared. If the defendant requests a continuance, or a change of venue, or, being fined, takes an appeal, this whole matter, except in regard to the summons, has to be repeated. As it was very rarely that the case was concluded on the first call, the appearances in court may be calculated as not less than about three hundred and fifty (350).

The only case which was tried in the quasi-criminal court was that of the City of Chicago vs. James S. Kirk & Co., soap manufacturers, which, I am happy to report, ended, after a severe fight, in favor of the plaintiff.

Upon the whole I have to report that the citizens as a rule have shown a very commendable desire to abate the smoke nuisance, and a very considerable amount of work has to be done in that direction. The extent to which this effort has been carried cannot readily be determined, but the condition of the atmosphere in the central business portion of the Southern Division of the city at the present day speaks for itself when compared with that of eighteen months ago.

Chemically speaking, smoke is composed of carbon, carbon monoxide (commonly called carbonic oxide), carbon dioxide (generally named carbonic acid), sulphur, sulphurous and sulphuric oxides, carbon disulphide, sulphuretted hydrogen (rarely), ammonium sulphide and carbonate, water, large quantities of nitrogen (from the atmosphere supplied below the grate), and, when thrown off from certain works, may contain hydrochloric, nitrous and nitric acids, or even metallic and arsenical fumes.

The question as to whether these products can be considered a nuisance or not, has already been, in my opinion sufficiently decided in the affirmative by eminent legal authority. Permit me to draw attention to their chemical and physiological properties.

Carbon. Dr. Knauff (Virchow's Archiv., band 39, p. 442,) confined animals in a box into which the particles of a sooty lamp passed; the animals were well fed and were healthy; the charcoal passed into the lungs, and was got rid of by expectoration in the form of pigment cells. In a cat, charcoal particles penetrated in three days from the lungs into the lymphatic glands and to the pleura. Villaret confined rabbits in a smoky atmosphere, and proved the existence of fine particles of carbon in the bronchi. These fine particles of carbon may, therefore, enter the lungs and remain there as sources of great irritation until dislodged, or become covered with epithelium, like the carbon in the lungs of the miner (miners' phthisis). There is also the objection to the mechanical obstruction of the external pores of the body.

Carbon monoxide, sulphurous oxide, and nitrous oxide are strong deoxidizers, abstracting oxygen from the softer tissues, and when absorbed into, from the blood. They may, therefore, be ranked as distinctively poisonous, the first being said to be diffusible through the pores of cast iron, and are all the products of incomplete combustion. Some carbon monoxide is given off even during complete combustion, though not nearly in the same quantity as under disadvantageous circumstances. It likewise affects health by forming in the blood a new and fixed deleterious compound with the hæmaglobin.

Carbon dioxide—one of the principal products of the complete combustion of ordinary fuel—is very readily dispersed throughout the atmosphere by means of the rapidly moving currents of air and the laws of the diffusion of gases. Again, it is one indispensable factor in the food of plants, and, being very soluble in water, is speedily carried into the soil by the action of rain or dew. Carbon dioxide, when exceeding five parts in 10,000 parts of atmospheric air, is objectionable. It cannot be said to be poisonous, but is asphyxiating by replacing a portion of, or reducing the percentage of, the oxygen which should be present. Woodman and Tidy, however, claim that it is poisonous, and then state that "air contains ordinarily from 3 to 6 parts of carbontc acid in 10,000. * * * * The air expired (in a room) contains from 4 to 5 *per cent* of carbonic acid. If the same to air be again respired, the additional quantity of carbonic acid expelled at each inspiration would gradually lessen until a total was reached of *10 to 12 per cent*, and then no more carbonic acid would be given off. An atmosphere under such circumstances must prove fatal."

This last statement must undoubtedly prove true, but such circumstances we can never expect in the atmosphere of a city; therefore, when speaking of smoke, I must abide by my previous statement, acknowledging that in some parts of a city we may have sufficient quantity, which, breathed for a length of time, would produce drowsiness and a gradual loss of muscular power.

The amount of sulphur and its various compounds thrown into the amosphere during combustion depends entirely upon the nature of the fuel used. These sulphur compounds do not seem to be very readily removed by diffusion throughout the air, although Oesterlen states that sulphuretted hydrogen, ammonium sulphide, nitrogen, carbon dioxide and carburetted hydrogen will pass easily through walls of cess-pools. Their actions upon the health have been very variously described.

The fumes of metals, such as antimony from type works, as also fumes of arsenical compounds from copper works, are, as all know, extremely dangerous to health.

The question now arises, "Can the smoke nuisance be abated?" Undoubtedly it can, at least to the extent that the Chicago ordinance has demanded. Well, how? Attempts have been made in this direction since the year 1785. At first the idea was rather the saving of fuel than the prevention of smoke. By the ordinary combustion of one U. S. ton of soft coal above 22 (22.32) pounds of soot are thrown off into the air. This is a matter of great expense, carbon (soot) being the chief heating substance of the coal. One pound of coal requires from 150 to 250 cubic feet of air to insure complete combustion. How is this object to be obtained? First, by having a furnace of suitable dimensions—height, width and length—with the proper area of air space between the fire bars. This last is regulated by the kind of fuel to be used—narrow interstices for wood, wide for hard coal. The width and length of the furnace are regulated by the dimensions of the boiler, whilst the height depends upon the amount of fuel required. Here, you will permit me to say, that my opinion is that there should be a very large space between the top of the fire bars and the bottom of the boiler. I have found in some instances in this city the coal actually in direct contact with the bottom of the boiler. Need I say that the chimneys connected therewith emitted dense volumes of smoke? The size of the furnace will also determine the dimensions of the doors. Firing should not be had recourse to very frequently because of the influx of large quantities of cold air every time the doors are opened, chilling the contents of the fire-box and the sides of the boiler. Smoke will be emitted either when there is too great or too small an amount of air supplied. An ordinary kerosene lamp very readily demonstrates this—turn up the wick too high, the result is smoke, (too little air for amount of kerosene): the wick being at the proper height, place the lamp in a draught, the result is the same, but for the converse reason—too much air. It would be well if some of our so-called engineers would sit down and study the workings of a common kitchen stove for a day or so. I say "so-called engineers" because, I regret to say, I have found a good many men in charge of boiler-rooms in Chicago who could not even be ranked as good firemen.

The size or dimensions of flues, breeching, and chimneys, must coincide with the conditions and regulations of the furnace.

In firing, my preference is toward that method known as the coking process, *i. e.*, pushing toward the rear of the firebars the already "live" coals, and placing the green coals in front, so that the gases arising from them in coking may be consumed in passing over the incandescent fuel. In this opinion I am upheld by many authorities.

When fresh coal is placed in a bright boiler furnace various hydrocarbons are given off. In coming in contact with the oxygen of the atmosphere, at the proper temperature, they are converted into water and free carbon—the hydrogen uniting with the oxygen at a lower temperature than does the carbon. This latter becoming united with a further quantity of oxygen is then converted into carbon dioxide. The carbon dioxide, passing on toward the rear of the furnace, meets with red hot carbon and becomes carbon monoxide. Some of it, however, passes on to the chimney without alteration. The carbon monoxide, if supplied with still more oxygen, will be reconverted into carbon dioxide, though this, as before stated, is never completely accomplished. The difference, then, between complete and incomplete combustion is, that in the former, no carbon (soot) and very little carbon monoxide are produced; whilst in the latter case carbon (soot) and much carbon monoxide are given off.

Devices for Abating the Nuisance.—Their name is legion. Permit me, however, to enumerate some of the principles on which they are founded:

1st. Automatic firing. This is an excellent principle.

2d. Alternate firing; also considered very suitable. It consists in having two separate furnaces and sets of firebars, etc. A is fired and the gases compelled to pass over or through the incandescent fuel in B, and *vice versa.*

3d. Sloping bars, either toward the front or rear; or laterally upward or downward, considered favorably by those who prefer the coking method of firing.

4th. Movable firebars. These may be either on the principle of an endless chain or of a rotary fire-grate. Liability to get out of repair and expense in the matter of fuel militate against them.

5th. The coking principle, already spoken of.

6th. Washing the products. This gets rid of the nuisance so far as the mechanical objections are concerned, and some, though not all, of the chemical. It has, however, been entirely discarded in Europe.

7th. High chimneys have been recommended by some, but in my opinion have not fulfilled what was promised for them.

8th. Air currents. There is a great variety of these, both hot and cold, from front impinging on the flame, laterally also on the flame, laterally through the bridge-wall, and from the rear through the bridge-wall. Some are introduced by means of steam-jets, whilst some are passed in dry by means of the natural draughts.

9th. Deflectors. These are brick or metal projections from beneath the boiler, in front and in rear of the ordinary bridge-wall. They have been of considerable value on locomotive boilers, though some claim they are liable to warp some of the boiler plates. My own knowledge does not agree with this opinion.

10th. Doors. These are sometimes perforated, slit or hanging, and seem to be of advantage in some cases, admitting air into the fire-box itself, as do all the air-jets, wet or dry.

11th. Mixed Devices. These are compilations of ideas taken from two or more of the above designs. They are rarely worked upon by men who have inventive genius.

12th. Petroleum Jets. These have been tried in several places, but, so far as I am aware, with but poor success. Steam has to be raised in the boilers before they can be applied.

13th. Smoke Burners. These are devices which return the smoke underneath the fire bars. I am not particularly impressed with them, as I believe them to be valueless.

14th. Boiler Setting. This, as been said before, is a great item for consideration under this subject, and may be spoken of as devices built for economy of fuel by giving a very large space for the perfect intermingling of the gases of the coal and of the atmosphere.

In conclusion I wish to state that the matter of smoke prevention is by no means yet thoroughly grasped, but may soon be if we obtain, along with the above considerations a matter which I thus expressed to the Engineers, "Intelligence in front of our boilers."

Permit me quote here a statement made by Wagner, with which I thoroughly coincide, as it bears out the remarks I have but poorly made above: "As regards smoke consuming and smoke preventing apparatus, it is only too evident that most of these do not answer the purpose so completely as might be expected. Practical experience has, however, taught that if the conditions of complete combustion are well attended to in construction of the furnace, with proper management and regular mode of stoking, adequate supply of air, and the application of the well-known means of preventing loss of heat by radiation, with coal, peat, or any other fuel, the combustion may be conducted so as to be smokeless; and at the same time the fuel thoroughly utilized."

Medical Department of Kansas City University,
Chemical Laboratory, Nov. 13, 1883.

THE PHILOSOPHY OF FLUXES.

The rationale of fluxing brings us face to face with a wide-spread popular fallacy that has remained undisturbed and unrefuted (so far as we know) by any of our teachers of modern science. Workmen generally believe that by adding what is called a flux to a melted or melting metal, the metal is made to melt at a lower temperature, or that being melted, the flux renders the metal more fluid.

If this were really the case, it would be a very remarkable fact, well worthy of scientific investigation. It would disturb all our tables of fusing points and the prevailing scientific doctrines of the relations between the solid and liquid states of matter.

SOLDERING FLUXES.—Let us first consider the familiar cases of soldering fluxes. For soft soldering we may use rosin or ammonium chloride (sal ammoniac) or hydrochloric acid (spirits of salt). What happens in such cases? The tin-man, for example, places a stock of solder and alloy of tin and lead on his work and applies the soldering-iron. If no flux is used the solder melted off from the stick forms a little ball which stands sluggishly on the tin plate and is ineffectual. If on the other hand, a little powdered rosin is there when the soldering-iron is applied the melted solder "runs," spreads itself with decided fluidity over the surface to which the rosin has been applied. The solder flows, and hence the rosin is fairly regarded as a flux.

Take another case. Two pieces of brass, fitted or pressed together with considerable surface of contact, are to be united by soldering. If these are placed in the fire, bound together, and heated to no matter what temperature, and a piece of soft solder be applied at the boundaries of the surfaces in contact no solder will run between these surfaces. If, however, a solution of sal ammoniac, or hydrochloric acid, or chloride of zinc, be dropped or brushed against the edges of the joints just when the metal is about the heat of boiling water, and this liquid be thus made to run into the joints, a great difference is made. The workman now has only to carefully heat the metal to a certain temperature (presently to be defined) when he finds that on application of the stick of solder it not only melts, but spreads or runs rapidly over the surface that was moistened by the flux; and if the operation were skillfully performed it insinuates itself with the fluidity of water between the joints, however close-fitting they may be. The fluidity thus imparted is even more decided than in the first case.

HARD SOLDERING,—Whether silver soldering, or brazing, is performed in a similar manner, excepting that the silver or the "spelter" (a fusible brass) is applied in granules mixed with the flux in a state of powder, the flux in these cases being borax.

The writer has had considerable experience in both hard and soft soldering of brass work, and after some reflection has framed the following theory: He is quite satisfied that these fluxes have no effect on the meeting point of the solder, nor even any direct effect on its fluidity when melted, and believes that their whole efficiency depends on their power of presenting to the melted solder a pure metallic surface, to which it can adhere, or in fact alloy itself more or less completely. We know that melted tin, or lead, or zinc will thus adhere and alloy themselves to clean surfaces of other metals, just as mercury will amalgamate with certain metals. If a piece of dirty brass or copper be dipped into a bath of tin or lead, or the solder alloy of these, it will come out unaltered; but if it be very carefully cleaned it will be "tinned" all over by them. The tinning and the galvanizing of iron plate further illustrates this.

How, then, do the above-named fluxes act? Let us consider the rosin first. This is a hydrocarbon, a powerful reducing agent, and which, when heated, combines with the oxygen of such metallic oxides as those of tin, and thus effects a reduction of the pure metal on the surface to which applied. Thus the tinman deoxidizes his tin plate surface, and then his solder amalgamates or alloys itself freely with and runs over or "wets" it. We take the liberty of using this term "wets" on account of its analogy with the familiar action of water which adheres to some surfaces or wets them, but runs off of others, such as greasy or dusty surfaces. This difference corresponds to the action of the solder with and without the flux.

But what is the action of the ammonium chloride? Careful observation enables us to answer this question. After applying the solution, the water dissolving the salt boils off, and there is left behind a white coating of the salt itself. Then we go on applying more heat, and if we are skillful, we watch this white frost, and when we see it begins to dissipate by volatilizing in white fumes, we apply the solder before the last of it has gone. Then the solder runs, but if we had applied it sooner or later we should have failed. In this case we believe that the ammoniacal salt dissolves the tin film of oxide and forms a compound which, like all other compounds of ammonia, is volatile at a certain temperature. Now in this case the temperature of volatilization of the flux corresponds to the melting point of the solder, and hence their adaptation to each other.

As our practical readers know, especially the old hands, the use of sal ammoniac is now rather old-fashioned, having been nearly superseded by solutions of zinc in hydrochloric acid, or of the acid itself. The action of these is the same as above described, but more decided and demonstrable, just as they are more efficacious. The hydrochloric acid dissolves the oxide, and the chloride thus formed is a volatile salt, especially the chloride of zinc.

In our apprentice days, when we received our first lesson in soldering together the segments of a "staff-head" before turning it in the lathe, we were told to watch the brass until it became "beefy," and then apply the solder. What was this beefyness? We have tested this question experimentally, and find that it is due to a removal of superficial film of zinc from the brass, thus exposing a red or coppery surface, to which the term "beefy" may be fairly applied when it is hot and free from oxide. The zinc in the brass oxidizes more readily than the copper, the zinc oxide is more readily soluble in hydrochloric acid or chlorides, and zinc oxide and its salts are more volatile than those of copper. Hence the preferential removal of the zinc and exposure of the beefy copper.

The same beefyness is displayed in hard soldering, and may be seen even after the soldering is completed and the work has cooled, if some portion of the brass surface that was denuded by the flux was not covered by the brass solder. Brass tubes frequently show this.

But why is borax used rather than chlorides, and how does it act? To answer this question we must consider the chemical properties of borax. It is a compound of boracic acid and soda, resembling water glass, which is a compound of silicic acid and soda. Both of these when heated with metallic oxides form glassy compounds. Blow-pipe analysis largely consists of fusing metallic oxides with borax or boracic acid, thus obtaining a glass bead in which the oxide is dissolved, the color and other appearances of such bead indicating the presence of the particular oxide. When powdered borax is laid over the metal to be soldered, and the metal is heated, the borax fuses, forms a glassy film upon the surface of the metal, which film takes up all the oxide and combines with it, forming a glassy borate of the metal. But this is not sufficient, for if that glassy film remained it would be as bad as the oxide in preventing the adhesion or amalgamation of the solder. Here then comes to our aid another property of the borates, viz., their volatility at high temperatures. The borax, with the oxide it has taken up flies off at a bright red heat, just at the temperature at which the granules of the silver or the spelter brass melt. Thus they fuse upon a virgin surface of clean metal and unite with it.

We have thus gone a little aside from our direct subject on account of the confusion that the use of this term "flux" may induce. Borax is also used as a flux in metallurgical operations where a metal, such as gold, mixed with impurities is melted. These impunities are taken up by the borax, made into a fusible glass, and thus fluxed or melted away. It is not the gold which is made more fluid, but the oxides of the baser metals that have to be removed.

The fluxing in the blast furnace is similar to this. Its action is not the liquefaction of the iron itself, but the gathering together of the impurities of the ore, converting them into a glass that shall fuse and run down with the melted metal, for we must always remember that the fundamental problem of the modern blast furnace is that everything pitched into its throat must come out either as a gas or a liquid. The retention or formation of any infusible solid would choke or "gobi" the furnace and put an end to its profitable operation.

Silicic and boracic acid are the two chief glass-making agents, the boracic glasses fusing at lower temperatures than the corresponding silicic glasses, and also being more volatile. But we may now dismiss these, and confine our attention to the silicates, and they do the fluxing in the blast furnace. This statement may appear paradoxical for the moment, seeing that not silica, but lime, is the so-called flux of the blast furnace charge. This is easily explained by reference to the analysis of the clay ironstone ores already given. They all contain silica; in some cases partly free as sandy matter, or combined with alumina, or combined with the iron itself.

Silicate of alumina alone is objectionable, on account of its high fusing point. Silicate of iron fuses readily enough, but it is a thief, as it carries away as useless glass the material we are seeking to obtain as reguline metal. We, therefore, require to add something that is more powerfully basic than the iron or its oxides, which will therefore combine more readily with the silica, and this should form a glass that is readily fusible and which will somehow separate itself from the melted iron. Cheapness is another primary desideratum.

All of the desiderata are united in lime. It is a powerful base, it is very abundant and cheap; its glass is much more fusible than iron, and is also so much lighter that it floats freely on top of the melted iron, and thus may be run off through an overflow conduit or tap hole. Lime, therefore, is used, but it must not be used at random for the following reasons: If the supply of lime is not sufficient to combine with the silica, this will unite with the oxide of iron and form a wasteful iron glass, or its silicon will remain excessively in combination with the iron itself. If, on the other hand, the lime is in excess, we may get into trouble, due to the fact that uncombined lime is a most refractory substance, practically infusible, as proved by its use in the lime-light where a mixture of oxygen and hydrogen gases in vivid combustion strikes against a cylinder of lime, making it so intensely white-hot that the light it emits is the most brilliant obtainable. This oxy-hydrogen is hotter than any furnace yet constructed.

CINDER OR SLAG.—This explanation of the rationale of fluxing in the blast furnace explains also the composition of the cinder (so often misnamed "slag," as we shall explain hereafter), which carries away everything excepting the pig iron and the gases. It is mainly a lime glass, and, being a glass, a multitude of schemes have been devised and patented for using it as a material for bottles and for other purposes to which glass is applied. The inventors have not sufficiently considered the fact that lime glass is much more iriable than lead glass, or soda glass, or potash glass, or the mixtures of these that form the material for our windows, bottles, etc.

The problem of utilizing this mixture of silicates in which silicate of lime variably preponderates is not yet solved, on a scale commensurate with the supply of the material. It still remains a worse than worthless waste product, as its disposal is costly, partly on account of its bulk and weight in carriage, and partly on account of the ground it covers and renders useless. Of all waste products of British manufactures this one is about the most unmanageable.—*Iron.*

ARCHÆOLOGY.

THE LAKE DWELLERS OF VENEZUELA.

In many parts of the world, particularly In Europe, there are remains of the structures of an ancient people known as Lake Dwellers, from the fact that they lived in houses built over the water. In that beautiful sheet of water in Switzerland, Lake Geneva, there are such remains, but there are savage tribes in Oceanica who illustrate the ancient practice to-day, dwelling in huts built upon poles, at a considerable distance from land. In America the only instance of this mode of house building is found in the lake of Maracaibo, which lies in the north of Venezuela. Whether or not this habit of living suspended above the water is indicative of special characteristics, in which fear of enemies is the chief element, we are not ready to say, but it seems altogether likely that such is the case, as the tribes who live in this isolated fashion are generally distinguished by a peaceable or non-warlike disposition.

In regard to the Maracaibo Indians, who are believed to be an offshoot from the Venezuela Indians, this is true, as it is related that many years ago a violent war arose among the Indians of Venezuela, and the conquered were driven out. Taking to their boats, they sailed away for the purpose of seeking a new region in which they might dwell.

This lake, which is about one hundred miles in length and sixty wide, is connected with the Gulf of Venezuela by a strait twenty-five miles long. The conquered Indians had purposed to pass through the strait on their way in search of a new country, but a violent storm came up, and compelled them to mass their boats closely, and tie them together with bamboo poles for protection. This maneuver enabled them to meet the storm successfully, and it suggested the idea of their building pile houses over the lake, which would be safe from fire and flood, and give them security against their enemies. They proceeded to carry out the idea, and ere long a village of bamboo houses sprang up, as it were, out of the water. Strong poles driven firmly into the bottom of the lake, and secured at the top by cross-pieces, constitute the foundation on which their houses are built. The roofs are formed of a framing of bamboo, arched as in the illustrations, and neatly thached.

For sleeping purposes they use hammocks. The hygienic conveniences of these houses are superior; ventilation and drainage are matters of nature's own provision, and cases of pulmonary disorders are unknown. These houses are built near enough together for access between them by means of short footbridges.

Living, as these people do, directly over the water, they subsist largely by fishing. They also make many articles of bamboo, and gather shells on the beach, and fruit on the neighboring land, which they sell in the city markets of Maracaibo. It is said that they have a stronger disposition to industry than the natives of Venezuela further inland. But this may be due to their mode of living and in being compelled to exert themselves to obtain the necessaries of life. —*Phrenological Journal.*

RELICS OF AN EXTINCT RACE NEAR SANTA BARBARA.

About two or three months ago C. W. Clark, of this city, decided upon collecting a small cabinet of curiosities, to include coins, relics and trinkets. The result has been the accumulation of a store of rare curiosities which would make an ordinary natural history society turn green with envy. The last important addition is a collection of stone utensils manufactured by a race of people now extinct upon this coast, who were evidently far advanced in the science of stone-cutting, and also in the arts culinary and ornamental. The Digger Indians were not the first inhabitants of this region. There was a race of people living here in Santa Barbara, more industrious and better informed as to how life and comfort might be prolonged and promoted than the poor, groveling, subservient race of "root-diggers" found here when the Dominican padres came here to plant and cultivate civilization. Most of the houses of the old residents of Santa Barbara's sea coast contain queer and well-finished articles of stone-ware dug up or found upon the surface of the earth, all relics of a people now extinct.

These articles are nearly all of stone. Some, however, are of bone and fibrous formation, and none of metal or wood. The archæologists have for years been digging up and investigating the formation of the mounds in Iowa, Indiana, Illinois, and Missouri. They have dug up and sent east shiploads of arrowheads of flint and spearheads, war-clubs and trinkets of a crude and rough shape. Pieces of pottery have been collected in Colorado, New Mexico and Arizona, all showing that civilization once existed upon this continent prior to the arrival of the now fast disappearing Indian race. We had a very industrious and intelligent race of people living upon this coast in the long, long ago. Who were they? Vancouver, the famous navigator, says in his description of this coast more than a century ago, that there were no less than thirteen populous villages of natives upon the sea-coast now known as Ventura and Santa Barbara. Where are those thirteen populous villages? Where are the native descendants? All that can be found concerning them are the fragments picked up in the valleys or the relics dug from the graves. The Indian graves of this section and the adjacent islands are prolific in specimens of the handiwork of an extinct population. These specimens that are exhumed, and of which the Smithsonian Institution, at Washington, contains many tons, are indications of industry practiced here two or three centuries ago, which puts all of our fine stone-cutting and sculpturing in the shade. These extinct tribes made piping or tubes out of the hard agate rock, beads out of shells, charms and talismans of exquisite shape and perfection, representing fishes and animals, out of abalone shells; fine fish hooks from mussel shells, and all kinds of cooking utensils from the solid rock. They had no metallic chisels or drills, no metals of any kind, no turning lathes, and yet their work is perfect.

The collection donated October 14th, to Clark's Natural Museum, includes one mammoth-sized mortar and pestle, both cut out of solid hard rock, the mortar nearly two feet across the top, the pestle two feet in length. Both are perfect in contour and finished as smoothly as rock can be dressed. The mortar would hold about half a bushel of grain and was no doubt the property of the miller of the tribe, who could grind corn meal very rapidly by the aid of such a large-sized hand-mill. Then there are a dozen or more beautifully finished mortars and pestles, all of solid stone, some of one variety of stone and some of another. Some of the mortars are of smoothly polished agate and very beautiful. The most remarkable of these exhumed Indian curiosities are the ollas or water vessels and the solid stone cooking vessels. These latter articles are wonderful. The largest is a globular vessel of solid stone chipped out of the hardest kind of rock and as round as a ball. It is hollow and has been patiently chipped out until the globe is quite hollow, about two inches thick, with an aperture about four inches in diameter at the top. It still bears the marks of fire, although it has been buried, perhaps, two centuries. There are several of these globular stone cooking vessels in Clark's collection and dozens of other aboriginal curiosities.

Dentistry seems to have been quite an art in the days when the extinct race held control here. Among the store of curiosities exhumed from the graves upon the Santa Barbara Islands and now in Clark's collection are six or seven set of false teeth. They are formed each from a shell which was fashioned to fit the roof of the mouth or could be adjusted outside of the gums. These shell teeth are perfectly formed and easily adjustable. Whether they were used for ornament or for mastication of food is one of those mysteries the grave still holds in concealment. The water bottles are round and are of woven glass mixed with asphaltum. The pipes are tubes of agate or fine colored stones gathered upon the beach. How the natives turned and polished this hard flint-like stone and then drilled holes through it so as to use it for a pipe is a mystery. Among these recently exhumed curiosties from the Santa Barbara Islands are dozens of highly polished stone rings; some of them have been broken, but have been mended with cement of which asphaltum is the principal ingredient. This cement used by these extinct tribes appears to have been durable and effective, as the shattered stone rings united by it are as strong and as solid as those not damaged.

The islanders appear to have made good use of seal's teeth and whalebone. The latter, when found in a petrified state, was used as our Chinese abalone gatherers use an iron bar—to pry up the mollusks from the rocks. Mr. Clark has one of these petrified bone crowbars, one side of which was used as a creator of fire. Its rough side resembles a file, and the rapid friction between it and a piece of dry wood creates fire —*Santa Barbara Independent.*

PIEDRAS PINTADAS OF COLORADO.

CAPTAIN E. L. BERTHOUD.

I inclose to you three photographs of prehistoric (?) carving that I consider of unusual interest to antiquarians and historians. I have just returned from a railroad survey in the San Juan Mountains, south of the head of the Rio Del Norte, and in Rio Grande County, Colorado; and on this trip I learned that there was a locality near where ancient carvings existed.

The place is twenty miles southeast of Rio Del Norte, at the entrance of the Cañon of the Piedra Pintada (Painted Rock) Creek. The carvings are found on the right of the cañon, or valley, and upon volcanic rock. They bear the marks of age and are cut in—not painted, as is still done by the Utes everywhere. They are found for a quarter of a mile along the north wall of the cañon, on the ranches of W. M. Maguire and F. T. Hudson, and consist of all manner of pictures, symbols, and hieroglyphics done by artists whose memory even tradition does not now preserve. An examination of the photographs made very closely with a reading lens suggested to me that the center third picture is intended to commemorate the first appearance of the Spanish discoverers in the sixteenth century, in the valley of the Del Norte; their encounter there with the naked natives of the country, and a battle between them and the Spanish cavalry, armed with lances, shields and swords, which the mounted figures are intended to represent.

The fact that these are carvings, and done upon such hard rock, invests them with additional interest, as they are quite distinct from the carvings I saw in New Mexico and Arizona on soft sandstone. Though some of them are evidently of much greater antiquity than others, yet all are ancient, the Utes admitting them to have been old when their fathers conquered the country.

VISIT TO AN ACOMA PUEBLO.

F. P. BAKER.

* * * * * * *

We left McCarty's Station, on the Atlantic & Pacific R. R., in Arizona, at 8:20 A. M. in a double wagon with a Mexican on horseback as a guide, for a visit to an Indian village on the top of a mountain about fifteen miles south of the road. I was told by an old Indian, that within his memory, until the past three months, it had never been visited by an American, although Mexicans often were there.

The drive to the Indian village is through a country of great beauty and picturesque scenery, It was through great parks, with mountains of rocks from 200 to 500 feet high on each side. Some of these peaks look like immense orchards, piñons and small cedar trees representing fruit trees in a *real* orchard. The ground is rich, with deep soil, and only needs water to make it very productive. It is covered with piñons and cedar trees and huge cactuses, and also with bunches of grass that are said to be very nutritious. Quite a number of herds of sheep and horses, belonging to Indians, were seen on the divide. About twelve miles out we began to descend into the upper end of what seemed to be a cañon. After going down a pretty steep declivity we reached the bottom, where we found that the cañon began to open out wider and wider into a beautiful park, with no trees, however, but a rich, deep soil, with bunches of grass thicker than any we had yet seen. This park contains many thousand acres of as beautiful prairie as one often sees. In it are numerous piles of rock, standing out by themselves, ranging from a single rock, perhaps, with a circumference of fifty feet and a height of 200, to much larger and higher ones. They look like sentinels standing guard over the grandest rock, which is 800 to 1,000 feet high and contains perhaps a thousand acres. It is on the top of this rock that the tribe of Acoma Indians live. The accent is on the first syllable, *Ac*. The last "a" has the broad sound as pronounced in maw. I can only compare it to an island in a small lake, and the other smaller rocks to other islands.

All around the base of this island, or rock, are deep beds of sand, looking for all the world like sand washed up from the bed of the ocean. There is no way of getting up upon the rock but from the side we approached, and then only by wading through a bed of sand to the foot of the rock, and then by steps cut in the side of the rock, zig-zagging up to the top, which is nearly 1,000 feet above the park. At one place there is a natural opening about six feet wide, where a half dozen men could defend themsilves against the approach of a small army. Up these steps the people and visitors have to go to reach the top, and up the same steps went the burros, on whose backs are carried up the wood to supply the 800 people who live on the rock, the wheat and corn which are raised on the plains below, and in fact everything that is consumed by the whole population. Nearly the whole 1,000 acres is nothing but bare, ragged rocks, with hardly a vestige of vegetation. Occasionally a few tufts of grass are seen, and I saw one large piñon tree, the only one on the rock.

There is in one ravine a large peach tree. I don't believe there is another so desolate a place inhabited by human beings, on the face of the globe.

Tradition has it that about 1569 this tribe and the Lagunas got into a quarrel over a right to the water and the Lagunas whipped the Acomas, who betook themselves to this rock as a place of security and finally settled on it, going out into the plain below to cultivate their crops, well armed and prepared to defend themselves against their enemies.

There are three rows of houses, each row about as long as a block in the city of Topeka. They are of adobe, three stories high. One side has no openenings whatever, being a bare wall some thirty feet high. The first story is about thirty-six feet wide; the second story say twenty-six feet wide, leaving an open space in front of it, and on the top of the first story, which is used to sit or squat on and, I guess, sleep on in hot weather. On the top of the second story is a third story about sixteen feet wide, leaving another open space on the top of the second story, which is used for the same purposes as the one below it, to sleep on. There are no openings on the lower story from the ground. The house is entered by going up the first story on a ladder, stepping upon the flat roof of the first story, entering the second story by a door and then going down some steps into the first story. The third story is reached by a ladder from the second story. The inside of the houses are clean, freshly whitewashed, and nearly everything has a tidy appearance.

There is a church, said to be over two hundred years old, which is almost indescribable. In the center is a placita, or hollow square, uncovered. Around this is what might be called a court or hall with small windows, out of which the approach of an enemy could be seen, and steps be taken to defend the inmates. Opening out of this court are many small rooms, used for shutting people up in, or hiding in, or some such purpose. One of them is now used as a prison. Then on one side of this placita is the church proper. It is built, like all other buildings, of adobe, nearly three feet thick. It has every appearance of great age. There are a few old pictures in it, the Virgin Mary, etc. At one end is a gallery, and the stone steps leading to it are worn nearly out from long usage. At one corner of the church is a tower in which is an old bell, which is rung on the death of any one, and also when the Catholic priest comes from a neighboring village, which is about once a month.

The only water used on the rock is rain-water, which is gathered in a natural cistern from the rain which falls in the rainy season. This natural cistern, as I have called it, is a tank formed by the surrounding rocks. It is about 140 feet long and an average of say fifty feet wide. In the rainy season this fills to the depth of about twenty-five feet. The steps leading down into it are full of holes just the shape of the human feet, where for hundreds of years the women have gone after water, always stepping in the same place from necessity. It is nearly or quite a half mile from the dwellings to the cistern, and one-half of that distance over a bed of sand. The water is all carried on the head in a vessel made of clay and holding about a gallon and perhaps more.

The wealth of the tribe consists in its flocks. They own in common about 20,000 sheep, 5,000 to 6,000 head of cattle, 600 to 800 burros and a large number of horses. They are herded on the plain below. They raise a good deal of corn. It is of a blue variety; also considerable wheat. They keep hens, turkeys and pigs on the rock, and eggs are sold to the merchant, Beppo, at fifteen cents a dozen. While I saw the forked stick plows, I did not see any in use. The corn was planted in an old corn field, without re-plowing. Some of the corn is up and looks well. In other parts of the field corn was being planted by simply making a hole in the ground with a short stick, dropping the corn in it, and covering it with the foot.

There is a tradition that the first priest that ever ventured upon the rock was thrown from a high one, but instead of falling to the ground, as the law of gravition provides, he went up to heaven. The point of rock off which he was thrown was shown me. It seems to me, however, that I have heard a similar story. I am aware that this is a very imperfect description of the place. To have given a fuller account I should have stayed another day. I wanted more to call attention to the fact that there is such a place, than to give an accurate description of it. It will be but a few years at most that such places can be found. It is not probable that this tribe of Indians will live another score of years in such a desolate place.—*Commonwealth.*

ASTRONOMY.

KEPLER'S THIRD LAW.

EDGAR L. LARKIN.

In the November issue of this REVIEW we published an article with the above title in which we said, in speaking of the periods of revolutions of planets and their distances from the Sun, that,—"The squares of the times are equal to the cubes of distances." This is a statement of Kepler's law at variance with those given in astronomical works. Herschel's Outlines, p. 259, gives it in these words: "The squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the Sun." On November 10th we received a letter from Prof. H. S. Pritchett, St. Louis, Mo,, which said,—"As your statement of Kepler's law is calculated to mislead any one unacquainted with the subject, it is proper that you should make some correction of it in the next number."

Thanking Prof. Pritchett for calling attention to this matter, we make the following explanation:

In late computations wherein values relating to the earth become factors, such as its mass, volume, density, distance, velocity, and gravity, we find each made equal to 1. This scheme has become nearly universal, and our object in so wording Kepler's law was to make it applicable to those who were in the habit of using ratios in place of crude numbers. Since no value but a ratio was inserted in the article, we thought our version of the law would be understood to apply to ratios. For fear that students might think otherwise we here show the exceptions to the law as we gave it. The main use of Kepler's third law is to find the relative distances of the planets from the Sun, which of course gives their relative distances from each other.

For many years such use was made of it, until finally it fulfilled its destiny and actually revealed the distances of all the planets from the Sun in relation to the earth's distance.

Kepler beheld the future with joy, because he was aware that if in coming years any astronomer should be so fortunate as to discover the distance of one planet from the Sun in miles, then all would be known, since the squares of times he knew, contained the secret of distances. Astronomers long ago made tables of the relative distances of the planets—including the Earth—from the Sun; and then began an untiring search, awakening the admiration of the world—a search not yet ended—to find the distance of one planet—the earth—in miles.

Let us imagine ourselves transported into the past, and watch astronomers at work finding the relative distances of the planets from the Sun. They had Kepler's law and therefore knew that there was a *certain* relation between the squares of times and cubes of distances. Suppose them at work on the task of finding how many times more distant Jupiter is from the Sun, than is the Earth. They could all see that Jupiter requires 11.8617 times greater period to revolve around the Sun than the Earth does. Then they squared 11.8617 and secured 140.6 as a product. Here, then, astronomers had a number—140.6, which they knew possessed valuable properties, since by the law, the distances—both unknown—of the Earth and Jupiter were involved in it. They knew that whatever were the distances of the Earth and Jupiter, the cube of Jupiter's distance divided by the cube of the Earth's, would give a quotient=140.6. After years of toil had passed away in observing Jupiter; in watching it in all parts of its orbit, measuring and recording its angular distances from the Earth and Sun, as well as its longitude from time to time, it was discovered by almost interminable labor, that its distance from the Sun is 5.2016 times greater than that of the Earth. Therefore, the distance of the earth from the Sun becomes equal to 1. The relation of the Earth's distance from the Sun to Jupiter's distance is as 1 is to 5.2016.

(We desire to use the word ratio instead of relation, but desist, for if we should, our version of the law would be true).

As noted above, astronomers knew if they could find the relative distances of the Earth and Jupiter with accuracy, that the cube of Jupiter's divided by the cube of the Earth's distance would equal 140.6. But why carry the computation further? Why cube Jupiter's distance and divide by the cube of the Earth's, when the work was already performed? The number 140.6 flashed out as a resplendent light, for behold! it *is* the cube of 5.2016. That is:—the square of Jupiter's time is *equal* to the cube of its distance, in the only units that could possibly be known to the astronomers of that epoch.

It would have been well if these founders of our science had erected a monument of granite, more enduring than the pyramids, and carved thereon these words: "The squares of the times of revolution of all the planets are equal to the cubes of their mean distances from the Sun." We think no astronomer now living would desire to obliterate such an inscription. This eternal law is one of the foundation stones of astronomy and we think all text-books should word it as above, and that every student should so memorize it. If any man ask that we explain the third law of Kepler, we will tell him that squares of times are equal to cubes of distances. Should he ask how to find the times, we would say: the only known method of finding the time of a planet's revolution is to observe how much longer or shorter period it requires to make circuit than the Earth does, because the motions of the Earth alone give us any conception of the flow of time. He desires to find the distance of Mars from the Sun in miles. We say square its time and extract the cube root of the product. The period of this planet is 1.88, that is—it takes .88 longer time to go round the Sun than the Earth does. The square of 1.88=3.537, whose cube root is 1.5238. Now, we assert that 1.5238 is the distance of Mars from the Sun, and re-assert that—the square of any planet's time is equal to the cube of its distance. Our reasons for saying that 1.5238 is the distance of Mars are, because we cannot find Mars' time without first finding the Earth's, nor its distance, likewise. Since we are forced to make the Earth's period 1, we claim the right to make its distance 1. Therefore, if we can find the distance of the Earth in miles, we have only to multiply this number by 1.5238 to find the distance of Mars in miles. But the Earth's distance is still unknown, so we assume the solar parallax to be 8″.8 which makes the Earth's distance, 92,882,000×1.5238=141,534,000 miles=the distance of Mars.

Thus, distances of all planets in miles can be found from their periods, with fifty times less labor than by any other process. And this is the only way in which Kepler's law should ever be used. We found the distance of Mars with little work, but will give the same case in the good old way, using numbers that appall the young student. We hear on all sides that—"the squares of times are *proportional* to cubes of distances." We know it, and will show some of the proportions in the case of Mars and the Earth. Mars' time is 686.9766 days, whose square=471,940. The Earth's period is 365.2563 days, which squared= 133,412, and 471,940÷133,412=3.537. Now, as we know this to be equal to the cube of Mars' distance, we would like to take its cube root at once and end the matter; but no, we must secure the same number by the proportional way. The Earth's distance, 92,882,000 miles, whose cube=801,834,445,006,000,000,000,000. Mars' distance is 141,535,000 miles, and cubed=2,835,251,231,305,000,000,000,000. To be proportional to squares of times, quotients must be equal, whence, 2,835,251,231,305,000,000,000,000÷801,834,445,006,000,000,000,000=3.537 as before; but then this 3.537 is the *cube* of Mars' distance, and we must proceed as at first to extract its cube root. Using Kepler's law, in the proportional way, is like burning all the logarithmic tables in existence. We cannot concieve of dispensing with a unit of time in cosmical physics, and fail to find one better than the year. The earth revolves in a time which is equal to 1; now let us see if we have violated mathematical usage in calling the Earth's distance 1, as we do its time. The ablest mathematicians make such statements. Thus:—in Newcomb and Holden's Astronomy, p. 228, it is said in formula that the force of gravity on the Earth's surface multiplied by the square of its radius equals the *mass* of the Earth.

Gravity on the Earth's surface=32.1 feet per second; and radius=20,899,081 feet; and 20,899,081 squared and multiplied by 32.1=14,020,367,931,290,408, which we are informed is the mass of the Earth. But it is not the Earth's mass in pounds, tons, or any other units. Is the assertion of such able astronomers false? By no means,—everybody at once understands that this vast number is equal to 1, that is, it is nothing but a ratio, for if we multiply gravity on the Sun's surface by the square of its radius in feet and divide the square by the above number, the quotient will be 333,426, an important number—the mass of the Sun, that of the Earth being 1. Here, a string of seventeen figures was made equal to 1; then we see no reason why 92,882,000 may not be represented by 1, and Kepler's law be allowed to stand in simplicity and sublimity.

This reasoning appears to us satisfactory, that we have a right to make the Earth's distance unity, and then word the law as we did.

Now for the exceptions—of which there are five, as follows: The squares of the times expressed in months, weeks, days, hours, and minutes, *do not* equal the cubes of distances in furlongs, rods, yards, feet, and inches. But since no one wants to use the law by handling these units, we did not make mention of them in the Kansas City REVIEW. Yes, we omitted the units—years, because if we used *years*, the number 1 would appear; and distance would have to come into the list as 1, spoiling the scheme, since squares of times at once become equal to cubes of distances.

We would much rather teach that squares of times equal cubes of distances; than that they are simply proportional. We would teach equality first, and make secondary the fact of proportion. We would exalt this *equality*, and class the proportions existing among these numbers as mathematical curiosities like others that may be deduced by different combinations of values of time, velocities, distances and the like. Here is a table of proportions existing in the solar system, beginning with Mercury and extending to Neptune.

The square of Venus' Time	÷by the square of Mercury's Time	= 6.5
The cube of Venus' Distance	÷by the cube of Mercury's Distance	= 6.5
The square of the Earth's Time	÷by the square of Venus' Time	= 2.64
The cube of the Earth's Distance	÷by the cube of Venus' Distance	= 2.64
The square of Mars' Time	÷by the square of the Earth's Time	= 3.537
The cube of Mars' Distance	÷by the cube of the Earth's Distance	= 3.537
The square of Jupiter's Time	÷by the square of Mars' Time	=39.8
The cube of Jupiter's Distance	÷by the cube of Mars' Distance	=39.8
The square of Saturn's Time	÷by the square of Jupiter's Time	= 6.16
The cube of Saturn's Distance	÷by the cube of Jupiter's Distance	= 6.16
The square of Uranus' Time	÷by the square of Saturn's Time	= 8.13
The cube of Uranus' Distance	÷by the cube of Saturn's Distance	= 8.13
The square of Neptune's Time	÷by the square of Uranus' Time	= 3.83
The cube of Neptune's Distance	÷by the cube of Uranus' Distance	= 3.83

Quite a number of similar tables might be made by beginning the series with each of the planets; and then by different combinations arranging the numbers in all possible ways. We might begin with Saturn and compare with the other planets; and then with Uranus, and so on, completing the work probably in six months. But then what would the tables be good for, simply to satisfy a curiosity that might be awakened in a morbid mental condition.

Nearly every work on astronomy fails to quote Kepler's law correctly; all astronomers know that as Herschel gives it, it is not absolutely perfect. The words, "when the masses of the planets are considered" should have been added. The third law is not true with mathematical precision unless the mass of each planet is allowed to enter the calculation. The error is perceptible in the case of Jupiter, but the combined mass of all the planets is so small in proportion to the Sun, that very few writers care to waste additional words when quoting the law. In view of the fact that late astronomical works make such frequent use of ratios, and since Kepler's laws are so well known, we here present four sentences whose differences are almost infinitely small. "The squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the Sun."—Herschel.

The squares of the periodic times of any two planets are to each other in the same proportions, when their masses are considered, as the cubes of their mean distances from the Sun.

The squares of the times are equal to the cubes of distances, when ratios are considered.

The squares of the times are equal to the cubes of distances.

And these ratios are units formed by the same hand that made the solar system; and should never be forgotten, whether by student or skilled astronomer.

With due deference to Prof. Pritchett, we make these explanations and corrections.

In November issue "Axis" should have read Axes, and ".1" as 1.

New Windsor, Ill., November 20, 1883.

SUN AND PLANETS FOR DECEMBER, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's R. A. is 16 hours 30 minutes on December 1st, and 18 hours 42 minutes on December 31st. About 9 P. M., of the 21st, the Sun will arrive at his greatest declination south, 23° 27′; a point called the winter solstice—the astronomical beginning of winter season. It is 18 hours 00 minutes of R. A.—the solstitial Colure, and 6 hours west of the Vernal Equinox. This will be the shortest day of the year—9 hours 10 minutes long in 40° north latitude. After that the Sun will decline northward and the days grow longer. The Sun will be nearest the Earth on January 1st. Solar spots are not so numerous as they were in October; ninety-five spots is the greatest number yet observed in November, on the 1st and 17th. Two were visible without telescope on the 17th, one near the west edge of the Sun, the other in southeast quadrant.

Mercury is evening Star, but will not be visible until near the last of the month, when it may be seen in evening twilight near where the Sun sets. Venus is also evening star, and will be somewhat conspicuous by the end of the month, about half an hour above Mercury. Saturn will be a lovely object all through December; rising at 4:30 on the 1st, it will be high enough for observation soon after dark. As stated on former occasions, a good sized spy-glass will show the ring and one or two moons; and a large telescope brings out a magnificent appearance. Saturn may still be known by its proximity to Aldebaran—being somewhat above and to the left of the star. Jupiter rises about 8:30 P. M., four hours after Saturn, and near the same point of the horizon. And here we have another grand object for telescopic observation. A very small glass shows a disk on the planet; the four moons and one belt. Mars rises just before 10 P. M., on the 1st, a little south of where Jupiter emerges to view. It rises one hour twenty-three minutes later than Jupiter on the 31st. Its phase is gibbous and not of much interest with a small glass. Uranus is morning star, rising at 1 A. M., on the 1st, and two hours earlier on the 31st. Neptune is still about 8′ southwest of Pleiades. The Moon passes Neptune on the 11th; Saturn next day; Jupiter in evening of the 16th; Mars in morning of the 18th; Uranus early on the 21st; the Sun (New Moon) on the 29th 6:30 A. M.; Mercury at 11 P. M. on the 30th; and Venus near 1 P. M. on the 31st.

REAPPEARANCE OF THE COMET OF 1812.

On the 3rd of September, Mr. Brooks, of Phelps, New York, discovered a telescopic comet. Its advent was quickly made known to the scientific world, and it was described as round and faint, and having no tail. Its course was toward the earth, and it was hoped that it would become visible to the naked eye in two or three months. It was generally accepted as a new comer making its first visit to the clime of the Sun, and was known as comet Brooks, or comet *b* 1883.

Instead, however, of being a new-comer, this comet is an old friend that made its first recorded visit in 1812, and is known as Pons' comet from the name of the discoverer, or, more simply, as the comet of 1812. Encke, an astronomer of the time, found that the comet moved in an ellipse with a probable period of nearly seventy-one years, so that its return was looked for about this time.

The Rev. George Searle, of New York, was the observer who discovered the identity of comet Brooks and the comet of 1812.

Cometic astronomy was comparatively in its infancy when Encke made the computation of the orbit of this comet. It is simply wonderful that, with the data at his command, he should have reached a result so nearly accurate. Within a few years, however, two series of observations of the comet have been discovered which were unknown to Encke. Two French astronomers, Messrs. Schulhof and Bossert, undertook to recompute the orbit, using all the data known. The Paris Observatory published the result of their labors in a pamphlet of 200 pages. From time to time, the enthusiastic French observers issued memoranda of the probable position of tne comet when near enough to be seen. Unfortunately, the first observations of comet Brooks did not seem to agree with the French ephemeris, and it was hastily concluded that the erratic visitor was a new member of the cometic family, come to take its first peep at our little planet.

The Rev. Mr. Searle studied the question more carefully, and verified the computations more accurately. He proved beyond question that the positions marked out for comet Brooks were identical, at the time of observation, with those in which a comet would be found that was traveling in the ellipse computed by Encke. He went further, using the new orbit of the French astronomers, and proving that the comet was observed in the exact position where it should have been found according to the orbit computed seventy years ago.

There is, therefore, no shadow of a doubt that our eyes behold the long expected comet of 1812. Its perihelion passage will take place on the 25th of January, 1884. It will then be about 60,000,000 miles distant from the earth, two-thirds the distance of the Sun.

In 1812, the comet presented, when discovered in July, the appearance of an irregular nebulous mass, with the tail entirely wanting. In September, the nucleus was 5′ in diameter, and the tail was 2° 17′ in length. Though not very bright, it was distinctly visible to the naked eye, and was observed for ten weeks before it disappeared in the star depths. The returning comet, when first seen, presented similar elements. About the 23d of September, however, a remarkable and unexpected outburst occurred, the nucleus expanding into a confused circular nebulous patch of light, and the comet increasing many times in brilliancy in the course of two or three days. On the 23d, the nebulous mass was 2′ in diameter; on the 25th, it was 4′ in diameter and shone with a lustre equaling a star of the seventh magnitude. The activity of the display is almost unparalled in cometic history, and is especially noteworthy on account of the comet's great distance from the Sun at the present time. Since this curious outburst, the comet has been a well behaved member of the family, but it is impossible to predict what vagary it may next indulge in.

The comet of 1812 may now be seen in the evening in the northwest in a telescope of moderate power, and is said to be visible in a good opera-glass. In a few weeks it will be easily perceptible to the unassisted eye, and when the year 1884 makes its advent, it will be near its culminating point. It will not equal the superb comet of 1882 in size or brilliancy, but it will be visible in the evening sky and will be so much more convenient to observe that there will be compensation in its lessened splendor.

It is an astronomical triumph, that with the inadequate means at command for computing an ephemeris, an astronomer seventy years ago was able to predict nearly the exact time for this comet's return. Our ancient friend is winging its swift flight toward us, and before long our eyes will be gladdened by a sight of its face after a long travel of threescore years and ten, when almost every eye that noted its first appearance has ceased to behold the shining picture that nightly arches over the earth.

There are several comets with a computed period of from seventy to seventy-five years. Halley's comet with a period of seventy-five years is the only one of them that has made more than one return. Its last appearance was in 1835, and it is next expected in 1911. The comet of 1812 with a period of seventy-one years now records its first return. The comet of 1815 with a period of seventy-four years is confidently anticipated in 1889.—*Scientific American.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

Temperature of the Air.	Oct. 20th to 30th.	Nov. 1st to 10th.	Nov. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	..	..	..	..
Max	.	..	..	..
Min. and Max	..	..	..	..
Range	..	..	..	..
Tri-Daily Observations.				
7 a. m.	42.2	43.0	31.7	39.0
2 p. m.	52.0	60.8	46.9	55.9
9 p. m.	44.0	48.6	36.1	42.9
Mean	46.1	50.8	37.4	45.9
Relative Humidity.				
7 a. m.	.91	.90	.89	.90
2 p. m.	.77	.78	.72	.76
9 p. m.	.87	.88	.80	.85
Mean	.—	.85	.87	.84
Pressure as Observed.				
7 a. m.	29.06	28.57	29.21	28.98
2 p. m.	29.09	28.57	29.18	28.94
9 p. m.	29.07	29.00	29.08	28.94
Mean	29.07	28.71	29.16	28.95
Miles per Hour of Wind.				
7 a. m.	9.	10.8	..	..
2 p. m.	15.	11.3	..	..
9 p. m.	12.	9.6	..	..
Total miles	3438	2194	3744	9376
Clouding by Tenths.				
7 a. m.	5.7	4.5	..	..
2 p. m.	5.9	5.4	..	..
9 p. m.	6.7	6.2	..	.
Rain.				
Inches	1.70	.70	.00	2.40

The last decade of October was very wet, making a total rainfall for that month of more than twice the normal at this station. The total was 6.14 inches.

November has been, to the 20th, comparatively free from rain, but the humidity was high and the weather cool.

Temperature on the 14th, 15th, and 16th, fell to 14°, 14°, and 15° respectively, which froze the ground enough to nearly spoil undug potatoes. The highest temperature in the report was 73° on October 28th.

REPORT OF THE CHIEF SIGNAL OFFICER FOR 1883.

In this report the Chief Signal Officer of the Army calls attention to the injurious curtailment of the service rendered necessary on account of the diminished appropriations by Congress. He urges increased appropriations for the future, and reports a deficiency bill to enable him to continue work already begun.

Referring to the weather indications, he says: The abandonment of stations made necessary by lack of funds must interfere with the weather predictions made by this office.

He gives numerous details of the fitting out of the Greely Relief Expedition and of the instructions issued for its guidance, but makes no allusions to its failure.

He says the scientific work of the bureau has been steadily carried forward. During the year an investigation has been made into the standard of thermometry adopted by the Service which appeared open to objection. This resulted in the adoption of a new standard which no longer agrees with that of the Yale College Observatory, but approaches more nearly to that of the International Bureau of weights and measures.

Attention is called to the necessity of a separate office on the Pacific Coast, under the charge of an instructed officer, and the report says: "If a weather service for the country is to be maintained, this important region should not be neglected as it has been."

The number of stations in operation on June 3, 1883, was 376—a decrease during the year of 118.

The report shows that the Service has made a slight gain in accuracy. Of the cautionary signals displayed 83.9 per cent were justified by results against 83 per cent last year. Eighty-eight per cent of the weather indications furnished the press were verified, as against 86.6 last year. On the Pacific Coast the verification of weather predictions was 90.5 per cent. Commercial bodies throughout the country have greatly aided the Weather Bureau. In fifty-four cities meteorological committees have been appointed and have furnished suggestions and advice.

The Bureau has made an investigation as to the relation between rainfall and growth of population in the northwest. There was also a careful study of the river floods in 1882 in order to discover some means of predicting such phenomena. Preliminary steps were taken toward better study of cloud formation by the aid of photography and the study of atmospheric electricity with a view to predicting local tornadoes.

The Service has suffered from the lack of officers capable of making weather predictions. Two years' training is requisite, and there are not enough capable officers to make the predictions and make a scientific study of the vast collection of meteorological data now on hand.

The number of stations in operation at the close of the year was 376, or 118 less than at the close of the preceding year. The number of stations from which telegraphic reports have been received is 139, a decrease of 13. Daily reports have also been received from 335 foreign stations, including 19 in British North America, and irregular reports at intervals from 605 steamships of 59 different lines, Monthly reports have also been made to the Chief Signal Officer by 339 voluntary observers in various parts of the United States.

The work of the Service has been done by 19 officers and 500 enlisted men.

During the last two years an attempt has been made to secure the enlistment of young college graduates, and it has met thus far with gratifying success. Out of 172 enlistments made within the period mentioned, 53 have been graduates of colleges.

Among the improved methods of distributing weather predictions introduced during the year, is that by means of railway trains. The Cleveland, Akron & Columbus Railway has adopted a system of weather signals which are displayed on their cars, and which thus give warning to the farmers of the country through which the line passes. A red ball denotes higher temperature; a red crescent, lower temperature; a red star, stationary temperature; a blue ball, general rain or snow; a blue crescent, fair weather; a blue star, local rain or snow. The predictions are sent to the road at midnight. The average percentage of accuracy of the warnings given in this way, as determined by persons not connected with the service, has been over 80 per cent. Arrangements are now making to extend this system to all lines of railway operated by the Baltimore & Ohio Railroad Company.

BOOK NOTICES.

WORLD-LIFE, OR COMPARATIVE GEOLOGY: By Alexander Winchell, LL. D.; 8vo., pp. 642. S. C. Griggs & Co., Chicago, 1883. For sale by M. H. Dickinson, $2.50.

This book, which gives the author's views of the processes of world formation, world-growth, and world decadence is, in the main, made up from lectures delivered before his classes and before popular audiences during the past fifteen years or more, but presents the ideas, theories, and arguments in a more substantial and profound manner. It is intended to be an incorporation of the soundest and latest views of the best writers upon the various branches of the subject with the carefully drawn conclusions of the author; the whole discussion, as he says, being conducted from the standpoint of nebular cosmogony, which "has shaped the views presented on the accumulation of the materials for world-formation, on the evolutions of nebulæ, stars, and planets, on the all-important influence of tidal-action in cosmic history, and on the grand cycle of cosmic existence."

It is divided into four parts: I. World Stuff with chapters upon Cosmical Dust and Nebular Life. II. Planetology, subdivided into essays upon the Origin of the Solar System, the General Cosmogonic Conditions on a cooling Planet, Special Planetology or Present Conditions and Cosmogonic History of the Planetary Bodies in our System, Planetary Decay or Cosmic Conditions more advanced than the Terrestrial Stage, Habitability of other Worlds. III. General Cosmogony, which includes discussions of the fixed Stars and Nebulæ, and of the Cosmic Cycle. IV. Evolution of Cosmogonic Doctrine, with an interesting account of Pre-Kantian Speculations, Kant's General History of Nature, Doctor Lambert and Sir William Herschel, and LaPlace's System of the World.

In presenting many of his theories Professor Winchell undoubtedly is entitled to the credit of having preceded many of his contemporaries, at least in his public lectures. For instance, he enunciated the theory of the vast quantity of cosmical or meteoroidal matter and its influence upon planetary motions some years before the investigations of Nordenksjold, Tissandier, and others. On the geology of the Moon his reasonings were in writing considerably before M. Faye's memoir appeared in which some coincident conclusions were reached without covering the same ground. He also first pointed out the importance of the atmospheric factor and the ice-clad condition of the ultrajovian planets.

He has made an effort to clear up the most serious difficulties encountered by belief in the nebular origin of the planetary system, for which he has stood up for many years, and of which he says, "the great idea was fascinating, its magnificence took possession of the imagination and its symmetry and coherence commanded rational conviction. It now commands the admiration and championship of the scientific world." Monographic summaries of various scientific doctrines, such as replies to objections to the nebular theory, views upon cosmical matter, estimation of the earth's age, etc., occupy a number of pages and are also full of original suggestions.

Copious foot notes give not only full bibliographical references and authorities, but in many instances mathematical operations, showing the author's processes; at the same time the text may be read separately for a logical treatment of the subject without following it into obtruse and recondite depths.

It is impossible to touch upon one in a hundred of the salient points in this work, and still we hope we have said enough to show the reader that it is one of powerful vigor, deep research and profound thought; worthy of the author, even after all his other works, and instructive and suggestive to students of every degree. The publisher's work has been well done, and nothing is lacking to make the book attractive in appearance.

THE SUN: ITS CONSTITUTION; ITS PHENOMENA; ITS CONDITION. By Nathan T. Carr, LL.D.; *Humboldt Library*, No. 49. J. Fitzgerald, New York, 1883.

One of the results of the attempts to popularize science has been the production of a class of writers who, without the training or knowledge necessary to the task, aim to produce explanations and theories in provinces where, as it might almost be said, "angels fear to tread." While the book under discussion cannot unreservedly be classed among these productions, it is so markedly on the border line between them and the works of well informed men that it is, for this reason, the more dangerous. The departure from accuracy of statement is frequently so slight that only one conversant with the subject would notice the delinquency. In the hands of persons, whether liberally educated or not, who are not familiar with the minutiæ of solar research the book cannot fail to produce erroneous and hurtful impressions.

It is at once evident that the author has never studied solar phenomena with the aid of good instruments, the *sine qua non* of knowledge in this department. His descriptions are misleading, and the discussions founded upon them err accordingly. The most prominent example of this error is the confounding the corona with the chromosphere, and the prominences with the faculæ; (§§ 9, 10, 11). But it is in the application of the principles of physics to the study of the constitution of the Sun that the most serious inconsistencies are found. There is a continual interchange of the terms 'cloud' and 'vapor,' 'fluid' and 'liquid;' and a clear idea of the essential properties of a gas seems to be entirely wanting. We find an incorrect view of the formation of a gas by heat given at some length (§ 15); the doctrine of the conservation of energy totally denied (§ 16); decided misapprehension of gaseous pressure (§ 18); and the attraction of gravitation entirely overlooked (§ 22). With this armory to fall back upon, it is not strange that the author should criticize the recognized masters of this department of research with considerable freedom and not without a slight flavor of pity and superiority. The danger to be feared from the publication of this book is the effect it will have in misleading persons who are anxious to know somewhat concerning our central luminary, but are not prepared to distinguish between the true and the false. To the student of the subject the book can have no interest excepting that belonging to a curiosity. H. S. S. S.

FINLAND: ITS FORESTS AND FOREST MANAGEMENT. Compiled by Jno Croumbie Brown, LL.D. 12mo., pp. 290. Oliver & Boyd, Edinburgh, 1883.

This is the third of a series of volumes, the publication of which has been undertaken as a contribution to the literature of forest science in the English language. The earlier volumes, "The Forests of England, and their Management in Bygone Times," and "The French Forest Ordinance of 1869, with Historical Sketch of Previous Treatment of Forests in France," have been noticed in these pages. Doctor Brown is an indefatigable student of such subjects has already published seven volumes on forestry, and has some three or four others under way. The object aimed at by him is to produce popular technical treatises which may be useful to students of forest science, who have not access to the works quoted, and to place his readers in a position to work out for themselves solutions of the problems raised, should they be so disposed.

This volume is divided into three parts, viz: I. The Lakes and Rivers of Finland with descriptions of the Saima Sea: Boating Adventures on the Ulea and the Tornea of the water systems of Finland. II. Forest Economy, with an account of the Primitive Treatment of Forests in Finland, including details of the practice of "Sartage" or "Svedjande" in Finland and adjacent lands, and Forms Assumed by the practice of other lands, followed by several chapters discussing the evils, merits, demerits and climatic effects of the practice in India, France, and Finland; Development of Modern Forest Economy in Finland; Forest Administration, Protection, and Exploitation; Forests and Forest Trees; Disposal of Forest Products, etc. III. Physical Geography, embracing chapters upon the Contour of the country, Geology, Fauna, Flora, and Climate.

The work is quite comprehensive, as this summary of its scope and contents shows, and its author has been very fortunate in reproducing in an attractive manner the results of his studies while on a vacation from his ministerial duties, a few months in the summer of 1879.

SEA-SICKNESS: ITS CAUSE, NATURE, AND PREVENTION. By Wm. H. Hudson. 16mo., pp. 147. S. E. Cassino & Co, Boston, 1883.

In this little volume the author presents a method by which, as he claims, the ocean traveler may secure immunity from sea-sickness without change in diet or aid of medicine. He asserts that this terrible affliction to most travelers is due wholly to violation of natural laws through ignorance of their true nature and that its prevention is possible to all by the use of correct principles, simple in themselves and easy in their application. The whole secret seems to be the yielding of the body to, instead of resisting, the motions of the vessel; complete relaxation of all the muscles and relinquishment of will. We, who have lived long in this region remember the horseback riding of the Mexican *vaquero*, his perfect abandonment to the action of the animal; this on shipboard results in perfect avoidance of sea-sickness, if our author is to be believed, and he speaks from an experience of thirty-five years. In addition to this the voyager's diet should be simple, his habits regular and his conscience as clear as possible. Many other suggestions are made, but the above are the principal ones and the first is the only one peremptorily insisted upon. The book can be read in an hour and it is well worth the attention of all who "go down to the sea in ships."

THE THEORY OF MORALS. By Paul Janet; translated by Miss Mary Chapman. Octavo, pp. 490. Charles Scribners' Sons, New York, 1883. For sale by M. H. Dickinson, $2.50.

The object of the author in this volume is to go back to first principles and to define precisely the fundamental ideas of morals and to proceed logically to a systematic and well connected exposition of them. It is apparently intended as supplement to the "Elements of Morals" published in 1869 by the same author, in which he presented the subject in an elementary form, adapted to the young, and divested of all metaphysical discussion and abstruse reasoning.

Professor Janet takes up the question at the germinal point, calls to his aid such authors as M. Jules Simon, M. Renouvier, M. Ferraz, M. Ad. Franck, Mme. C. Coignet, M. E. Wiart, M. Herrenschneider, all writers of distinction on the subject of Morals, adds to their elucidation the powerful light of his own intellect and develops a scheme which, as he modestly claims, contains some elements too much neglected heretofore, some untangled intricacies, some solutions of involved points and some suggestions for future investigators.

In setting forth he adopts the position of the philosopher, Schleiermacher, in resolving all moral ideas into three fundamental ones, viz: the idea of good, the idea of duty, and the idea of virtue, and takes this distinction, with a free interpretation, as the basis of his theory of morals. To show the course of reasoning in this primary statement we quote a few sentences: "These ideas may be said to follow each other and to be linked together in the following order: good, duty, virtue. Virtue indeed, according to the most generally accepted definition, consists in following one's duty, that is to say, in following that rule of action which our reason commands or advises. Duty, in its turn, consists in doing that which is good, it is the rule of action required of us by the practice of good. Thus virtue presupposes duty, and duty presupposes good. If there were nothing good, there would be no rule of action to teach us to choose one object rather than another, there would be no duty. If there were no duty or rule of action, there would be no virtue, that is to say, no enlightened choice between good and evil. Hence, an enlightened choice of good—that is to say, virtue—presupposes a rule of choice, or duty, which again presupposes a reason for the choice—that is to say, a good." Following this is a close discussion of the real definition of these three terms, resulting in the conclusion that "objective moral science will be the theory of good; formal moral science will be the theory of duty; subjective moral science will be the theory of morality or of virtue."

This is the basis of the whole work, and the remainder of the volume, say four hundred and eighty-five pages, is devoted to an examination and discussion of "the points of view first of those who consider, in moral science, nothing but the subject; second, of those who consider only the form of the object, i. e., the philosophy of pleasure; and the philosophy of duty." The ultimate theory unfolded in the discussion seems to be that "Morality leads to religion, which is simply belief in the divine goodness. If the world is not derived from good and does not go to good, virtue is a powerless chimera. *Practical* faith in the existence of God is then what Kant has called it, the postulate of the moral law."

This is a very weak and imperfect suggestion of the object and scope of the work, which must be carefully read to be fully comprehended, and the reader must be possessed of a truly philosophic mind to attain that full comprehension.

SEVEN SPANISH CITIES. By Edward Everett Hale. 12mo., pp. 328. Roberts Brothers, Boston, 1883. For sale by M. H. Dickinson, $1.25.

If readers of travels do not learn all that is desirable to be known about Spain soon, it will not be the fault of the authors and publishers. Within the past year or so, we have had "Spain and the Spaniards," by De Amicis, and "From the Pyrenees to the Pillars of Hercules," by Henry Day, besides other books, magazine articles and newspaper correspondence in abundance, and now Rev. Edward Everett Hale comes up with "Seven Spanish Cities," published by Roberts Bros., of Boston. The consolation in this special case, however, is that Mr. Hale is always sparkling and original, never dull or imitative. If he were to write a work on wood sawing it would doubtless be spicy and piquant to an high degree, while the truly American habit of seeing everything that others see, and a great deal more, would manifest itself openly.

This little work is the result of observations made during a few weeks' passage through Spain in May and June of 1883. There is very little of fact either in description or history that is new, but upon closing the book one has the impression of a new revelation. Madrid, Cordova, Seville, Saragossa, or Zoragoza, as he writes it, are all invested with a new interest. We have the facts as heretofore, but a kind of halo of freshness surrounds them, a play of fancy and humor, never wanting in any of Mr. Hale's efforts, that attract the reader and hold his attention to the work, even when other works on the same subject lie before him unread, or merely skimmed over.

It is presented by the publishers in a very neat and attractive style.

THE BOYS' AND GIRLS' PLUTARCH. By John S. White, LL.D. 8vo., pp. 468; Illustrated. G. P. Putnams' Sons, New York, 1883. For sale by M. H. Dickinson, $3.00.

Plutarch has been for more than 1600 years a source of information and inspiration to the students and writers of most nations and languages. He wrote more books than almost any other ancient author, and the same sprightly and attractive vein pervaded them all, while his accuracy is in most matters unquestioned.

The volume under consideration has been especially prepared by Professor White, long Head-Master of Berkeley School, for the use of boys and girls. It is most handsomely printed, bound, and illustrated by the publishers, and the subjects selected are well chosen, both for the entertainment and instruction of the readers for whom the work is intended. We select a few at random: Life of Theseus, Lycurgus, Solon, Themistocles, Demosthenes, Cicero, Alcibiades, Quintus Fabius Maximus, Cato, Alexander the Great, Cæsar, etc.; also comparisons of the lives of Theseus and Romulus, Demosthenes and Cicero, Alcibiades and Coriolanus; also descriptions of the Engines of Archimedes, the noble character of Caius Fabricius, the Death of Cæsar; with tables of weights and measures mentioned by Plutarch, a chronological table, and an index for reference as to the pronunciation of proper names, etc. There are forty-five illustrations, well selected and handsomely executed.

We know or no book more likely than this to be fully appreciated by boys and girls.

ENGLISH VERSE: Edited by W. J. Linton and R. H. Stoddard. Five volumes, 16mo., pp. 300 each. Chas. Scribner's Sons, New York, 1883. For sale by M. H. Dickinson, $1.00 per volume.

The volumes referred to above are: I. Chaucer to Burns; II. Lyrics of the 19th Century; III. Ballads and Romances; IV. Dramatic Selections; V. Translations. Of these but the first two have been published; the others are, however, to follow in rapid succession and all are promised by December 1st. Each volume contains as an introduction an essay by Mr. Stoddard on the period or class of English poetry which it covers. The poems of each author are grouped together, and at the end of each volume are brief biographical and bibliographical notes by the editors upon the poets represented in it.

The advantage of this collection over the many that have preceded it is that it covers more completely than any other, the whole field of English poetical literature. At the same time its division into five moderate sized volumes is a far more convenient arrangement than that of a single massive tome as is frequently the practice. The arrangement of clearly distinct subjects or classes by volumes and giving the poets chronologically in these volumes is an admirable one. All of the old familiar masterpieces are found, and many notable omissions of previous collections supplied, so that in comprehensiveness this will be unequaled, while the work of the editors, at home and abroad, in verifying the texts of the several authors has resulted in giving us an absolutely perfect and reliable edition. The notes added to many of the pieces will surprise the reader who has been accustomed to regard the ordinary versions as correct, by showing him numerous inaccuracies and abridgements in some of the most familiar poems.

Each volume is supplied with careful indexes of authors, poems and first lines. The paper, type, press-work and binding are good, and the price is unusually low.

HISTORICAL SKETCHES OF NEW MEXICO. By L. Bradford Prince. Second edition; 12mo., pp. 330. Ramsey, Millett & Hudson, Kansas City, Mo. For sale by The Kansas City Book and News Co.

No one is better prepared than Judge Prince to write a history of New Mexico, not only from his long residence in the Territory, but from his late position as its Chief Justice and as President of the Historical Society of New Mexico, as well as from his tastes and literary habits; but a complete history cannot be written by any one, from the fact that most of the records prior to 1680 were burned in the Pueblo Rebellion, many of those of more recent date were sold for waste paper by Governor Pile, and so lost or destroyed, and the remainder are unpublished and generally unavailable at present for the purposes of the historian.

In spite of these facts, Judge Prince has succeeded in working up a very valuable compendium and also in putting it into an attractive and readable shape; having consulted all of the leading authorities—both Spanish and American—for events long past, and having pressed into service most of the principal citizens of the Territory for information of value on its more recent history.

He divides the history of New Mexico into three epochs: the aboriginal or Pueblo, the Spanish, and the American, and devotes twenty pages to the first, about one hundred and eighty to the second, and nearly one hundred to the last.

Without going into particulars, we may say that the whole book will be found intensely interesting, especially to the people of the western portion of the United States, who have had so close an intercourse with the country and its peculiar people for the past fifty years or more.

OTHER PUBLICATIONS RECEIVED.

The State University: Its Work and Its Place in the Public School System, J. A. Lippincott, LL.D., Chancellor Kansas State University, pp. 17. The *Homiletic Monthly*, November, 1883, Vol. VIII, No. 2; I. K. Funk, D. D., Editor, 64-pages, monthly, N. Y., $2.50. Report of the Department of Health, City of Chicago, 1881–2, pp. 177. Annual Report of the Commissioner of the Genera Land Office, 1883, Hon. N. C. McFarland, Commissioner. *Welcome Tidings*, Vol. II, No. 3, Rockford, Ill., E. F. Golden, Editor, $1.00 per annum. On Some Phosphides of Iridium and Platinum, Prof. F. W. Clarke and O. T. Joslin, Laboratory of University of Cincinnati. Village Committees of Cape Anne and Salem, by Herbert B. Adams, Ph. D., pp. 81. *Young Scientist*, Vol. VI, No. 10, edited by John Phin and F. T. Hodgson, New York, monthly, $1.00. Report from Consuls of the United States on Commerce, Manufactures, etc., of their Consular districts, No. 32, August, 1883, pp. 414. *Scientific and Literary Gossip*, Vol. I, No. 12, October 15, 1883, S. E. Cassino & Co., Boston, 50c per annum. *Journal of Progress*, Vol. I, No. 1, October, 1883, edited by J. H. Bently, Philadelphia, Pa., 60c per annum. *V. P. Journal*, Vol. I, No. 1, edited and published by James Elliott, Cobourg, Ont., $1.00 per annum. The *Bio-*

graphical Magazine, November, 1883, New York, $1.00 per annum. *The Manufacturer*, Toledo, O., Vol. I, No. 1, $1.00 per annum, Chas. Reed, Editor and Publisher.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Paper Electric Insulator.—An Electric Insulator is now constructed of paper-pulp. Liquid silica, or silicon, is used as a cementing agent, and when these constituents are combined in proper proportion, a superior insulator is produced, covering at once, all the ground heretofore almost monopolized by the different forms of glass. This improvement is the subject of a patent recently granted to Charles C. Hinsdale, Cleveland, Ohio.

Extension Step-Ladder.—A very convenient device in step-ladders, has the front and rear stiles longitudinally slotted, each adapted to slide respectively one upon the other. The lower stiles have hinged brace-rods provided with pins which slide in the slots of the inner or upper stiles. There are also spring catches which secure the parts in their places after adjusting the ladder to any desired height. Patented by Messrs George A. Bell and W. W. Norman, Morley, Mo.

Apparatus for Oiling Engine Cylinders.—A very simple apparatus for lubricating the cylinders and valves of engines has been lately developed by Mr. J. G. Donnenworth, of Browning, Mo., of which the main features are,—a hollow piston-rod having the usual outward form and connections provided with a common oil-cup located upon that portion not entering the cylinder or valve-chest. In contemplating this method of oiling the interior surfaces of cylinders and valves, one cannot have other feelings than those of admiration for the striking exhibition of originality displayed by the inventor, in adapting so few and simple means to accomplish an end now considered by the best authorities one of the most important and difficult, connected with the successful operation of the steam motors of to-day.

Locomotive Chair for Invalids.—There is a chair for invalids which introduces some novel and useful features and for which Mr. George Arbogast, of Chicago, Ill., has recently received a patent. It consists essentially of a chair having one small rear wheel hung upon a swivel and two larger front guide- or driving-wheels and a hinged and vertically-slotted back, arm-rests adjustably secured at their rear ends to the said back by set-screws, slotted brace-bars pivotally fastened at their upper ends to the arm rests and adjustably connected at their lower ends by thumb-screws to the lower end of the back, and there is also a leg-rest pivoted at its upper end to the arm-rests. Rising vertically to a convenient height from the front axle, to which their lower ends are secured, are two hand-crank standards, mounted in the upper ends of which are two hand-crank wheels. Power is communicated to the driving-wheels through the medium of a chain which connects the crank-wheels with spracket- or gear-wheels upon the driving axle, having spurs or cogs adopted to mesh with the links of the chain.

Improvements in Sugar Manufacture.—An improved method of manufacturing sugar from sorghum, maize and sugar-cane, has been patented by Mr. O. B. Jennings, of Honey Creek, Wis. In the manipulation of sorghum and southern cane, as anticipated by Mr. Jennings, in his specifications, the cane is reduced by a grinding or other process to a dust-like fineness, thereby thoroughly rupturing the juice-cells. And for carrying out this particular process, there is described in the invention an apparatus consisting of numbers of circular-saws for reducing the cane to a proper degree of fineness. Afterwards sprinkling or mixing before defecation, a quantity of dry lime or lime whitewash powder with the finely divided cane, then subjecting the material to a temperature of not less than 212° F. but an average of from 228° F. to 267° F. according to the ripeness. The juice is then removed from the precipitated or woody matter, by washing with water for which vessels and appliances of special adaptation are brought into use.

Speed Gauge for Locomotives.—A gauge or speed recorder to be applied to railway trains has been invented upon entirely new principles by Mr E. R. E. Cowell, of Detroit, Mich. There is a small glass tube used in connection with a receptacle filled with oil and in which a small propeller-wheel is driven at a speed corresponding to that of a predetermined wheel of the engine or car. The device is connected to the car-wheel by a narrow gear-wheel on the axle, meshing into another having attached a flexible shaft leading up to the position assigned the device in the engine-cab. The connection is made to one of the forward truck-axles, as its wheels having no brake do not slide upon the rails. By the use of a device of this nature the engineer has at all times in front of him, the exact speed in miles per minute or hour the train is making, whether the time be daylight or a dark and foggy night, hence he need make no suppositions as to the rate of speed or disobey orders as to speed through unavoidable ignorance. By the successive application of such simple and economical safety apparatus, and by discarding such devices as are no longer considered useful, we shall be led upward step by step until in the near future a locomotive engine will not be considered complete without them.

AN ELEMENT OF FRENCH LITERATURE.

E. RANDALL KNOWLES.

France has a literature so widely divergent in its aspects that we can hardly criticise it as a symmetrical unit. In the spheres of philosophical and purely scientific literature it has not a peer among modern nations. But the very quality which raises it to such a height in these departments debases it in others. The logical frame of the French mind, while absolutely essential in scientific investigation and speculative philosophy is the bane of French poetry. Because the French use the finest logical precision in all scientific research, they are naturally inclined to transplant it to the realm of poetry, where imagination, bodying forth things unknown, should not be governed by the laws of formula or syllogism.

The classical poetry of France will live preserved in the most sacred archives of the national institutions; but it can never become cosmopolitan simply because it has not those affinities with human nature which can break it away from local associations. Racine struggled to liberate himself from the bondage of his own logical inclinations. We cannot but believe that it was the ambition of his life to bequeath to literature, in the portraiture of some of his characters, a legacy of true universal life. But in his constructions he is tethered by a chain which holds him near his starting point. His original conceptions are vivid. They are ofttimes the outgrowth of the profoundest genius, but when we view the lights and shades of the finished painting, we are convinced that it falls far short of the poet's ideal. We are not carried on with the sweep of events until we find ourselves undergoing the same mental transformations, sympathizing with all the moral struggles of the actor, but we are constantly admiring the beauty of the imagery, the musical rythm of the verse. In short we are admiring, not the production but the Racine himself.

Perhaps the most effective manner of representing the difference between the French and English schools of poetry is by a comparison of the prime sources. The rich contrast between the ancient Sagas and Eddas of the North, and the Troubadour poetry of the South exists to-day, though softened by time, between the poetry of the two nations. We do not say that these old poems are absolutely typical. They embody only the strongest features. The former was the product of barren, frozen Scandinavia; the latter sprang from the vine-clad hills and blooming vales of France. The one abounds with brutal passion, ignoble instincts, sublime moral struggles. The other deals with lighter themes. The burden of its song is but the inspiration of surrounding scenery. The delicate tracery of nature, the gentle breezes of the dales, the sweet songs of birds, have been transferred into the music of verse. Naturally, therefore, the prevailing characteristic of the poetry is harmony of structure, logical order, outward symmetry, everything that ministers to the æsthetic taste and delights the senses.

The poet has not launched out into the great deep of human life to discover its boundaries and sound its depths. This species of literature, which flourished in Provence and Normandy from the eleventh to the thirteenth century, followed a tendency which has been developed into a settled literary doctrine in France. The poetry of Matherbe and of Lamartine, though separated by two centuries and a half, does not display only the characteristics of their authors, but the thread of French nationality runs through them all. They have come from that loom which has gathered out of the very centres of French life its love of the beautiful, the histrionic, the superficial, as also the speculative, the scientific, the logical, and woven them into a woof and warp so paradoxical and so diversified that the world offers no parallel. The power of analysis, the delineation of the subtle passions, that probing to the core of the instincts and emotions which convulse the soul, do not thrive in the French mind. They are exotics if they exist at all. Men do not talk as Frenchmen represent them. The poet is not true to nature. Passion welling up from the human heart never vents itself in studied speeches or measured climaxes. That electric current of sympathy which runs through the hearts of English poets and their readers is here broken at the outset. It is impossible, by the very constitution of French genius, to scale the heights of spiritual thought attained by Milton, or to give to weak and erring men the heroism, strength and intellect that is depicted by Shakespeare, or to clothe the elements with those weird and fantastic forms which abound in Dante's Inferno.

Nevertheless, the predominance of the reasoning faculty has a grand purpose to effect. True, in poetry, thought has been sacrificed to style, yet the result is that France can proudly boast of a language so clear and forcible in its diction that it has become the medium of diplomacy, the interpreter of philosophy and the pioneer in scientific research, and it is just in these departments that Europe has yielded France the scepter. So far as truth is attainable by logic, so far as French thinkers can mount from some established dogma or hypothesis to height after height in the search for first principles, they hold undisputed sway. But beyond this they are totally unreliable.

When they have entered that mysterious unknown equipped only with their own poor reason, they find themselves either stricken with impotence or reduced to the alternative of becoming egotists and skeptics. How else shall we account for the long roll of French skeptics from the days of Abelard down to the present time? They have been slow to believe by intuition. Those great truths which our natures attest as being something mightier than all reason, nay, as the very part and parcel of the Divinity Himself, they attempt to reach by rational processes. Thus they have become rebels against their own consciences, and antagonists to the highest truths of Christian philosophy.

COMPARISON OF STRENGTH OF LARGE AND SMALL ANIMALS.

W. N. LOCKINGTON.

M. Delbeuf, in a paper read before the Academie Royale de Belgique, and published in the *Revue Scientique*, reviews the attempts of various naturalists to make comparisons between the strength of large animals and that of small ones, especially insects, and shows that ignorance or forgetfulness of physical laws vitiates all their conclusions.

After a plea for the idea, without which the fact is barren, M. Delbeuf repeats certain statements with which readers of modern zoölogical science are tolerably familiar, such as the following: A flea can jump two hundred times its length; therefore a horse, were its strength proportioned to its weight, could leap the Rocky Mountains, and a whale could spring two hundred leagues in height. An Amazon ant walks about eight feet per minute, but if the progress of a human Amazon were proportioned to her larger size, she could stride over eight leagues in an hour, and if proportioned to her greater weight, she would make the circuit of the globe in about twelve minutes. This seems greatly to the advantage of the insect. What weak creatures vertebrates must be, is the impression conveyed.

But the work increases as the weight. In springing, walking, swimming, or any other activity, the force employed has first to overcome the weight of the body. A man can easily bound a height of two feet, and he weighs as much as a hundred thousand grasshoppers, while a hundred thousand grasshoppers could leap no higher than one—say a foot. This shows that the vertebrate has the advantage. A man represents the volume of fifteen millions of ants, yet can easily move more than three hundred feet a minute, a comparison which gives him forty times more power, bulk for bulk, than the ant possesses. Yet were all the conditions compared, something like equality would probably be the result. Much of the force of a moving man is lost from the inequalities of the way. His body, supported on two points only when at rest, oscillates like a pendulum from one to the other as he moves. The ant crawls close to the ground, and has only a small part of the body unsupported at once. This economizes force at each step, but on the other hand, multiplies the number of steps so greatly, since the smallest irregularity of the surface is a hill to a crawling creature, that the total loss of force is perhaps greater, since it has to slightly raise its body a thousand times or so to clear a space spanned by a man's one step.

By what peculiarity of our minds do we seem to expect the speed of an animal to be in proportion to its size? We do not expect a caravan to move faster than a single horseman, nor an eight hundred pound shot to move twelve thousand eight hundred times farther than an ounce ball. Devout writers speak of a wise provision of Nature. "If," say they, "the speed of a mouse were as much less than that of a horse as its body is smaller, it would take two steps per second, and be caught at once." Would not Nature have done better for the mouse had she suppressed the cat? Is it not a fact that small animals often owe their escape to their want of swiftness, which enables them to change their direction readily. A man can easily overtake a mouse in a straight run, but the ready change of direction baffles him.

M. Plateau has experimented on the strength of insects, and the facts are unassailable. He has harnessed carabi, necrophori, June-beetles (Melolontha) and other insects in such a way that, with a delicate balance, he can measure their powers of draught. He announces the result that the smallest insects are the strongest proportioned to their size, but that all are enormously strong when compared, bulk for bulk, with vertebrates. A horse can scarcely lift two-thirds of its own weight, while one small species of June-beetle can lift sixty-six times its weight: forty thousand such June-beetles could lift as much as a draught-horse. Were our strength in proportion to this we could play with weights equal to ten times that of a horse, while an elephant could move mountains.

This seems, again, great kindness in Nature to the smaller animal. But all these calculations leave out the elementary mechanical law: "What is gained in power is lost in time." The elevation of a ton to a given height represents an expenditure of an equal amount of force, whether the labor is performed by flea, man or horse. Time supplies lack of strength. We can move as much as a horse by taking more time, and can choose two methods—either to divide the load or use a lever or a pulley. If a horse moves half its own weight three feet in a second, while a June-beetle needs a hundred seconds to convey fifty times its weight an equal distance, the two animals perform equal work proportioned to their weights. True, the cockchafer can hold fourteen times its weight in equilibrium (one small June-beetle sixty-six times), while a horse cannot balance nearly his own weight. But this does not measure the amount of oscillatory motion induced by the respective pulls. For this both should operate against a spring.

A small beetle can escape from under a piece of cardboard a hundred times its weight. Pushing its head under the edge and using it as a lever, it straightens itself on its legs and moves the board just a little, but enough to escape. Of course, we know a horse would be powerless to escape from a load a hundred times its own weight. His head cannot be made into a lever. Give him a lever that will make the time he takes equal to that taken by the insect, and he will throw off the load at a touch. The fact is that in small creatures the lack of muscular energy is replaced by time.

Of two muscles equal in bulk and in energy the shortest moves most weight. If a muscular fiber ten inches in length can move a given weight five inches, ten fibers one inch long will move ten times that weight a distance of half an inch. Thus smaller muscles have an absolutely slower motion, but move a greater proportional weight than larger. The experimenter before mentioned was surprised to find that two grasshoppers, one of which was three times the bulk of the other, leaped an equal height. This was what might be expected of two animals similarly constructed. The spring was proportioned to the bulk. In experiments on the insects with powerful wings, such as bees, flies, dragon-flies, etc., it was found that the weight they could bear without being forced to descend was in most cases equal to their own. In some cases it was more, but the inequality of rate of flight, had it been taken into the reckoning, would have accounted for this.

Take two creatures of different bulk but built upon exactly the same plan and proportions, say a Brobdignagian and a Lilliputian, and let both show their powers in the arena. Suppose the first to weigh a million times more than the second. If the giant could raise to his shoulder, some thirty-five feet from the ground, a weight twenty thousand pounds, the dwarf can raise to his shoulder, not, as might be thought, a fiftieth of a pound, but two full pounds. The distance raised would be a hundred times less. In a race the Lilliputian, with a hundred skips a second, will travel an equal distance with the giant, who would take but a skip in a second. The leg of the latter weighs a million times the most, but has only ten thousand times as many muscle fibers, each a hundred times longer than those of the dwarf, who thus takes one hundred skips while the giant takes one. The same physical laws apply to all muscles, so that, when all the factors are considered, muscles of the same quality have equal power.—*American Field.*

EDITORIAL NOTES.

THE recent trip to Memphis over the newly finished Kansas City, Springfield & Memphis Railroad was exceedingly instructive and entertaining to all who participated in it. That portion of the line southeast from Springfield was a *terra incognita* to nearly all of the party, and its mountain scenery, its wealth of timber and mineral, its limpid streams, and even its cypress swamps and cane-brakes near the Mississippi River, were a source of surprise to them.

Memphis itself, historic from the succession of its disasters by flood and field, pestilence and hard times, is now a proud monument to the energy and wisdom of its citizens. Her permanently paved streets, admirable system of drainage, immense cotton trade, numerous and extensive manufactories, radiating lines of railroad and crowded levee, all evince a solidity and permanency of growth and condition which were as unexpected as they were gratifying to the visitors. It is too late to give any details this month, but we hope to do so in our next issue.

The hospitality and courtesies of both railroad company and citizens of Memphis were boundless, and all who enjoyed them are now wondering how the people of this city can fittingly return them.

WE expected to publish a full account of the proceeding of the Kansas Academy of Science at its meeting in November, but did not receive the report in time for this number of the REVIEW. The meeting was unusually well attended by the members and the papers read exceptionally good. We hope to give some of them in full next month.

The new officers are Dr. R. J. Brown, President; Prof. F. H. Snow and Joseph Savage, Vice-Presidents; Prof. E. A. Popenoe, Secretary; Dr. A. H. Thompson, Treasurer; Profs. O. H. St. John, J. H. Carruth, and J. T. Lovewell, Curators.

THE Kansas City Academy of Science at its regular meeting the last Friday in November, listened to a masterly address by the well known engineer, Octave Chanute, Esq., upon the Sewerage of Kansas City—Present and Future, with especial reference to its sanitary and economic aspects. As the REVIEW was then in press we were compelled to postpone any notice until next month.

THE Third Biennial Session of the Kansas State Social Science Club was held in Topeka, November 8th and 9th, with 150 ladies in attendance. The report of the Treasurer shows receipts, $71.22; expenses, $27.10,—leaving a balance on hand of $44.12. Papers were read as follows: By Mrs. Judge Humphrey, of Junction City—"Legal Status of Married Women;" by Miss S. A. Brown, of Lawrence—"Ethics of Schools;" by Mrs. Judge Safford, of Topeka—"The Flower Mission;" by Mrs. B. F. Mudge—"Rudimentary Studies of Nature for Children" read by Mrs. Atwood, of Manhattan, in Mrs. Mudge's absence; by Mrs. J. N. Simpson, of Lawrence, and Mrs. Major Hopkins, of Leavenworth, on "Prehistoric America;" by Mrs. Ruth M. Wood, of Leavenworth, on "Physio-Pathological Basis of Mental Culture;" by Mrs. T. D. Thacher, of Topeka, on "Home Decoration;" by Mrs. Wilder, of Manhattan, on "Domestic Services;" and by Mrs. J. K. Hudson, on "Literature for Children." In the evening a grand reception was tendered the Club by the citizens of Topeka, at the Library Hall, where the sessions were held. The Association decided to hold its next meeting in Kansas City.

SINCE our last issue Doctor Marion Simms, in this country, and Prof. C. W. Siemens, of England, have died, both eminent in their respective professions, and both apparently in the midst of their usefulness.

HAVING recently purchased a set of geological specimens from Professor S. H. Trowbridge, of Glasgow, Mo., and found them exceedingly satisfactory, we take pleasure in recommending him to others who may need such or any kind of natural history specimens for their own cabinets or for those of any school, college, or society. Professor Trowbridge was for many years a teacher of natural science, and his experience is worth a great deal to him in collecting and making up suitable sets for special purposes.

JOHN F. SHORT, late Professor of History and Philosophy in the Ohio State University, died on November 11th at Columbus. He was author of "North Americans of Antiquity" and numbers of leading histories of this country and Europe.

SOME remarkable ruins have been discovered in Tunis by Lieut. Massenet, who has been dispatched on an archæological mission in the neighborhood of Bograra and El Kantara, in the Gulf of Gabes. The exact spot of the discovery is near Fabella and El Kantara, to the south of the Island of Djerba, and it is believed from the importance and extent of the ruins that they form what was once the capital of the island, many years before the Christian era. The sight is said to be most impressive. The remains of a great temple—from its form presumably dedicated to Zephyr—have been brought to light near the seashore. They are of marble, and of singular architectural richness, composed in parts of huge blocks measuring more than fifty square yards at their base. Immense columns of red and green marble form the eastern entrance, and there is a square inclosure surrounded with white marble friezes, supported by twisted columns.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Atlantic Monthly*, for December, presents the following attractive table of contents: A Roman Singer, XI., XII., F. Marion Crawford. Mary Moody Emerson, Ralph Waldo Emerson. The Initiate, A. F. Recollection of Rome during the Italian Revolution, III, William Chauncy Langdon. O-Be-Joyful Creek and Poverty Gulch, H. H. The World Well Lost, Edmund C. Stedman. Newport, XII-XIV, George Parsons Lathrop. Bermudian Days, Julia C. R. Dorr. Some Alleged Americanisms, Richard Grant White. Luther and His Work, Frederick H. Hedge. Social Washington, Henry Loomis Nelson. Mr. Longfellow and the Artists. Foreign Lands. Recollections of a Naval Officer. Recent Poetry. The Contributors' Club. Books of the Month.

Harper's Magazine for December is a Christmas Number, with an extraordinary wealth and variety of papers, poems, and pictures, by an array of authors and artists (American and English) seldom, if ever, brought together before. This will take the place of the mammoth *Harper's Christmas* of 1882, which will not be repeated this year.

The Number has four extra plates, in addition to its usual 160 well-filled pages. The illustrations alone have cost, it is stated, over $10,000.

The Number opens with a charming Christmas title-page, drawn by Dielman, the artist of "A Girl I Know," in which pretty pictures of Santa Claus and his reindeers and of the Christmas waits are united by a wreath of Christmas holly.

The opening paper is by George William Curtis, the first distinctive article outside of the *Easy Chair* that he has written for years. It deals with "Christmas," old and new, and particularly with how the Pilgrim Fathers declined to celebrate it.

The poet, Whittier, contributes a most worthy and beautiful Christmas poem, "The Supper of St. Gregory," illustrated by F. S. Church.

The Editorial Departments are as bright as usual; the *Drawer* has a pleasant introductory Christmas bit from the pen of Charles Dudley Warner, and several illustrations.

The Publishers announce that this notable Number (in which nothing is continued over from the volume just finished) is but the beginning of a series "unexampled in magazine literature."

As *Harper's Monthly* begins its volumes with the December number, now is the time for our subscribers to avail themselves of our clubbing offer made elsewhere in this issue.

Popular Science Monthly for December offers the following literary and scientific feast: Alexander Von Humboldt, by Emil du Bois-Reymond, (with portrait). Suggestions on Social Subjects, by Professor W. G. Sumner. The Habitation and the Atmosphere, by M. R. Radau. A Belt of Sun-Spots, by Garrett P. Serviss, (Illustrated). The Morality of Happiness, by Thomas Foster. Genius and Heredity, by M. E. Caro. The Remedies of Nature.—Enteric Disorders, by Felix L. Oswald, M. D. Land-Birds in Mid-Ocean, by George W. Grim. The Illusion of Chance, by William A. Eddy. Female Education from a Medical Point of View, by T. S. Clouston, M. D. The Chemistry of Cookery, by W. Mattieu Williams. Vinous Superstitions, by Dr. Th. Bodin. Malaria and the Progress of Medicine. The Loess-Deposits of Northern China, by Frederick W. Williams. The Natural Setting of Crystals, by J. B. Choate. Surface Characters of the Planet Mars. The New Profession, by Henry Greer. Concentric Rings of Trees, by A. L. Child, M. D. Correspondence: Human Foot-Prints in Stratified Rock, Asthma and its Treatment, Animal Friendships. Editor's Table: Dead-Language Studies Necessarily a Failure, Queer Defenses of the Classics. Literary Notices. Popular Miscellany. Notes.

THE *Popular Science News*, formerly known as the *Boston Journal of Chemistry*, is now publishing from month to month in addition to its ordinary full scope of articles, a series of sketches of the lives of eminent chemists (with portraits), such as Sir Humphrey Davy, Cavendish, etc.

THE KANSAS CITY REVIEW.—The Novemver number of that very able journal is received, and its table of contents shows that it is full of very interesting matter. The REVIEW has reached its seventh number of its seventh volume. We take it that but few people, and probably not its projector who still continues at its head, Col. Case, expected seven years ago to make it a success. But he has gone along adding to its attractions every month, and whether it has paid financially or not, it has paid the reader hundred fold in a thousand ways. Send T. S. Case, at Kansas City, $2.50 and secure it for a year, and our word for it you will never regret it.—*Topeka Commonwealth.*

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KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VII. JANUARY, 1884. NO. 9.

PROCEEDINGS OF SOCIETIES.

THE SEWERAGE OF KANSAS CITY.[1]

O. CHANUTE, C. E.

The importance of the selection of an adequate system of sewerage and drainage upon the health and fortunes of a city, cannot well be overestimated. Not only does it involve the expenditure of vast sums of money, but more precious still, the welfare and health of the citizens depend upon the wisdom of the selection, and errors once committed are, if not impossible, at least very difficult to correct. Indeed, the more the subject is considered thc more its importance grows upon the mind of those who, like the audience that I now see before me, are interested in the prosperity of the city. I therefore hope that what I have to say shall be critically received, so that whatever is sound may result in good, and whatever may be erroneous shall be eliminated.

Nearly two years ago, upon a very brief visit to Kansas City, and before I had come back to reside among you, I became aware that it was proposed to adopt what is known as the "combined system" of sewerage. I thought that this would prove to be a mistake, and feeling a great interest in the welfare of the city, I asked a few citizens and the reporters of the public press to meet me one evening, when I laid before them chiefly what others had said upon the subject of sewerage, and upon the dangers to health of an improper selection. I endeavored to point out that not only would the "combined system," so called, be

1 Read before the Kansas City Academy of Science, Friday evening, November 30, 1883.

very much more expensive than what is known as the "separate system," but that if we judged by the experience in other cities, it would also largely increase what physicians call "zymotic" diseases, such as typhoid, diphtheria, scarlet fever, etc., a class of diseases from which Kansas City had hitherto been happily remarkably free, and which are supposed to be produced by imperfect ventilation and drainage, and especially by the exhalations of large sewers.

At that time there were, if I remember rightly about four and a half miles of sewers in the city, while at the present time there must be over twenty miles, so that enough has been done in the meantime to give us some data by which to form a judgment as to the soundness of the reasoning which was then advanced, and if we distrust the experience of others, at least to give us some experience of our own.

Since my return to Kansas City I have been endeavoring to inform myself as to what the facts really are, and I find that there is a general impression that the city is not as healthy as it was in the early days of its history. I have been informed by some of the leading physicians, that there has been an increase in zymotic diseases (the much dreaded scarlet fever, typho-malaria and diptheria), and that they show a marked difference in type from the same diseases as they existed in the days before sewers; but that in few cases only have they been traced directly to the effect of the sewers, or to defective plumbing. Other physicians again, while admitting an increase in zymotic diseases, attribute it to the increase of population, or to the turning up of the soil while carrying on public improvements in various parts of the city.

As vital statistics have been kept here much too short a time to permit of any comparisons being made, or to form the basis for an actual demonstration of the effects of the sewers, I must abstain now from making a positive statement upon this branch of the subject, but I hope that the physicians of the city, who, both from their experience and scientific training, are the persons best fitted to reach sound conclusions on this subject, will favor us with their opinions, and with the actual facts occurring within their knowledge.

Upon one point, however, I believe all persons are agreed, and that is, that with a separate system of sewers in which the house refuse shall be confined by itself in small pipes, daily flushed for their whole length by automatic means, there would be no chance for the development of the so-called sewer gas, and no danger of infection from that source. All believe, therefore, that whether the "combined system" is really as dangerous as has been represented by sanitarians elsewhere or not, the "separate system" would certainly be safer.

This brings us to consider in what respects these two systems differ from each other, and why the one should be thought to be unhealthy, while the other is admitted to be safe. Some persons seem to have an idea that the subject is intricate and mysterious; that the two systems differ in the same way as do two complicated designs for different purposes, or two plans for some intricate machine. In point of fact, however, no subject is simpler or more easily understood, and the only difference in principle between the two systems, is that in the "combined system" the water, which comes from the occasional rains, the "storm-water," so called, is admitted into the sewers, along with the house refuse, while in the "separate system" the house refuse alone is carried away by one set of pipes (which are daily flushed), while the "storm-water" is carried away partly in open gutters, and partly (whenever it accumulates to such an extent as to cause annoyance) by another set of underground sewers.

This is all the difference there is in principle between the two systems, but this difference, simple as it is, involves several important consequences.

The first is that the large sewers, in the combined plan, have to be carried along of the full great size required by the storm-waters, under every portion of the district to be drained, instead of being confined as in the separate system, to those short sections where the "storm-water" accumulates enough as to prove objectionable. It will readily be understood that this will largely add to the expense; for once the "storm-water" and house refuse are mixed together in a sewer, we no longer dare to admit them to the light of day, until they are clear of human habitations.

The second consequence is that the combined sewers must be made large enough to pass at the same time both the "storm-water" and the daily sewage, and the further consequence is that during at least nine-tenths of the time (for I do not suppose that in this climate it rains anything like one tenth of the time) the sewers are not more than one-twentieth full, while on the other hand they are not unfrequently overtaxed during the remaining one-tenth of the time, by our semi tropical rains.

It may be questioned here in passing, whether the peculiarities of the climate of Kansas City have been taken sufficiently into account, in carrying out the system of combined sewers. They are proportioned as I understand it, upon the rule of allowing for a rainfall upon the drained district, at the rate of one inch per hour. This is an English rule, and a very proper one in that climate, where it rains nearly every day, but seldom violently. Here, where for weeks and perhaps months, we sometimes do not get a drop of rain, and where, when it does come, it sometimes pours down three or even four inches in an hour, sewers proportioned by the English rule may prove both too large and too small—too small to carry off the occasional semi-tropical shower, and too large, much too large, to be properly ventilated through the openings which it is practicable to make.

The result necessarily must be that during at least nine-tenths of the time, the Kansas City sewers will be nineteen-twentieths full of noxious gases, which physicians tell us are dangerous to life. We may, perhaps, keep these gases out of our houses by perfect plumbing, but to me it seems far wiser to prevent their production, by breaking away from tradition and adopting what I consider as a more appropriate and rational system of sewerage for this city.

It must however be admitted, that at first consideration the combined system of sewers seems a perfectly plain, obvious and sensible method to adopt. There is a certain amount of house refuse or sewage and a certain amount of storm-water to be carried off, and what can be more obvious than to provide one single sewer to do it all. We have been laughing for a good many years at the Pennsylvania Dutchman who cut two holes in his barn door, one for the cat and the other for the kitten, and we may fancy that we would be equally the objects of ridicule if we were to imitate his conduct in planning our sewers.

I hold, however, for myself, that the Dutchman was right in cutting the two holes, if it was necessary that the cat and kitten should go into the barn at the same time, and that is precisely what occurs when we have a rain storm. The storm-water has to be taken care of, and the house sewage has to pass through the sewers at the same time.

Moreover the combined system has all the weight of precedent and all the prestige of great antiquity. It is more than 2,000 years since men have been building sewers, and it is natural that when modern engineers tell us that the storm-water and house refuse should be separated, we should hesitate to innovate upon what we suppose to be a venerable practice, sanctioned by the experience of so many centuries.

I confess that in my own case, when the subject first came to my notice, some three years ago, I questioned seriously whether the proposition did not contain somewhere a fallacy—whether in course of time some hidden defect would not be discovered in the separate system which would result in its abandonment.

In point of fact, however, we are not now using our sewers as did our ancestors, and the combined system is really of modern origin. Sewers were originally built for storm-water alone, at those points where it became a nuisance, and what we now consider as sewage proper went into cesspools, to be periodically removed by hand. In England it was illegal to use the sewers for household purposes up to 1815, and it was only in 1847 that the latter use was made compulsory. The result of this combination has been so unsatisfactory that the English sanitarians and engineers have been experimenting with all sorts of devices to obviate or mitigate the evils thus created. In France it is still the rule that sewers shall serve for storm-waters alone, and a distinguished French engineer, M. Lavoinne, in giving recently an account of the Memphis systems of sewers, says: "It is to be noted that the system which we have described, is precisely the reverse of that which is generally practiced in France, where the principal office of the sewers is to carry off storm-waters, and where they are made large enough to be traversed by the workmen who are to clean them. Moreover, in Memphis the system is connected with all the house closets, the solid product of which is generally with us excluded from the sewers."

This matter has created a great deal of interest in France, and to give a better idea of the positions taken by French engineers, I will read the following translation of Engineer Lavoinne's conclusion upon the subject, to wit: "The immediate disposal of all excreta, whether liquid or solid, coming from dwelling houses, is evidently the best method of guarding against danger, from a sanitarian view. If their disposal is made through a sewer of sufficient section to pass both these excreta and the storm-waters, it will be subject to all the variations which may result from the intermittency of the storm-water, which will generally run too slowly to carry away the solid matters, unless indeed a sufficient volume of water can be artificially obtained to flush the sewers or even to provide a constant subterranean current of water, more or less clean.

"The establishment of a special outlet for the offensive matters alone, the volume of which varies but little, in order to insure their speedy disposal under conditions peculiarly appropriate to their volume and nature, not only possesses the advantage of much better satisfying the demands of sanitation, but it admits of a much better use of flushing waters, by avoiding the admixture of a portion of water, which is often unnecessary, and which sometimes has to be carried away a considerable distance at great cost in get rid of it, solely because it has been contaminated by sewer-water.

"In the large sewers of our most populous towns, and in which the water-supply pipes are generally attached, the insertion of other pipes, for the purpose of carrying sewage alone, and communicating by branches with dwelling houses, seems a satisfactory solution, in consequnce of the small sizes required, of the problem of the drainage of cesspools, which it is still dreaded in France, notwithstanding the examples of neighboring countries, to connect with the public sewers. The expense of the special pipes to be introduced into the houses would be more than offset by the expense of periodically cleaning the cesspools, frequently to the detriment of the public health; and by the elimination of the permanent dangers of infection, which the decomposition of the decayed matter presents."

Living as we do in a new country, we do not realize how modern, (nor how great, comparatively), are the conveniences which surround us in our houses. Nor do we realize how these conveniences affect the plans which were found sufficient by our ancestors. For instance, in a treatise on hydraulic engineering, published in 1858 by an English engineer, I find it stated that it was but a few years since the supply of water to private consumers was effected in all countries upon what is called the intermittent system, and that the constant, "high pressure" system, which is the only one we know in this country, was considered as an innovation which was not free from objection, on account of the resulting waste.

Now it is doubtless a great convenience, one with which we would not part for any consideration in this country, to put water on tap in nearly every room of our modern houses, but it results in cutting an equal number of openings to the sewer; and every stationary wash-bowl, bath or closet opens the way for the entrance of sewer gas: while the men who less than a century ago combined storm-water and domestic refuse in the same sewers, had one, or at most two such opening to guard in their houses, and in the majority of cases none at all, as the water was drawn from some hydrant in the yard, and the slops emptied by hand in some out-door sink.

It is evident that these multiplied openings to the sewers must prove increased sources of danger if gases are allowed to be generated, and that when storm-waters are admitted to the sewers, the hydraulic ram resulting from a flood, must produce pressure in the sewers, and drive the gas into the houses. These difficulties and dangers connected with a combined system of sewerage seems to have been recognized in England soon after their introduction, which, as already stated, dates from about 1815, for in in 1842 Mr. Edwin Chadwick, an eminent sanitarian, proposed and advocated a separate system of sewerage which has since been supported by many eminent engineers, upon sanitary grounds. This separate system has been successfully introduced in several English towns, and that it has not been more rapidly adopted is probably due to one imperfection in the system as carried out in England, which results from the introduction into those sewers which carry off household waste of a part of the storm-waters, that which falls upon the roofs and yards, (while that which falls upon the streets is rigidly excluded) for the purpose of flushing and cleaning the sewers.

It was reserved to an American sanitary engineer, Mr. Geo. E. Waring, Jr., to finally perfect this separate system of sewerage, by excluding all of the storm-water, which latter cannot be relied upon to flush the sewers regularly, and substituting therefor an automatic flush tank, which, filling itself slowly by a spigot from the water supply, discharges itself suddenly and flushes the sewers once or twice in twenty-four hours, as may be desired.

I will not take up your time with a description of the separate system, to which the name of Mr. Waring has been justly attached. This description has been so often given by the public prints that you must all be familiar with it; but I will say that as carried out at Memphis by Mr. Waring, it is less a new invention (about the permanent efficacy of which there might then be some question) than an outgrowth and combination, made with great good judgment, of several excellent features that had been previously tried and been successful.

Many of you have very recently been in Memphis, and while there you doubtless inquired into the working of its system of sewerage. It seems to be the universal opinion that the system there is a perfect success, that it accomplishes every object that was aimed at, and has transformed this fever-plagued spot into a healthy city; while four years of constant use have not developed a single hidden fallacy in the system, or marred the unanimous satisfaction of the citizens; and this, as I am informed, in spite of the fact, that (contrary to the general belief on the subject) much of the work was originally hurriedly and imperfectly done, so that it ought to show all the defects which generally result from bad workmanship.

The general result so far as ascertained, therefore, is that the separate system at Memphis is a complete success, that it has not failed in any particular to accomplish all necessary purposes, and that it is giving very general satisfaction to the citizens.

Ask yourselves now the question, whether the citizens of Kansas City are equally well satisfied with the results of the combined system? I am afraid from the answers which I have received in private that such is not the case.

And yet, as it seems to me, no city is so well adapted as Kansas City to the successful introduction of the separate system. The grades are steep and the slopes are short, so that storm-water can be quickly and cheaply gotten rid of by open gutters, combined with a few storm sewers; and in our climate the rains are needed to wash the streets. We have a light dry soil, admirably drained naturally, so that one of the three offices which are performed by the combined sewers, that of draining the adjoining soil of water (at the expense of occasionally polluting it with sewage) through the crevices in the work, will not be required, or if required, will be better done by laying tile drains in wet places, along with the sewers proper, as was done in Memphis. So that every consideration of expediency, of health and of economy points to the adoption of the separate system for those parts of Kansas City which are yet unprovided with sewers.

There are also special reasons why the separate system is the best adapted to the needs of this city. In a rapidly growing town, where we are dilligently building up and digging down, where the streets are being constantly disturbed, and where we have the hurly burly which so astonished our late Mexican visitors, it is almost impossible to prevent the intrusion into sewers, to which storm-water has access, of all sorts of debris and incongruous materials, which are pretty sure to obstruct the sewers, if not to choke them. If there are, therefore, anywhere good reasons for making strorm-water sewers large enough for men to go into them to clean them, (and as we have seen, this is the French practice,) certainly those reasons exist in Kansas City.

Moreover, the combined system of sewers can be scarcely carried out much in advance of the grading of the streets, and of their paving and guttering. Otherwise they would probably become useless in consequence of the changes of grades, which are not altogether unknown here, or choked by the bringing in of earth and rubbish from the unpaved streets; while, if we adopt the separate system, it can, by being placed in the alleys, be at once carried out in advance of grading the streets, in all parts of the town where sanitary reasons exist for them.

Now, let us see what will be the financial results. I have only at hand the data furnished in the report of the city engineer for the year ending December 31, 1882. From this it appears that the total area of the city is 2,907 acres, of which 200 acres had been fully sewered, and 223 acres more partly sewered, at a total cost of $314,914. If we assume this sewered portion to represent an area of 307 acres (and this cannot be far wrong), the cost has therefore been at the rate of $1,026 per acre; and if the combined system continues to be carried out, at the same relative cost, the total expenditure will be:

Cost of 307 acres sewered December 31, 1882	$ 314,914
Cost of 2,600 acres to be sewered at $1,026	2,667,600
Total.	$2,982,514

I understand, however, that in consequence of good management and close economy on the part of the city engineer, the cost has been largely reduced from that of previous years, and he estimates that in the parts of the city not already laid off in districts, the cost will not greatly exceed $1.50 per 100 square feet, or $653.40 per acre. We must therefore revise the calculations previously made, and in order to make sure that we shall get a minimum estimate, we will assume that the whole of the 2,600 acres remaining to be sewered, some of which of course is included in existing districts, shall be completed at the above estimated cost of $653.40 per acre. The revised estimate will then stand thus:

Cost of 307 acres sewered December 31, 1882	$ 314,914
Cost of 2,600 acres to be sewered, $653.40	1,698,840
Total	$2,013,754

It, therefore, appears probable that the cost of the present system of sewers, if extended to the whole area of the city, will be between $2,000,000 and $3,000,000. This brings us to the inquiry as to what will be the cost if we should adopt the separate system for these portions of the city yet unprovided with sewers. The cost in Leavenworth is stated to be, as near as possible fifty cents per 100 square feet, or $217,80 per acre. If we assume these figures as correct, we have the following estimate:

Cost of 307 acres sewered December 31, 1882	$ 314,914
Work done during 1883, say 100 acres at $700	70,000
Cost of 2,500 acres to be sewered at $217.80.	544,500
Cost of storm-water sewers to be built hereafter. . . .	150,000
Total	$1,079,414

So we may say, in round numbers, that it is yet possible to save a million of dollars to the city, by adopting the separate system of sewerage for the portions not yet undertaken.

It will be noticed that in the foregoing estimate the sum of $150,000 is allowed for storm-water sewers, to be built at points where the accumulation from the gutters proves to be a nuisance. I do not believe that there will be many such points. In Memphis there are said to be none at all; but even if we have to double or treble that estimate, we shall still realize a notable economy over the cost of completing the present system.

Let us even assume the very worst possible supposition, one which is nearly impossible, that the storm-water shall prove in time such a nuisance, over all parts of the city, that we shall be led to underlay every portion of its site with another set of sewers for storm-water alone. It will certainly be admitted that this contingency is remote, that it will not occur for many years, and I will ask whether it is not better, even in that event, to construct now a set of cheap sewers for sanitary objects alone, even if we have hereafter to encounter the full cost of another set to provide for storm-water alone, which, be it remembered, may wet the feet of passengers, render crossings impracticable for a short time, or even occasionally tear up gutters, or flood a cellar; but which cannot endanger health or life, as we are led to believe by sanitarians the combined sewers do.

The case then stands thus: Memphis has been the first city in this country to adopt thoroughly the separate system of sewerage, as improved, designed and combined Mr. Waring. It is thoroughly satisfied with the result, the city has been reclaimed from the unhealthiness which scourged it, and during a four years' experience no hidden fallacy or defect in the system has appeared.

On the other hand Kansas City has begun to carry out the combined system, and after three or four years of experience is not satisfied with it.

The combined system is said by sanitarians to involve grave dangers to public health, while the most that is claimed by its advocates is, that if proper precautions be taken it is not so dangerous after all. On the other hand, the separate system is free from the slightest taint of suspicion. It is universally admitted to be healthy and safe.

Kansas City can even now probably save $1,000,000 by adopting the separate system for the portions of the town as yet unsewered, and even if this should not turn out to be true, even if a second set of sewers shall be needed some day, it is clearly better to carry out what is within our reach now: to adopt a cheap system which can at once be extended to all parts of the city in need of it, and to trust to the future resulting prosperity, to enable us to pay for the luxury of passing our storm-water underground.

But in point of fact, it is not true. It is in my judgment impossible that a second set of sewers for storm-water alone, shall ever be needed under all parts of our city; so that every consideration of economy and of sanitation points to the adoption of the separate system for the future.

SIXTEENTH ANNUAL MEETING OF THE KANSAS ACADEMY OF SCIENCE.

At 2 o'clock on the afternoon of November 20th, the Kansas Academy of Science met at the State House, in the Senate Chamber, at Topeka, the occasion being the sixteenth annual meeting of the society.

The meeting was called to order by the president of the society, Dr. A. H. Thompson, of Topeka. The following members of the academy were present at the opening: A. H. Thompson, Geo. S. Chase, T. J. Lovewell, G. C. Stearns, F. G. Adams, Topeka; Profs. E. A. Popenoe, Kellerman, J. D. Graham, Manhattan; R. J. Brown, Senator Aller, Leavenworth; Joseph Savage, Prof. Dyche, Prof. F. H. Snow, Lawrence; Robt. Hay, Junction City; J. R. Meade, Wichita.

After the call to order President Thompson made a short introductory speech, after which the regular business of the session was taken up, and Prof. Snow, Senator Aller, and Geo. S. Chase were appointed a committee on nominations to prepare a list of officers for next year.

The committee reported the names of the following officers: President, R. J. Brown, Leavenworth; Vice-Presidents, Prof. F. H. Snow and Joseph Savage, Lawrence; Secretary, Prof. E. A. Popenoe, Manhattan; Treasurer, Dr. A. H. Thompson, Topeka; Curators, Prof. O. H. St. John, Prof. J. H. Carruth, and

Prof. J. T. Lovewell, Topeka. The committee further recommended that the president fill out the appointment of commissions.

The report of the committee was accepted, and the new officers were declared elected.

Robert Hay, of Junction City, made a verbal report of his geological and palæontological researches in Norton County. Mr. Hay spent the greater part of the past summer in that county, engaged in his scientific researches, and has made quite a curious and valuable collection of fossils and minerals. Chief among the fossils are portions of a mastodon. Many of the bones are in an excellent state of preservation. Several varieties of chalk were also exhibited.

Professor Cragin reported on the alcoholic specimens in the State Museum, and said that better accommodations would be furnished the Academy for their specimens in the future, as Secretary Sims of the State Board of Agriculture had promised to provide all necessary cases and jars, and the alcohol needed.

Professor Snow moved that the curators make a report on the condition of the museum and the necessary changes, before the close of the meeting.

The motion was carried, and Secretary Popenoe followed with a report on the library. On motion he was authorized to make a purchase of the missing volumes or sets, of the different States and societies.

At this point the new president, Dr. R. J. Brown, was escorted to the stand by Messrs. Snow and Savage, and Professor Snow made a short speech introducing him.

Dr. Brown responded and in doing so gave a brief history of the society and its past work, and stated that under his administration the enthusiasm and interest should not be allowed to flag. He believed the society was on the right road to success, and by united effort great good could be accomplished.

At the close of his speech the business was resumed, and Prof. Snow moved that twenty-five per cent of the annual dues be made a library fund. A general discussion of the library fund question followed. Senator Aller thought that the fund might be increased by increasing the membership of the society. To do this it would be necessary to hold the annual meetings in different places, instead of at Topeka every year. At the suggestion of the president it was found that the constitution provided for the annual meeting to be held in Topeka.

A motion was then made to have a committee on new constitution appointed, and Messrs. Snow, Savage, and Popenoe were so appointed, and requested to report Friday.

Prof. Cragin then stated that some steps should be taken by the society to secure the early publication of papers and the results of the Academy's researches from time to time, for the reason that several times in the past the Academy had lost the credit of certain scientific discoveries because their publication had been delayed until after somebody else had made the same discovery. Nothing else could be done, however, under the present circumstances, as the publications can only be made once in two years in conjunction with the reports of the State Board of Agriculture.

After some discussion on this point, the whole matter was referred to the executive committee, consisting of the secretary, treasurer, president and curators.

The question of the next place of meeting was also referred to this committee.

Professors St. John and Carruth being absent, Messrs. Chase and Savage were appointed to fill their places as curators and members of the executive committee.

The following new names for membership were presented to the society and accepted, after which the meeting adjourned until 7:30:

R. R. Moore, H. R. Bull, Mara Becker, D. C. Tillotson, C. H. Hallowell, Topeka; E. H. S. Bailey, Prof. Nichols, Dr. J. A. Lippincott, Lawrence; Thos. P. Fenlon, W. M. Fortiscue, Leavenworth; W. A. Kellerman, J. T. Willard, Manhattan; Ambrose Wellington, Carney; Dr. E. M. Turner, Norton; J. L. Meade, Wichita.

Evening.—In the evening at 7:30 the members of the Academy assembled in the Senate Chamber to listen to the address of the retiring president, Dr. A. H. Thompson, of Topeka. Quite a large number of visitors were present, and the audience was very attentive throughout. Dr. Thompson's subject was, "The Origin and History of the Kansas Academy of Science," and it was admirably handled. Without being tedious it was comprehensive and complete, going back to tne early history of the State when geological investigations were first made in 1855 by Major Hawn. In 1858 Prof. G. C. Swallow, of Missouri, and Prof. F. B. Meek made a report upon the "Rocks of Kansas." In 1864 Prof. B. F. Mudge made his first annual report as State Geologist. This last named gentleman, whose name will ever be held in high esteem among scientific men of the United States, will be especially revered in Kansas as the father of its scientific work. To his memory Dr. Thompson pays full tribute in the following words:

"But there is one man to whom we are more indebted, perhaps, than to all other causes combined, for all that we have and all that we are. Our origin, our maintenance during the years of our struggling and uncertainty and all our final success, are due to his enthusiasm, devotion and energy. One who was at once the best, the wisest, the grandest man whose name ever graced the annals of science in Kansas. I refer of course to Professor Benjamin F. Mudge. Any mention of the Academy or of its past work or purposes without naming Professor Mudge would be, to use a vulgarism, "like the play of Hamlet with Hamlet left out." The name and work of the Academy is inseparable from the name and work of Prof. Mudge. The Academy was his child and its very existence is due to the affection he had for it and the care he bestowed upon it.

It is an honor of which we shall ever feel proud, that our organization should have been the care of such a man; that he was mindful of it in the days of its weakness; that its prosperity gratified him and that he considered its welfare before all other societies which were honored by his membership.

Personally, the fullest praise can do scant justice to his many superior qualities of mind and heart; words cannot portray his delightful presence, his genial face, his well-stored mind and his boundless kindness and enthusiasm. But he is gone, and we have left only the memory of his inspiring presence, our undimmed affection and the ever useful record of his works. And how we miss him at every step; the void is yet painfully vacant, four years after his untimely death. How we used him in every undertaking to counsel and help us. His loss to the Academy and to science in Kansas can never be estimated. It is scarcely too much to say that if he had lived we would have had a geological survey before this; for his extraordinary popularity throughout the State, and the profound respect and regard in which he was held by all classes of intelligent people, would have gone far towards securing that much desired enterprise.

I have collected some reminiscences of our dear friend and benefactor in connection with notes gathered relative to the steps taken toward the organization of the first natural history society and its history. They are from my gleanings, from contributions by different friends, especially by Mrs. Mudge, and from personal recollections. The first brief report of the geological survey of Kansas gives an outline of his early scientific labors in the State of his adoption. * * * * * It was during the war and attended with many difficulties. The field was new and its geological features entirely different from those to which he had been accustomed in his New England home. Though harder for him it only added zest to his enthusiasm, and he bravely overcame obstacles which would have discouraged one less in love with Nature and her laws. His own wants were few and simple. With public funds he was strictly conscientious, yet the appropriations for the survey were so small as to hamper him greatly, and he supplied provisions for the early part of his trip from the home larder to lessen expenses. His travels were sometimes perilous and frequently involved very hard labor. He was much perplexed when he had the main part of his report ready, to find that characteristic specimens which he had sent to the palæontologist carefully labeled, had been disarranged or lost, so that after embarrassing delays the report was finally put through the press incomplete. He never despaired of having more generous appropriations from the State when he or some other geologist would complete so important a survey. * * * * * In lecturing he prepared his thoughts with care; but once having clearly fixed in his mind what he wanted to say, his retentive memory had no further use for the notes.

And how much we did enjoy those lectures! How the memory of them hangs like a fragrance about the walls of even this dingy capital building, where we have listened to him year after year. How contagious and inspiring was that exhaustless enthusiasm to all the young men with whom he came in contact. It was my privilege to have him for a near friend for many years and many are precious moments, in private conversation as well as in public lectures, that I have sat drinking at the fountain of knowledge which flowed in charming streams from his lips. How well I remember a day, years ago, when he came hurriedly into my office, on Kansas Avenue, all aglow with excitement, to inquire if I had een the tracks on a piece of Osage flagging which was being used as a cross-walk on the avenue at Sixth Street. I was loth to admit that I had crossed and recrossed on the stone with the rest and like them had never noticed the tracks. But we went together to see the stone and sure enough there were the marks as distinct as could be and his beautiful enthusiasm was at its height. That was one of the first examples he had seen of these tracks which he afterwards investigated and described so charmingly. He dropped all his affairs, went directly to the quarries the very next day and procured a quantity of the rocks with tracks.

While State Geologist, the delightful experience of discovering hitherto unknown fossils and the valuable economic deposits of Kansas, awakened in him a strong desire for the formation of scientific societies, not only for a wider dissemination of knowledge of these resources, but the preservation within our own borders of such rare specimens. He improved every opportunity by lectures and conversations to encourage a growing interest in science. The large area and the few railroads were discouragements to most people regarding a State organization, with perhaps a lack of interest. He really longed for the scientific companionship which he had enjoyed in the east from boyhood—the libraries, public societies, parlor clubs, field meeting of the Essex (now Peabody) Institute, long botanical excursions with congenial companions—how much he missed them. But in 1867 Rev. J. D. Parker, Professor elect of Lincoln College of Topeka, spent some weeks at Manhattan. He was fresh from his studies and an enthusiastic lover of Nature and together with Professor Mudge they prospected and walked, talked and planned. It is probable that it was at the tea table of Hon. J. T. Goodnow, with Professors Mudge and Parker, that the subject of a Natural History Society for Kansas was first broached. That is Mr. Goodnow's recollection of it. Prof. J. D. Parker writes in his obituary sketch of Prof. Mudge in the Kansas City REVIEW OF SCIENCE (Vol. 3, page 570) that, "during the summer vacation of 1867, he first became personally acquainted with Prof. Mudge, when by special invitation, he spent three royal weeks at his home in Manhattan. The days were spent in scientific rambles and in making collections in the vicinity, and the nights until a late hour in discussing scientific subjects. During this visit was matured the plan for organizing the Kansas Natural History Society, which afterwards grew into the Kansas Academy of Science. Of this organization Prof. Mudge was elected the first president and was again president at the time of his death. During those twelve years he was unwearied in his labors for the Academy, always cherishing plans for its development and growth and whose success formed one of the most joyous experiences of his life."

In no organization did he take a greater interest, and he has come in from the plains, hundreds of miles, bronzed and travel worn, to attend its meetings."

Full credit is also given by President Thompson to the earnestness and zeal of our friend Prof. J. D. Parker, and several interesting letters are given showing his deep personal interest in the Academy at all times.

Dr. Thompson's history of this Association extends down to the present time and is replete with information, all interesting and much of which has never been put on record before. It will be published in the official report for 1883, and will form a valuable portion of that volume.

SECOND DAY.—On the morning of the 21st the Academy again met in the Senate Chamber and was called to order by the president.

Before the programme was taken up, the following new names for membership were proposed, and accepted by the society: Dr. Alice K. Brown, Jerry Fields and W. E. Sterne, Topeka; Judge Jas. Humphrey, Junction City; and W. S. White, Wichita. The regular programme was then taken up, the first department being that of Geology.

The first paper announced was "The Southwestern Extension of the Keokuk Formation, with Notices of its Fish Remains," by Prof. O. H. St. John, of Topeka. Owing to the absence of Prof. St. John on account of ill health, his paper was read only by subject, and the next paper, "Bibliography of Kansas Geology," by Mr. F. G. Adams, Secretary of the State Historical Society, was read. Mr. Adams' paper was a sketch of the various books touching upon the geology of Kansas, the story being briefly told in each case. The first book to which he referred was a History of Louisiana, published about the year 1809 by E. H. DuPratz. It contains an account of a visit to Kansas in that early day, and is full of valuable information. A number of other valuable works referring to the geology of Kansas were mentioned, and brief selections from some of them were read, as well as extracts from several scientific reports bearing upon the same subject.

At the close of the paper Prof. Savage gave some very interesting reminiscences of Hayden, the naturalist who was mentioned by Prof. Adams as among the prominent authorities on Kansas geology.

Prof. Savage was with Hayden in 1872, during an expedition to the Yellowstone, and became intimately acquainted with him. He related how Hayden, in 1857, then a young man, began his scientific investigations living among the Sioux Indians and studying the phenomena of Nature in the wild and unexplored regions of the West, and stated that Hayden had often told him that to his first winter's severe experience away from civilization, he owed all his later success.

The next paper was one entitled "Preliminary Report on the Geology of Norton County," and was read by Robert Hay, of Junction City.

This paper was unusually interesting from the fact that it was the result of careful scientific investigation by the author. Mr. Hay spent the summer in Norton County, the greater portion of the time engaged in making geological researches in that region. While there he discovered and exhumed a number of rare fossiliferous specimens, and made a valuable and interesting mineralogical collection, all of which he exhibited and explained to the Academy during the reading of his paper.

In treating the geology of Norton County he took up first its potamography and gave a full description of its river systems and their bed formations. Under this head he stated that he had found a number of formations, the first of which was the Niobrara, or Cretaceous, composed of (1.) blue shale and (2.) yellow chalk. This formation was found principally along Solomon Creek, and imbedded in it were found occasionally crystals of calcite, cinnabar and quartz. The next layer he found to be green sand, and the fourth a greenish clay shale. Fifth in the group came the Loup Fork Miocene, with the Pliocene next, composed of a chalky, sandy marl. The seventh and last was the alluvium or soil. Mr. Hay took up as his second division of the subject, Stratigraphy, and treated somewhat at length of the dips and seams in the Norton County deposit. He stated that he had discovered in the county an unusually large break in the strata.

Under the head of Palæontology, he exhibited the following specimens of fossil remains found in the county: The entire lower jaw, part of upper jaw, four teeth, femur, two pelvic bones, humerus, radius, astragalus, os calcis, metatarsal and metacarpal bones of the rhinoceros (*aphelops*); teeth of three-toed horse, teeth of brontotherin, tooth of oreodon, portions of humeri of mastodon, radius and carpal bones of same, ribs of same, tortoise shell and skeleton nearly complete, fragments of three other turtles, tusk of mastodon, fragment of tooth of same, beaks of toothed birds and other cretaceous fossils.

The Professor urged strongly the establishment of a museum by the Academy, and stated that his specimens would become part of it, and that others would certainly be added by further explorations which are soon to be made.

Under the head of Economic Geology, he treated at length of the minerals of the county, and exhibited various specimens of sandstone, limestone, calcite, agate, jasper, rose quartz, chalcedony, feldspar, diorite, etc. Prof. Hay stated that coal was found in the Solomon Valley in small quantities as pockets in the blue shale, but he believed that coal would not be found in great quantities except at an excessive depth, probably three times as deep as the Leavenworth shaft. In all of his explorations Professor Hay was assisted by Dr E. M. Turner, of Norton County.

Professor F. H. Snow, of the State University, then gave a verbal report on "The Bones of Fossil Horse and Rhinoceros from Northwest Kansas," and in doing so exhibited a number of specimens from the collection at the State University. Professor Savage then spoke of the field that Norton County had afforded for investigation, and believed there were other counties in the state equally as fruitful.

The next paper was one entitled "The Loup Fork Group in Western Kansas," by Prof. C. H. Sternberg, of Lawrence. The paper was principally an exhortation to the State and State authorities to arrange for a museum, and as Mr. Sternberg was absent, the paper was read by title and referred to the committee on publication.

The next, "Note on New Kansas Mineral," by Prof. J. T. Willard, of the Agricultural College at Manhattan, was read by title also, as the professor was absent.

Prof. Snow read a short paper on "Octahedral Limonite," communicated by Prof. Erasmus Haworth, of Penn College, Iowa.

This was followed by a paper on "The Age of Kansas," by B. B. Smyth, of Topeka. He treated extensively the river systems and their geological characteristics. Also referred to the atmospheric and meteorologic phenomena, and gave an account of a sand-storm which occurred in 1880, during which fine sand was carried in clouds from Barton County to the eastern part of the State.

The paper of J. C. Cooper, of Topeka, "Notes on Some Rare Minerals New to the United States," was called, but owing to author's absence, the paper was read by title only, and referred to the committee on publication.

AFTERNOON SESSION.—At 2 o'clock in the afternoon the Academy again convened, with Dr. Brown, the President, in the chair. The first hour was devoted to business. The committee appointed on Wednesday to revise the constitution and by-laws of the society made its report. On motion the constitution was adopted as a whole. On motion it was unanimously decided to hold the next annual meeting at Lawrence in November, 1884.

The curators of the Academy's museum then made a report, which was adopted. We can give but the portion containing the recommendations of the committee, viz.:—That the curators of the Academy be authorized as a special committee to proceed to thoroughly overhaul the collections now in the cases referred to; to re-label and arrange such portions thereof as can be located with certainty, and to clean the shelves of such portions as have lost their value by reason of their localities being indeterminable; to gather together the scattered and unboxed material and arrange and label as much thereof as may be practicable, and to store away the balance of the material somewhere in the building where it may be found, should occasion ever require. In the prosecution of this work that the committee be allowed $15 for assistance and material, and that they be allowed to make any exchanges that they may consider practicable.

"Your committee are informed that the present secretary of the Agricultural Board is willing to furnish additional cases for the use of the Academy's collections and to turn over to the Academy all collections now in the possession of said board, which relate only to natural history subjects.

Your committee would therefore recommend that the curator's committee be authorized to confer with the Secretary of the State Board of Agriculture, who is at present absent from the city, and arrange with him for the construction of such cases, and such arrangement of the same as may be found most expedient, and that such curators be authorized to receive from the Agricultural Board all such collections as such Board may consent to turn over to the Academy and to provide for the care of the same.

A motion was then made to add Geo. S. Chase and Professor Cragin to the permanent board of curators, thus making five in all.

The business session was then closed to make way for the regular programme.

Prof. L. L. Dyche, of Lawrence, detailed the particulars of the finding of the mammoth (*Elephas Americana*) at Newton last spring, Prof. Dyche having examined the fossil soon after its exhumation. He stated that the entire specimen has been disposed of to eastern parties.

The following topics of Prof. F. W. Cragin, of Washburn College, Topeka, were read by title and referred to the committee on publication: "Notes on the Embryology of Porcellio," "Notes on some *Crustacea* of Kansas," "Additions to the List of Kansas Reptiles and Batrachians," "List of *Hymenomycetes* Collected near Topeka," "Key to the Known Species of *Cyclops*."

Prof. I. D. Graham, of the Agricultural College, and Prof. Cragin, had each prepared a paper on "Preliminary List of the Fishes of Kansas," and upon consultation it was decided to combine the two, so they were read by title and ordered referred to the committee on publication when ready. An excellent paper on "Practical Fish Culture," was presented by Prof. I. D. Graham. The paper was very interesting and instructive, and evinced close study and careful investigation.

Under the department of Ornithology Prof. Popenoe read the following short papers by N. S. Goss, of Topeka, the State Ornithologist: "Birds New to the Fauna of Kansas, and Birds Rare in the State;" "Notes on the Nesting Habits of the Yellow-Throated Vireo (*Lanivireo Flavifrons*); Observations on the Breeding Habits of the American Eared Grebe (*Dytes nigricollis Californiatus*).

Professor F. H. Snow then followed with a brief verbal report on the "New Species of Lepidoptera, discovered in New Mexico in 1883." These new species, twenty-five in number, were discovered by himself while sojourning there during the past summer. He then took up the topic, "Additions to the List of Kansas Coleoptera in 1883." This was also a brief verbal report, and the professor stated that the list of Coleoptera would now number about 2,000 in Kansas, the largest list in the United States by a single society belonging to one State or Territory, except the list of the Coleoptera of the District of Columbia, which numbers 2,800, as prepared by a Washington scientist. The professor stated that the Academy hoped to beat this record before a great while. Prof. Snow then continued with "Further Observations Upon the Gila Monster (*Heloderma suspectum*)." He gave a verbal report and stated that from experiments he had been led to believe that the reptile was not poisonous though it was generally believed to be so. At the close of his remarks, a general discussion of the subject arose, and several interesting facts in regard to experiments with this species of lizard were brought out.

The next subject, "Observations on the Habits of Ants," was handled by Prof. Joseph Savage. He made a very short verbal report, merely calling the attention of the Academy to the fact that in the ant-hills of the plains he had always found Indian beads in great quantities. He explained this by stating that these beads were carried there from great distances by the ants themselves.

Prof. Frank Kizer, of Emporia, then, by the aid of a set of drawings, explained the Indian sign-writing, and noted a number of interesting facts in connection therewith. The drawings were copied from a large rock in Greenwood County upon which they had been made by the Osage Indians.

EVENING.—In the evening a large audience was assembled in the Senate Chamber of the State House to listen to lecture of Dr. R. J. Brown, of Leavenworth, President of the Academy.

The subject of the lecture was "The Ocean—Its Flora and Fauna," and the lecture was interesting throughout.

Dr. Brown has been spending considerable time on the Atlantic coast during the past summer and has put together in a very interesting form the impressions made on him by the seaside phenomena, and illustrated the lecture by fine diagrams showing the depth of the ocean bed, kinds of coral, etc. He had also specimens of shells and corals from Florida and elsewhere.

The lecturer spoke of the primeval ocean before all geologic ages and the first appearance of continental land, and the gradual appearance above water of all the land of the world built by the waters; some like chalk and limestone by animals—corals and diatoms and foraminifers; some from the breaking down of the former rocks in the shallow sea and the gradual deepening of the ocean bed. The distribution of heat by the oceanic current was dwelt upon, the depth at which the Fauna and Flora exist, and the magnificence of the latter was described. It is more than likely that this paper will be published in full in the next number of the REVIEW.

On the following day Dr. Brown was elected a life member of the Academy because of his exceedingly liberal donations from time to time to the Academy. This was a double compliment, from the fact that Dr. Brown is the first person upon whom the Academy has conferred the honor.

THIRD DAY.—The meeting was called to order at 9 o'clock by the President, Dr. Thompson. For the purpose of expediting the publication of some of the most important papers read, the following resolution was passed:

Resolved, That the publication committee be instructed to publish at once their selection of the papers under the best arrangement they can make, and for any cost which the Academy's treasury may not be able to meet, they be empowered to levy and collect any additional assessment not exceeding $2 each.

Professor F. W. Cragin was elected librarian.

The committee appointed to audit the expense account of Prof. Hay, who made geologic researches in Norton County during the past summer, reported favorably and the claim of $92.30 was allowed. Besides allowing the claim the committee and society complimented the professor upon the successful results of his explorations in the interest of science.

The department of Botany was taken up and Prof. W. A. Kellerman gave an interesting lecture on "New Fungi of Kansas." Prof. Kellerman followed closely the classification of Cohn, giving the following divisions of Fungi: Protophyta, Zygosporeæ, Oosporeæ, Carposporeæ, Bryophyta, Pteridophyta. Taking up each division separately he gave the various classes and explained the phenomena of the reproduction and growth of each, illustrating his remarks by charts and drawings. Four new Fungi have recently been discovered in Kansas, all of which are parasitic in their nature and are found on plants. A number of microscopic specimens of parasitic Fungi were shown, together with the leaves upon which they were found.

Under the department of Anthropology, Mr. F. G. Adams, of Topeka, Secretary of the State Historical Society, presented an interesting paper on "The Metate," or stone mill used by the Indians of New Mexico and Arizona in grinding corn. He exhibited one of the mills, which consists of a stone mortar and pestle and explained fully the method by which the corn or wheat is ground. The mill exhibited is evidently of lava stone, and is in possession of the State Historical Society. Mr. Adams explained the method of using the mills and stated that they were still in use among the Indians in Arizona and New Mexico.

The committee on State Geological Survey which was appointed last year made a report to the Academy through the chairman of the committee, Mr. Geo. S. Chase. The report was quite lengthy, detailing in full the history of the origin and fate of the bill which was introduced in the Legislature asking for an appropriation of $10,000 for the survey. The bill, it will be remembered was lost, though great efforts of its friends were used to secure its passage.

At the close of the reading, the report was adopted, and the committee, as follows, was continued: Geo. S. Chase, Chairman, Prof. J. T. Lovewell, Dr. A. H. Thompson, Rev. Peter McVicar and Henry Inman, of Topeka; Prof. F. H. Snow, Prof. G. E. Patrick and Prof. Joseph Savage, of Lawrence; Prof. E. A. Popenoe and Prof. G. H. Failyer, of Manhattan; Dr. R. J. Brown, of Leavenworth; and Prof. Robert Hay, of Junction City.

While the subject of a geological survey was under discussion, Governor Glick arose and addressed the Academy. He stated that in 1864 a geological survey was begun by the State, and a State geologist was appointed, but the second year a dispute arose over the office of State geologist and the survey was discontinued. The Governor believed that a State survey would be of vast benefit to the State, and he was very anxious that the Legislature should provide for such a measure. He hoped the members would continue to agitate the question until they secured the final passage of a bill appropriating the funds necessary for such a work. He spoke of the surveys of other States and said that Illinois had to agitate the question many years before getting a State survey, Ohio was fifty years old before the measure was secured, and Indiana was nearly the same age. However, he believed that Kansas would secure an appropriation for such a survey before many years. Kansas, he stated, was developing rapidly and needed such a survey. Her development was more rapid than any State in the Union, and she was fully able to appropriate money for a geological survey soon.

Mr. Geo. S. Chase, the chairman of the committee was called upon to read the bill which was introduced in the last Legislature and voted down. The committee on survey was asked to make a report again at the next meeting of the Academy.

Prof. F. W. Cragin, of Washburn College, Topeka, then read a paper "On the Ruins of the Cliff Dwellers of Chapillo, Blanca and Pareto." The professor gave an interesting account of his observations among these ruins, which are about forty miles west of Santa Fe, N. M., and referred to the curious ancient drawings found upon the rocks in the cliffs of that region. Prominent upon those noticed was a figure shaped like a Spanish cross, and also a drawing representing a mastodon. This was considered very curious from the fact that the drawings are probably 2,000 years old.

AFTERNOON SESSION.—In the afternoon at 2 o'clock the Academy again assembled in the Senate Chamber and was called to order by the president.

By request, Prof. Hay, of Junction City, who exhumed the fossils in Norton County, occupied ten minutes in exhibiting and explaining the specimens to the members of the classes in Chemistry and Natural Philosophy of the Topeka High School who were brought in by Prof. Larimer.

Mr. J. T. Willard, of the Agricultural College at Manhattan, read a short paper entitled, "Note on a New Kansas Mineral." The mineral, of which he exhibited a specimen, is ferrous brown, appearing like Hæmatite, and was found in the northern part of Riley County. The mineral when first discovered was supposed to be hæmatite, but on close analysis was found to be manaconite, a variety of iron ore similar to hæmatite but differing slightly in its action under the blow-pipe and with acids.

The department of Physics and Chemistry was the next taken up and an exhaustive paper on "Purification of Water for Domestic and Manufacturing Purposes," was presented by Mr. Wm. Tweeddale, of Topeka. This paper was quite lengthy and treated fully of the subject in its various and varied relations.

The next paper "Is the Sun Composed of Fire?" was read by title and referred to the committee on publication, the author, Mr. F. E. Jerome, of Russell, being absent.

Mr. Geo. S. Chase followed with "Archæological Notes," which belonged properly in the department of Anthropology, but had been deferred on account of Mr. Chase's absence when the paper was regularly called. This paper gave an account of a trip made by the author to New Mexico, and he gave an account of some relics found near Taos, New Mexico. Mr. Chase exhibited several small black stone images which he believed were used by some prehistoric race either as an object of worship or as a sign of rank, probably the latter.

Dr. Thompson believed that such images were treasured by Indians of the present day, having been made by their ancient predecessors, not so much as objects of reverence as signs of rank.

Professor Savage made a short address on "Lightning Freaks during the Summer of 1883," and in doing so referred to a small cyclone which he had witnessed. The cyclone, shaped like an inverted cone, while revolving rapidly would occasionally separate near the ground, and then come together again. Each time as the points of the two portions of the cyclone came together a blue flame was seen to pass apparently from the ground to the top of the cyclone. Professor Savage also described the electrical phenomena of the severe storm on the night of July 10, 1883.

Professor E. H. S. Bailey, of the State University at Lawrence, presented a very practical paper on "The Composition of Vessels for Culinary Use." He explained why new tin vessels were somewhat poisonous, and advised thorough cleansing of them before using. He also referred to the poisonous character of copper and brass vessels, and stated that particular care should be taken in their use. He followed this by a paper on "The Distribution of Saccharine Matters in the Stem of *Sorghum Vulgare.*" This paper was a very practical one and detailed a number of experiments in the analysis of the plant in its different stages of growth. The professor exhibited a table in which is shown the result of a number of experiments that may prove valuable to sugar manufacturers. It was found on analyzing the various joints of the sorghum plant that the per cent of glucose or that part of the cane product which forms molasses and not sugar, decreases from the first or bottom joint to a minimum near the middle and then increases toward the top joint where it reaches a maximum per cent. On the other hand the sucrose which forms the sugar, begins in the first joint with a per cent about three times as great as the glucose, and increases to its maximum near the middle of the stalk, decreasing to a minimum in the top joint. This is the proportion noticed in the thoroughly ripened plant, but in the greener samples the glucose and sucrose become more nearly equal in their per cents. It will thus be seen that the part of the plant most productive of sugar is the middle.

Professor E. L. Nichols, of the State University at Lawrence, made a short lecture on "A New Class-Room Experiment upon Ebullition." He referred to a method of super-heating water above the boiling point without allowing ebullition to take place. He illustrated his lecture freely with diagrams and sketches, and made it interesting throughout.

At the close of this paper the High School pupils in charge of Prof. Larimer arose to retire and while standing were addressed by Dr. Brown, the President of the Academy. He urged the students to take up some department of science and make it a specialty. He stated that even after graduation they would find the pursuit of such a study not only profitable but pleasant. He thanked the students for their visit to the Academy, and expressed the hope that he would meet them again as earnest workers in the scientific field.

Professor Larimer, on behalf of the students, expressed their gratification at their reception and the interesting information obtained by their visit, after which the school retired.

"The Utilization of Mineral Waters," by Prof. E. H. S. Bailey, of Lawrence, was read by title, and referred to the publishing committee.

Professor H. E. Sadler, of the State Normal School, at Emporia, read a paper on "Coal Oil Legislation," in which he referred to the fact that the coal oil trade had become a great monopoly, and that unless legislation were used in the interest of the subject the oil would become even more adulterated than it now is. There is no law in Kansas to prevent the selling of even the most impure and dangerous oils, and he believed that stringent laws should be enacted.

Miss Mara Becker, of Washburn College, read a short paper on the "Well-Waters of College Hill" giving in tabular form the results of a number of chemical analyses of the well-waters on the college grounds.

Mr. R. R. Moore, of Washburn College, gave some "Notes on Waters Used by the Sonora R. R. Co., in Steam-Boilers," the results of a series of practical experiments by himself.

Mr. H. R. Bull, of Washburn College, closed the programme with "Notes on Tea Analysis," the results of another series of experiments.

A resolution was passed by the Academy thanking the *Capital* and *Commonwealth* for their reports of the proceedings, in which we cordially join, having freely used them in this account. The names of C. S. Gleed and Rev. L. Blakesley, of Topeka, were presented for membership and they were accepted.

With a few parting words to the members of the Academy and urgent requests to be present at the next annual meeting to be held at Lawrence, the president pronounced the meeting adjourned.

In the evening the members of the Academy and their friends were pleasantly entertained at the home of Prof. J. T. Lovewell, near Washburn College.

In a paper read at the recent meeting of the National Academy of Sciences, Prof. J. S. Newberry gave the results of his thirty years' travel and investigation in those parts of North America, which bear evidence of glaciation. He claims to have found conclusive testimony that at least one-half of the continent has been the seat of ancient glaciers, some of which must have been at least 500,000 feet in thickness. The proofs are most pronounced, he says, in Washington Territory, and among the lakes and fissures of Yellowstone Park, where geologists sent out for the purpose by the Government are now engaged in making a thorough and systematic examination. He adds that he is fully convinced that the irregular line of lakes in the eastern part of British America was formerly a river in which glaciers settled and widened and broke the bed of the river.

ENGINEERING.

THE ALLEGHANY PORTAGE RAILROAD.

H. C. WEAVER.

The discussions concerning Captain Eads' ship railroad across the Isthmus within the last few years calls to mind a similar railroad built and operated in Pennsylvania when I was a boy, some details of which may interest the readers of the REVIEW.

This road extended from Hollidaysburg, on Juniata, over the Alleghany Mountains to Johnstown, on Conemaugh, a distance of 36 69-100 miles. Its construction was authorized by an act of the Legislature of Pennsylvania approved March 21, 1831. The engineering work was commenced the next month and the work of construction began the following summer. On the 18th of March, 1834, the road was opened as a public highway.

It consisted of eleven "levels" and ten "inclined planes;" the latter being numbered from Johnstown eastward—five on each side of the summit. The details of the planes were:

No.	Length in feet.	Rise in feet.
1	1,607.74	150.
2	1,760.43	132.40
3	[1]1,482.50	130.50
4	2,195.94	187.86
5	2,628.00	201.64
6	2,713.85	266.50
7	2,655.01	260.50
8	3,116.92	307.60
9	2,720.80	189.50
10	2,295.61	180.52

The "summit" is 1,398 feet above Hollidaysburg; 1,171 feet above Johnstown; or 2,325 feet above mean tide in the Atlantic Ocean.

At the head of each inclined plane were two stationary engines of thirty-five horse-power each. One was in active use; the other was "reserve" to be used in case of accident. These propelled endless wire cables to which the cars were attached. On the "levels" between the planes horses were used to move the cars; subsequently locomotives were supplied to some and perhaps to all the "levels."

The cost of the road was $1,783,176. This does not include the expense of the new road afterward constructed to avoid the "planes." Subsequent expenses charged to cost ran the sum to $1,828,461.38.

The Pennsylvania Railroad Company became the owner of the Allegheny Portage Railroad, on the 1st day of August, 1857. It was included in the sale by the Commonwealth of the "Main Line" under the act of May 16, 1857. The cost of the "Main Line" as computed in 1843, was as follows:

Columbia Railroad	$4,204.969.96
Eastern Division of Canal	1,736,599.42
Juniata Division of Canal	3,521,412.21
Portage Railroad	1,828,461.38
Western Division of Canal	3,069,877.38
Total	$14,361,320.35

1 Possibly only 1,480.25.

The consideration to be paid by the P. R. R. Co. for these improvements was $7,500,000 and $1,500,000 in consideration of a release of tax on tonnage.

The length of the "levels," I am not able to give at present. They were not "dead levels," but had, generally, an inclination of from ten to fifteen feet per mile. Those nearest Hollidaysburg and Johnstown had steeper gradients. Sylvester Welch was engineer in charge of the construction of the Allegheny Portage Railroad. In October, 1834, Jesse Chrisman started from Luzerne Co., Pennsylvania, with a small boat containing ten or eleven persôns, with provisions, cooking utensils, etc., en route for the west. At Hollidaysburg, Pennsylvania, he intended to dispose of the boat, but at the suggestion of John Dougherty, who constructed a railroad car for the purpose of carrying Mr. Chrisman's boat over the Alleghany Mountains, the boat was again launched in the canal at Johnstown and proceeded on its way to Pittsburg.

The Portage Railroad was completed in the fall of 1883. In transporting freight from Philadelphia to Pittsburg it required the bulk to be broken three times, first at Columbia, to which point the railroad ran from Philadelphia, when it was transfered from the cars to the canal-boats; then again at Hollidaysburg it had to be transferred from the boats to the cars; and again at Johnstown, on the western side of the Alleghany Mountains, it had to be transferred from the cars to the boats.

Mr. Dougherty invented the trucks for the purpose of conveying what were called section boats, (also his invention). These boats he placed on the canal in 1836; some were made in three and some in four sections. These boats were loaded in Philadelphia and carried on the railroad on trucks, or flat-cars, to Columbia, then run into the canal. The sections hooked or fastened together ran to Hallidaysburg and were then loaded upon the trucks again. By having the track laid into the water the cars were run in under the boats, and again the boats were run into the canal at Johnstown, and sent to Pittsburg, and returning eastward they were operated in the same way. Prior to placing the section boats on the main line of the Pennsylvania Canal, freight had been shipped from Philadelphia to Pittsburg without breaking bulk, by means of what were called "car-bodies,"—large boxes—that were constructed like a small box-car with wheels: they were carried on flat-cars and were carried on the canals in open boats constructed for that purpose that plied between Columbia and Hollidaysburg, and between Johnstown and Pittsburg. These boats were long enough to admit from four to six car-bodies; the latter were placed on trucks loaded at Philadelphia and carried by rail to Columbia, there by huge windlasses they were lifted from the trucks and placed in the open boats, and transported to Hollidaysburg; again placed on the trucks and at Johnstown again put in the open boats, etc., and returning eastward the operation was reversed. James O'Conner was the originator of the car-body method of transportation. Mr. O'Conner was an Irishman by birth, and a man of some education, and this was called O'Conner's Line of boats. I may say that while Mr. Welch was the engineer in charge of construction of the Portage Railroad, Moncure Robinson is entitled to the credit of conceiving the plan.

One of the projects for surmounting the barrier presented by the Alleghany range was to construct a canal tunnel, about five miles in length, from the upper waters of the Juniata River to those of the Conemaugh River, and singular as it may seem half a century afterwards this project was abandoned because of the limited supply of water. Some idea of the volume of transportation can be formed from the fact that in the summer of 1834 1,220 boats passed the town of Huntingdon, showing the vast amount of freight carried at that early day, in the history of internal improvements. I am indebted to the Hon. J. Simpson Africa, Secretary of Internal Affairs, Pennsylvania, and John Dougherty, Esq., for valuable data in the preparation of this article.

STREET PAVEMENTS.

THEO. S. CASE.

A most important subject in a growing city is the construction of its streets, i. e., their grades and their paving. The former are controlled largely by the topography of the city itself, and the latter should be governed by the former; also by the various questions of utility, adaptability of home material, cheapness, durability and hygiene. For a city to remain in the mud when any kind of paving material, that will lift her out of it, is accessible, is not only inconvenient and disagreeable, but it is expensive. Business, which governs everything, first demands facilities involving speed and cheap handling of heavy loads. The mud-pike is evolved from the ordinary dirt-road, the corduroy road is the natural precursor of the plank-road, the gravel-road precedes the Macadamized road, then follow the Nicholson pavement, the cedar-block, the Russ or Belgian stone-block, the Medina sandstone, the asphalt. Each in its turn has its advocates and its day, and each in its turn is denounced for its faults and abandoned for its successor. Each, however, has its advantages and adaptabilities to particular localities, but when the tide of fashion or prejudice or favoritism comes along these attributes are lost sight of.

In cities that have passed the formative stage and are settling down into permanency, the principal materials used in paving are wood and stone, with all manner of experiments upon combinations, shapes and construction; and it is somewhat singular that the errors of cities have very little weight in preventing their repetition in others. While wooden blocks are being thrown out as worthless in Washington, they are being largely laid down in Chicago, Kansas City, and even in London. While stone is strongly urged as the only permanent material in some of our western cities, it is regarded by the best engineers in some of the eastern cities as second to asphaltum blocks and even to wood. The fact is that the circumstances of climate and topography, together with the proper or improper manner of construction, are factors too little considered both by engineers and city governments. Wooden pavements are laid on wet foundations, slippery stone blocks on steep grades, and contractors are permitted to evade the terms of their agreements in construction, and yet dissatisfaction is expressed at want of success in attaining the objects desired.

Whether in ancient times better roads and pavements were built than at present, or whether only the best ones remain, is uncertain, but it is certain that some of the remains of such structures found, in Rome for instance, evince engineering skill and perfection of work in a high degree. These were laid out carefully, excavated to solid ground, or in swampy places made solid by piles. Then the lowest course was of small-sized, broken stones, none less than three or four inches in diameter, over these was a course, nine inches thick, of rubble or broken stones cemented with lime, well rammed: over this a course, six inches thick, of broken bricks and pottery, also cemented with lime; upon this was laid the *pavimentum* or pavement, composed of slabs of the hardest stone, joined and fitted together as closely as possible. This was costly—the Appian Way, about one hundred and thirty miles in length, having almost exhausted the Roman treasury—but it was as enduring as Nature's own work. In Peru and Central America similar remains, 1,500 to 2,000 miles long, were found by the Spaniards, which, as Prescott says, "were built of heavy flags of freestone, and in some parts, at least, covered with a bituminous cement which time has made harder than the stone itself." The roads of modern times lack most of the elements of durability which these possessed and consequently wear out in a very few years.

The greatest enemy to wooden pavements is damp air. If wood is submerged in water or if it is kept perfectly dry it will not rot, but if it is exposed to moist air it will rot rapidly. It can be protected to a very considerable degree against wear by protecting the surface, hence all that is necessary to render it very durable is to insure it against exposure to dampness. The method of preparing the foundation at present adopted in Kansas City, i. e., constructing it of broken stone cemented together with water lime, is admirable, provided the surface moisture from rains, etc., can be kept from penetrating the interstices between the wooden blocks and resting upon the cemented surface below. If this cannot be prevented, then the foundation would be better without the cement, for it is plain that the blocks must, so to speak, stand with their feet in the water all the time, and their rotting must begin at once. But if the coal-tar or asphaltum, now sparingly and uselessly thrown upon the surface of the blocks, can be poured upon them so abundantly as to fill the interstices and prevent the water from passing down to the concrete below, we shall find that the rotting process will be indefinitely delayed and that the wear will also be vastly decreased. As we cannot keep the blocks submerged, we must keep them dry and protected from the action of the air—oxidation—to the fullest extent possible. These remarks of course apply to the work in relaying the blocks after removal for repairs of sewers, gas-pipes, water-pipes, etc., and to the work done by the street commissioner in keeping the streets in repair. He should be supplied with proper material and be required to inspect such paving frequently, filling all cracks or openings of every kind as often as observed. In this way wooden pavements may be made as durable as they are pleasant in other respects, while at the same time they will still remain less expensive than stone.

As to stone pavements, the Guidet, Belgian, and Camp or Medina sandstone, are equally valuable and durable, each being first-class for streets upon which heavy traffic is done, and each being decidedly objectionable everywhere else But to give the best results at the heavy cost of such pavements they should be kept scrupulously clean; otherwise they have all the inconveniences of slipperiness, dust and slop, in addition to the almost intolerable noise which essentially belongs to them. On heavy grades the stones should be set sloping, so as to produce projections at their edges for the benefit of the draft animals in pulling up or holding back in going down. Without attention to this, much of the benefit of the stone surface is lost, from the fact that so much smaller loads must be hauled over them.

The ideal pavement in our opinion is that composed of asphaltum, either in solid sheets or in blocks. It is noiseless, indestructible by the elements, smooth, impermeable by liquids, easily cleaned and when properly put down, exceedingly durable, besides being easily put in perfect repair when cut or broken for any reason.

The foundation should be of the best quality, as it should for all other pavements, and the asphaltum mixture put on in sheets on level stretches and in suitably sized blocks, laid as above, upon all steep grades.

As to the comparative durability of these three styles of pavement, assuming the foundation to be about the same in each case, experience shows that stone blocks of good quality will last the longest time, wooden blocks the shortest and asphalt blocks will come between the other two. In the matter of cost, wooden blocks will cost least, asphaltum next, and stone most. In cost of maintenance and repairs, rock comes first in point of economy, asphaltum second and wood last. In regard to hygienic value, asphaltum stands conspicuously first, stone next, wood last.

After carefully considering the matter as a home measure, while I am satisfied that the above summary is correct, I am also quite convinced that be substituting a cheaper wooden block for the cedar, and expending enough more upon the point of making the pavement impervious to water from above, to actually accomplish it, we can have a cheap pavement in this city which shall possess all the good qualities of both stone and asphaltum, at a lower cost than either, and use no materials except such as can be found in our immediate neighborhood.

At the present time there is a growing sentiment among the people of St. Louis in favor of pavements made of fire-clay brick, which have been carefully tested and pronounced a success in a report made by a committee of engineers and citizens. Among other things they report that "these bricks show all the endurance of granite," "they make a smoother, cleaner, and less noisy street," "are more easily repaired," "give better foot-hold to horses," "neither fire nor frost affects them," and "that streets can be made of this material at half the cost of granite."

BOTANY.

INSECTS AND COLORED FLOWERS.

REV. L. J. TEMPLIN.

In the *Popular Science Monthly*, Vol. XIV, pp. 529–30, is a short letter written by Thomas D. Lilly, of Virginia, in which he details some observations in regard to the influence of color in flowers in attracting insects to them. He speaks particularly of petunias and morning-glories. He says: "In every variety of situation and circumstance the white petunias have been neglected for the colored, in exact proportion to the intensity and vividness of color; and the same is found to be true, in a less degree, as regards the deep and pale morning-glories." The conclusion at which he arrives is that it is the color, and that only, that determines the visits of bees and butterflies to these flowers, for he states that,—"If there was any difference whatever in the sweetness or fragrance, it was in favor of the rejected white flowers." If these statements are to be accepted, the conclusion is, or the conclusion the writer would have us draw is that in their visits to flowers, insects are guided neither by their sense of smell nor by their past experience as to the sweetest flowers, but wholly by their sense of sight; and that is guided and controlled, neither by the shape nor size of flowers, but entirely by the brilliancy of color. This seems to be but a limited statement of the views held by evolutionists in general as to the influence of color on the perpetuation and dispersion of both plants and animals. We are told that the brilliancy of color in both birds and insects is the accumulated results of the æsthetic taste in them that leads to the selection of the highly colored ones of their own species as mates to the neglect and rejection of those less favored in the beauty of their adornment. Mr. Grant Allen, speaking of this in butterflies, attributes it to a real enjoyment that they derive from the contemplation of beautiful colors. In "The Evolutionist at Large," he says: "It is sufficient to believe that the insect derives some direct enjoyment from the stimulation of pure color, and is hereditarily attracted by it wherever it may show itself. This pleasure draws it on, on the one hand, toward the gay flowers that form its natural food, and on the other hand, towards its own brilliant mates.

As to this last he says: "But out of two or three such possible mates it naturally selects that which is most brightly spotted, and in other ways most perfectly fulfills the specific ideal." But notwithstanding the pleasureable sensations that prompt it to seek the brilliantly colored flowers the butterfly, is all unconscious of any such influence, for according to this savant it is all unconscious of any such influence whatever, and is moved only by a blind impulse over which the insect has no control. Speaking of a new born butterfly, he says: "Soon a flower catches its eye, and the bright mass of color attracts it irresistibly, as the candle-light attracts the eye of a child a few weeks old. It sets off toward the patch of red or yellow, probably not knowing beforehand that this is the visible symbol of food for it, but merely guided by the blind habit of its race, imprinted with binding force in the very constitution of its body. Thus the moths which fly by night and visit only white flowers whose corollas still shine out in the twilight, are so irresistibly led on by the external stimulus from a candle falling upon their eyes that they cannot choose but move their wings rapidly in that direction."

And again, "The butterfly in like manner is attracted automatically by the color of his proper flowers, and setting upon them, sucks up their honey instinctively." So also, "The picture of his kind, as it were, is imprinted on his little brain, and he knows his own mates the moment he sees them, just as intuitively as he knows the flowers upon which he must feed." So after all it is not any æsthetic taste that guides his choice, nor is it choice in any correct sense that determines the result, but simply a blind, unintelligent and irresistible impulse over which the insect has no more control than has the falling leaf over the attraction of gravitation that draws it to the earth. And yet we are to believe that this blind force has been so controlled by æsthetic emotions as to produce all the beauty of color displayed in the petals of flowers, the wings of insects and the feathers of birds. Now we are taught that this love of the beautiful, or, at least, the attractive power of bright colors in flowers and fruits is the great means employed by nature to secure the fertilization of flowers and the distribution of seeds. We may stop here and inquire if it be true that plants with brilliant colored petals are more prolific or receive the attention of bees as fertilizing agents more surely than others.

The honey-bee, with which we are better acquainted than with any other honey-eating insect, may be taken as an illustration. Does this visit only or principally brilliantly colored flowers? It strikes me a careful examination of the habits of this little friend will throw a flood of light on this subject.

Having given considerable attention to the subject of bee-plants, I offer the following list as comprising the principal ones throughout a large portion of our country. I insert the color of the flowers of each:

Alsike clover—red and white.
Boneset—white.
Blackberry—white.
Buckwheat—white.
Basswood—white.
Catnip—reddish tinge.
Clematis—white.
Cleoma—purple.
Currant—yellowish white.

Corn—red and white.
Dandelion—yellow.
Fruit trees—pink and white.
Golden rod—yellow.
Gooseberry—yellow.
Grape—greenish white.
Horehound—white.
Iron-weed—purple.
Mignonette—yellowish white.
Maple—red and white.
Mustard—yellow.
Oxeye daisy—white.
Raspberry—yellowish white.
Red clover—red or pink.
Strawberry—white.
Smartweed—pink.
Silk, or milkweed—purple to white.
Sweet clover—white.
Turnip—yellow.
Tulip-tree—yellowish white.
Virginia creeper—greenish white.
Willow—purple or white.
Wild plum—white.
White clover—white.

Here we have a list of thirty-two of the principal bee-plants of the country. I think any apiarist who has given careful attention to the forage plants of his bees will admit that nine tenths of the honey that his bees collect is gathered from the plants enumerated above; and yet a large proportion of them are white. Indeed, I think in a large portion of our country it is safe to say that three fourths of the honey is gathered from three species of plants—buckwheat, basswood, and white clover; all of which have white flowers. Many of the plants named above have very inconspicuous flowers, of which I may name maple, raspberry, grape, Virginia creeper, currant, gooseberry, sweet clover, and corn. If it were the bright colors alone that attracted bees to flowers, some of these would never receive the visits of a single honey gathering insect. But observation proves that the inconspicuous flowers are often thronged by insects to the neglect of more showy ones. As an illustration, a vine of Virginia creeper that clambers over my house was literally swarming with bees during the past summer, when sunflowers, roses, and hollyhocks, in its immediate vicinity were entirely neglected.

The "yellow patches" of sunflowers could readily be seen for half a mile, while the minute blossoms of the ampelopsis could scarcely be distinguished at the distance of a rod. I also observed a similar fact on a patch of mixed clover,—consisting of red, Alsike and white—which was constantly visited by bees during the flowering season. I noticed that a bee very seldom touched a head of the red clover, though it was the tallest and much the most attractive and brilliant, so far as color was concerned. There seemed to be but little difference in the number visiting the other two varieties; but when a bee began on either kind it continued on that till it had secured its load.

The conclusion to which I am led is that so far from the brilliancy of flowers being the only attraction of bees, they are but little, if at all, influenced by this consideration, but they are guided almost wholly by the presence of accessible nectar. How they first learned of its presence there I am not sure that I can tell, but most likely by the sense of smell. When, therefore, men assert, as above, and as Mr. Tyndall in his Belfast address, in giving the views of Mr. Darwin, tells us that "The beauty of flowers is due to natural selection, those that distinguish themselves by vividly contrasting colors from the surrounding green leaves, are most readily seen, most frequently visited by insects, most often fertilized and hence most favored by natural selection;" so far as the more frequent visits of insects is concerned, this grand scheme of "natural selection" exists only in the minds of these speculators.

But next let us inquire what dependence is to be placed in the statement that those plants having brilliantly colored flowers are more frequently fertilized and so more prolific than others. We might stop here and simply ask, are such plants more prolific than others? and leave those who make the affirmation to give us some evidence besides their simple statements. Is the hollyhock any more prolific than the chickweed that fertilizes itself before it opens its tiny petals? Is the sunflower more prolific or more able to hold its own in the "struggle for existence" than the sand-bur? Corn fertilizes itself by simply shedding the pollen from the tassel upon the silk without any insect agency. Wheat is generally fertilized before the stamens and pistils have protruded beyond the palæ of the chaff.

The fact is that the doctrine of insect agency in the fertilization of plants has been pushed too far—much farther than the facts will warrant.

Mr. Thomas Meehan, than whom there is none more competent to speak on this subject, after extended and repeated experiments for the express purpose of throwing light on this subject, draws the following conclusions: (1). "That the great bulk of colored flowering plants are self-fertilizers. (2). That only to a limited extent do insects aid fertilization. (3). Self-fertilizers are every way as healthy and vigorous, and are immensely more productive, than those dependent on insect aid. (4). That when plants are so dependent they are the worse fitted to engage in the struggle for life—the great underlying principle of natural selection." Where is there a more prolific seed-bearing plant than the lambs-quarter—*Chenopodium alba*—though both flowers and seeds are so inconspicuous as to be scarcely noticeable. Still another example is found in the Amaranth family which though very minute in both flower and seed is one of the most prolific weeds to be found in the country—often multiplying by tens of thousands. Let us turn now for a moment to the consideration of colored fruits, as this is so intimately associated with the above that we can hardly separate them.

The same claim is set up for color in fruits as aids in their dispersion that we see has been made for it in flowers as aids to their fertilization.

Mr. Tyndall, as above, says: "Colored berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving the trees and shrubs possessing such berries a greater chance in the struggle for existence." Likewise Mr. G. Allen says: "Strawberries, raspberries, and blackberries, all belong to the class of attractive fruits. They survive in virtue of the attention paid to them by birds and small animals."

Of course then in the absence of these "birds and beasts," and "small animals" all these trees and shrubs would soon perish from the face of the earth. How then is it that those plants destitute of colored fruits manage to survive. How do maples and poplars and hundreds of other trees and shrubs that have no colored fruits survive? Why then do the potentilla still live, so like a strawberry in all except the enlarged, fleshy receptacle that we dignify with the name of "fruit." "Ay," says Mr. Allen, "there's the rub. Science cannot answer as yet." How then can it speak so confidently in regard to the strawberry?

Have these priests been into the secret chamber of nature and received a revelation of some of her secrets while others have been withheld? That these colored fruits do contribute somewhat to the dispersion of their seeds may be very consistently admitted; but that their existence is dependent on this, or that this gives them any special advantage, in the battle for life, over other species not thus favored may be as consistently denied. This is but one of several means employed by the Author of nature for the dispersion of seeds and the consequent dissemination of plants. One class is furnished with winged seed (samara) that cause them to be floated on the air to a considerable distance from the parent tree. The maple, ash, negundo, etc., are examples of this method. Another is furnished with a downy pappus that causes them to float in the air to a long distance at times. The dandelion, thistle, fire-weed, poplar, are illustrations of this. Still another method that I may mention is where the seeds are furnished with barbs or hooked spines by which they attach themselves to the clothing of persons or to the hairy or woolly coats of passing animals, and are thus carried to distant places and dropped, as in the case of burdock, cocklebur, beggar-lice, sand-bur, etc. Any of these methods furnished just as much assurance of the proper dispersion of seed to their species as do the colored fruits to those kinds producing them. The fact seems to be that the system of evolution sought to be built up and sustained by arguments drawn from the color of fruits and flowers, as above, is a speculative hypothesis based on suppositions and imaginings, bolstered up by doubtful analogies, and facts taken out of their true relations and explained by fanciful and forced interpretations.

CAÑON CITY, COLORADO.

PHYSICS.

REMARKABLE ELECTRICAL DISTURBANCES IN IDAHO TERRITORY.

D. A. WILLIAMS.

For the benefit of those interested in electrical science perhaps a few facts regarding the difficulties experienced in operating the telegraph lines of Idaho Territory may be useful, and possibly a remedy suggested by the scientific reader of the REVIEW.

On account of the dryness of the climate of Idaho Territory, it has been supposed no such difficulty as was experienced during the past summer would ever occur, but the practical telegraphers of the Oregon Short Line Railroad have met an obstacle, although it may not be insurmountable, is nevertheless very annoying, and new in telegraphic experience.

Twenty-five miles west of Pocatello the railroad and telegraph line crosses the Snake River just below its change of direction from west to almost due south. The road crosses the river directly over the American Falls, or Rapids, which it is thought by some develop or throw into the atmosphere, thence to the wire, a large amount of electricity.

The Snake River is not again seen from the railroad until a distance of one hundred and thirty-five miles is reached almost due west, thus the river courses around a great bend or elbow; when at King Hill it is again touched by the railroad but not crossed.

The writer was located at Shoshone, nearly midway between the American Falls and King Hill Station, which is also the junction of the Wood River Branch of the O. S. L. R. R., extending northward to the silver mines of Idaho. It was here that the writer had an excellent opportunity to observe the electrical disturbances as they occurred frequently between the months of May and October the past season.

When the telegraph wire had been extended as far west as King Hill we noticed whenever a storm-cloud appeared southwest (where they always appeared in summer,) there would occur a strange noise on the wire. At first the noise would be faint, but as the cloud (which to all appearances shed no rain, as rain seldom falls on the great lava plains of that district,) approached, following the course of the river, the peculiar humming noise would continue to increase until it became a roar, but more remarkable still, every "relay magnet" on the telegraph wire between the American Falls and King Hill would become useless and remain so until the storm had passed north of the American Falls. When the electric current was reversed, and the magnets would appear as in an open circuit. Occasionally the circuit would as suddenly close, but the telegraphic characters heard were the reverse of the ordinary Morse Alphabet, and the wire would appear to be crossed with another wire, but which was not the case, there being but one wire on the road, which rendered crossing impossible without human agency.

The Snake River in its course performs nearly a half circle, and runs about twenty-five miles due south of Shoshone, but very few of these storms, or electrical clouds, ever passed directly over the town of Shoshone. In one or two instances late in the season, such was the case, however, and a fine shower accompanied the cloud, but all the effects of the overcharge (for that is what it seems to be writer to be) of electricity also accompanied it. In this case we thought the cloud had left the river at the Great Shoshone Falls, taking a northerly course until it spent its force in the Wood River Mountains.

During these storms several experiments were tried hoping to solve the mystery and provide a remedy, but without success. When the "ground wire" was attached to the telegraph wire at Shoshone, cutting off the west, for the purpose of getting rid of a portion of this foreign current, it was found the current was very much stronger, suggestive of a very heavy foreign battery in contact with the wire. As before stated, during the prevalence of these storms the magnetic current would become reversed; rendering all magnets on the line useless, between the points were the storm originated and where it again crossed the line, when the ground wire was applied to the wire as just mentioned, the magnetic current on a portion of the line would again assume its proper relation to the main batteries, but could not be used on account of the great increase of electricity, which would go and come at intervals of about five minutes. The ground wire was then applied to the east side of Shoshone, thus cutting off all battery from the west end of the wire, but the same state of affairs appeared, only there seemed to be a continuous metallic circuit, when for a time we would notice no humming noise, but the overcharge of electricity would be as strong as on the east side. This fact astonished us and could not be accounted for until it was discovered by the writer that his ground wire was not in the ground at all, neither had any on the line been put in the ground, but only attached to a "T" rail, or a box-car wheel (the same car being used as a telegraph office). The rails are laid with the patent "Fish Plate" joint, thus making an excellent conductor of electricity, and ordinarily the ground wire thus attached to the rail or wheel, made an excellent ground contact. These ground wires were afterwards placed in the ground with better results though by no means satisfactory to the telegraph department, it was found that during these storms the ground (this section is the gold bearing field of Idaho) was very heavily charged with electricity; we think the "cross" mentioned was thus accounted for, but how to account for the appearance of the reverse of a telegraphic alphabet of Morse characters on the wire is a question the writer would be glad to understand, it being also understood, of course, that at Pocatello where is located the dispatcher's office, the characters used were plain "Morse," while west of American Falls, until we reached Medberry west of King Hill, they were all reversed except when the storm-cloud had performed its circle; then an open circuit would occur between the stations mentioned, although the line was intact.

The coming of these peculiar storms could be foretold by tne strange humming noises, not like that made by the wind, but more like humming of bees, as we sometimes think we hear in a telephone receiver.

Taking off the main battery at Shoshone seemed to have but little effect upon the telegraph line during the prevalence of these storms. The relay magnets could not be adjusted to overcome these accumulations as is done in this section. When the main batteries were off the ground wires were on, showing the presence of an *earth current* as well as an *air* current on the wires.

There is possibly a solution of the difficulty in working of our telegraph wires during such an electrical display as we had last winter and spring. The writer has a theory regarding *earth currents* during these storms, and hopes at a future opportunity to demonstrate by actual experiment, that the "*earth wave*" is stronger than the "*air current*" as we have been led to believe during the auroral displays of our winter and spring.

It may be stated regarding the Idaho electrical storms, that there was no main battery on the telegraph wire west of Shoshone during the past summer, as the wire was in process of construction. There was also a slight escape of electricity from the wire through the "switch-board" to the lightning arrestor, but not as great as in an ordinary thunderstorm, such as we have witnessed at Kansas City and other cities in this section.

PHILOSOPHY.

SPHERAL EVOLUTION.

CHARLES MORRIS, PHILADELPHIA.

All the life and activity of the universe is dependent upon its effort to attain equilibrium of temperature. Yet its temperature inequality is only a temporary condition. A process of equilibration is in steady operation. When this reaches its ultimate result, and the temperature of the spheres and of space becomes everywhere equal, all life must cease, and general stagnation succeed the existing play of energy. Such is, briefly stated, the celebrated hypothesis of Sir William Thompson, according to which the universe is a wound-up clock, which is kept in motion by the gradual descent of high temperatures and ascent of all low ones, and which will run down when temperature becomes everywhere equal, and will thenceforward remain in eternal rest.

This hypothesis is not an agreeable one to contemplate, and many strenuous efforts have been made to break the strength of the argument upon which it rests. But it must be admitted that these efforts have been, so far, futile, and that it is impossible to escape, with our present knowledge of physical laws, from the conclusion above enunciated It is undeniable that every heated substance or sphere is losing its heat, that every cold substance or sphere is receiving heat from hotter sources and that all material activity is a result ofthis interchange. This process can have but one result, judging from the present standpoint of science. Heat equilibration and material stagnation must ensue. General rest and death must succeed the energy and activity which now give vitality to the universe.

If, however, we can, as yet, adduce no physical principle to annul the conclusions of this celebrated hypothesis, it cannot be declared that no such principle exists, since it is quite possible that we are ignorant of, or mistaken in regard to, many of the governing laws of nature. Facts always have the precedence of theories, and there are certain facts which seem irreconcilable with the hypothesis referred to. As it has never yet been considered, so far as we are aware, in the light of these facts, we propose to adduce them here, as an illustrative argument against its conclusions, where all logical arguments have failed.

As to the primary condition of the universe two theories exist. It either began its existence at some definite period, in response to a creative fiat; or it has existed from eternity, and has during infinite time been subject to the same laws which now control it. If the latter view is accepted the stagnation hypothesis at once goes by the board. A clock whose motion is not perpetual, and which began to run down at an infinite period in the past, must have come to rest infinite ages ago.

If, however, the universe commenced its existence at some finite period in the past, its present activity is perfectly compatible with a movement towards final stagnation. We cannot deduce from the conditions of the stellar universe which hypothesis of "the beginning" is the correct one. But these conditions may lead us to some conclusion as to the probable course of stellar evolution.

We know that all stellar evolution has been a process of material condensation and integration. Diffused matter has gathered into nebular masses. These have condensed into solar nebulæ, and the latter into suns with attendant planets. Many of the planets have cooled off and solidified superficially, and in some cases perhaps completely. Suns have also cooled, and in many cases may have lost their luminousness.

The visible universe presents instances of this whole range of gradations. There are distinguishable in the skies stellar masses of many degrees of luminosity. Some indicate in the spectroscope an intensely heated condition. Others appear much less heated. Some have grown comparatively cool. Others, as the companion of Sirius, are but faintly luminous. Still others, as the companion of Procyon, have lost all visible light-giving powers. That there are dark suns which have cooled far below the luminous stage cannot be proved, but is quite within the range of probability.

On the other hand numerous stellar bodies exist which have not yet attained the solar state. Nebulous masses are visible whose variety of conditions is yet greater than that shown by suns. From a stage in which they are little short of solar condensation they can be traced through greater and greater degrees of rarefaction until they become dim and shapeless whiffs of light-yielding matter, that seem but just blown together out of the homogeneous gas of space.

This represents what we can see. The telescope unfolds an extraordinary range of stellar evolution, from the just visible and utterly shapeless nebula, to the sun which has almost cooled into darkness. That we see all that exists it would be idle and probably false to affirm. We have one or two indications of the existence of dark suns, and it is quite possible that thousands of such exist, many of which may have grown non-luminous untold millions of years ago. At the other end of the series it is all but certain that nebulæ exist too faint to be resolved by our telescopes. Millions of others may exist which are in a far less evolved condition than those we see. We can behold in space the line of stellar evolution, yet existant in examples of nearly its every stage, from the faint nebula to the darkening sun. The scope of logical deduction carries our vision still further, and adds to the extent of this line at both its ends. Such is the existant condition of the material universe, as revealed to us in the depths of space. Must conclusion arise from this condition? This is the problem which we have now to consider.

If the universe was created at some definite period, with its existing laws of material evolution, it must have begun its existence either as homogeneously diffused matter, or as matter partly diffused and partly aggregated into masses. If it is to be finite in duration, and end at length in irreversible stagnation, the latter method of creation must be the true one. Unless there is some reversing agency at work it is impossible to understand the extraordinary diversity of conditions of aggregation in the stellar universe, except on the hypothesis of a creation in these diverse conditions.

It is true that there is a great difference in the rapidity of condensation of stellar masses, in accordance with their difference in size. If we compare the Moon, the Earth, Jupiter, and the Sun, we have four spheres, whose evolution began simultaneously, which are now widely different in degree of condensation. It is quite possible that a great number of spheres, which began to condense simultaneously, might, after many millions of years, present a great diversity of conditions, if they were greatly diverse in original size. But this idea will not explain the diversity of the stellar masses, in which there is no reason to believe that degree of condensation is accordant with difference in bulk, or that the fainter nebulæ could have begun their evolution simultaneously with the larger and cooler suns. The indications, indeed, point strongly towards a successive beginning of condensation in many of the visible masses. This is strengthened by the fact that the nebulæ are not scattered indiscriminately among the suns, but are mainly grouped in a region of space by themselves, as if a secondary and much later creation had taken place in this region.

We seem thus forced toward the alternative of a heterogeneous creation.

Here a solar sphere was called into existence, there a nebula, there a mass of diffused matter, destined to become condensed into nebulæ and suns. We can not well reach any other conclusion from the facts, if we accept the theory that the process of stellar evolution is an irreversible one, and that the universe is moving steadily onward towards a condition of eternal stagnation.

And yet, if a logical examination is made of this hypothesis of original heterogeneity, it can scarcely be sustained, since it requires a method of creation that is so improbable as to be barely conceivable. It tells us that some of the solar orbs were called into existence in a mature or nearly mature stage, others were born immature, and others left to evolve from their germinal condition. This would be to affirm that stellar creation was here direct, here partly indirect, and here completely indirect. It would be synonymous with the affirmation that both direct creation and evolution are true of the animal world, some species being called into existence by a direct creative fiat, others created in embryo and left to attain maturity by development, and others evolved by natural processes from inorganic nature. Whatever theory of animal development be accepted it will certainly be no such double hypothesis as this. Nor can we safely affirm any such double process of stellar development or origin.

The only direct evidence we possess of the method of stellar development is that displayed to us in the geological history of the earth. We are fully satisfied that the earth has developed from a far less mature condition to its present state. And the facts in favor of the nebular hypothesis are less positive proof of an evolution from a nebulous mass to the present conditions of the solar spheres. The testimony of the stellar masses of space adds to the strength of this evidence, and points to nebulous masses yet seemingly in their primitive stage, while we are to some extent justified in imagining others which have in comparatively recent times begun their condensation.

From these various reasons we can scarcely avoid the belief that evolution from diffused matter has been the history of every sphere of space, and that the great range of conditions between the embryo and the mature stages now existing are positive evidence that the present condition of the universe does not represent that of the original creation. The evidence of the spheres is strongly in favor of an evolution of them all from a primitive germinal stage, and of some reversing principle which will, and has frequently in the past, overcome the tendency to temperature equilibrium and stagnation, and reduced mature spheres to their primitive stage of diffused matter.

If we can imagine a period in which all the material of the present universe was spread through space in a diffused condition of partial or complete homogeneity, there seems but one conclusion. Spheral evolution, under the influence of gravitation, must have everywhere at once begun. All the matter capable of condensing would have gathered into nebulæ, leaving the remaining matter in a state of excessive rarity. These nebulæ would have become spheres, and finally only spheres of various degrees of condensation, with intervening rare matter, would have existed. If the process was irreversible this condensation must have gone on, until final stagnation was reached.

Yet the record of the skies tells a different story, since it speaks of spheres which are hoary with their weight of ages, and of numerous other masses which have but recently drawn together out of the matter of space. Whence came the latter? It is impossible to conceive that they delayed the commencement of their evolution until after other spheres had gained their mature stage, nor can we imagine that the diffused matter left from the first period of evolution was sufficient in quantity and suitable in condition to set in train such an extensive second evolution as the story of the nebulæ indicates.

The facts strongly favor some reversal of the original process, and indicate that these new-forming nebulæ are built up from the diffused material of spheres which had gained the ultimate phase of their condensation, and then through the operation of some energy, of whose character and whose laws of action we are ignorant, reversed their condensing process and become again dispersed as diffused matter through space. In this manner the requisite substance for a new process of nebular and spheral evolution would be provided. Whether such a dispersal of the matter of older spheres, if it took place, did so immediately, through some grand disrupting convulsion, or gradually, through some slow and unavoidable reversal of the processes of natural energy, is of course beyond the reach of conjecture. But it can be affirmed with some reason that the conditions of matter visible in the depths of space, and the logical conclusions as to the conditions of invisible matter, indicate that the universe is not a clock which is destined to run down and end in eternal cessation of life and motion, but a self-winding clock, a perpetual-motion time-piece of eternity, which can never cease to run, but whose springs of motion, when they have almost lost their force, shall again, through some natural law, as yet unknown to us, regain their primitive energy, and again set the wheels of evolution in play with all their pristine force.

ARCHÆOLOGY.

A MONSTER MASTODON.

Mr. Herschfelder, American Vice Consul here, and a well-kown archæologist, was fortunate enough to secure some stone tablets with well defined hieroglyphics from Muskoka. He had scarcely settled himself down to business again when he was off on another expedition, this time to a place in the vicinity of Woodstock, where he has been digging and delving for the past four or five days. The story of his expedition is an interesting one. Twelve years ago, while some laborers were engaged in digging a drain on the farm of George Crumble, about five miles east of Woodstock, and in the township and county of Oxford, one of them met with an obstruction which he smashed with his spade and pitched to one side. It turned out to be a bone belonging to some gigantic animal, but nothing further was thought of it and the matter was forgotten. About two years ago it was decided to tile drain the same field, and in clearing out the old drain other bones were found. An enterprising individual by the name of Carter secured them, and after cleaning, varnishing, and duly labeling the relics, proceeded to exhibit them at so much a head, for the benefit of the rising generation. Mr. Herschfelder came to hear of them, and after paying a good round sum secured the bones. Another payment secured the right to dig over Crumble's field, in which they were found. A gang of men were at once set to work. A ditch 75 feet long, 40 feet wide and four feet deep was dug, and the enthusiastic archæologist was rewarded by finding fully one-half of the bones of a gigantic mastodon. It is needless to say they were very carefully taken from their resting place and boxed up for shipment to Toronto. They are in a remarkably good state of preservation, and their situation rendered the task of exhuming them one of comparative ease. The surface soil consists of a light sand, under which is a layer of decaying vegetable matter. Under this again is a harder layer of decaying vegetable mold; then comes a soft, yellowish-colored clay, and last the hard blue clay in which the remains were found, the latter being only about four feet below the surface. So far as known at present these are the first remains of the kind ever discovered in Canada. To give an idea of the huge proportions of this monster, whose race was extinct long before antiquity had begun, a few measurements of some of the bones which Mr. Herschfelder brought back with him are given. Several of the ribs measure 44 inches long by about 12 in circumference. The lower jaw is no less than 30 inches long, and must have weighed, in the living animal, upwards of 150 pounds. The surface of one of the teeth is 7 inches long by 3½ wide, while the root is buried over 4 inches in the jaw. One vertebra measures 17 inches in length, and one of the bones of the fore leg 30 inches long by 24 inches in circumference. Mr. Herschfelder thinks he has fully one-half of the skeleton, and expects to get more.

The mastodon is an extinct proboscidian mammal, coming near the elephant, and either in the tertiary or more recent deposits in all quarters of the globe, except Africa. It has the vaulted and cellular skull of the elephant, with large tusks in the upper jaw. From the character of the nasal bones and the shortness of the head and neck it is thought that, like the elephant, it had a trunk. A few remains of the mastodon had been discovered in the United States as early as 1705, but not until 1801 was anything like a complete skeleton obtained, when a tolerably complete one was found in Orange County, New York.

The geological position of the remains of this species has long been and still is a subject of dispute amongst geologists. In a few instances they are said to have been found below the drift in the pliocene and even in the miocene, but they have generally been obtained from the post-pliocene or alluvial formations at a depth of from five to ten feet. Some have thought that the mastodons became extinct since the advent of man upon the earth, like the dinornes and the dodo. According to Lyell the period of their destruction, though geologically modern, must have been many thousand years ago. According to Owen the mastodons were elephants, with molars less complex in structure and adapted for coarser vegetable food, ranging in time from the miocene to the upper pliocene, and in space throughout the tropical and temperate latitudes. The transition from the mastodon to the elephant type of dentition is very gradual.—*Toronto Mail.*

THE AGE OF THE WORLD.

W. M. PAGE.

According to the reckoning of our Jewish fellow-citizens, who are at this time celebrating their religious festivals on account of their New Year Day of Atonement, and Feast of Tabernacles, it is from the creation of Adam to the present time 5,644 years.

	YEARS.
The Seder Olam Lutha makes it	6,243
The Eastern Jews	6,104
The Western Jews	6,068
The Chinese Jews	5,963
The Seder Olam Rabba	5,635
Rabbi Gershom	5,638
Rabbi Habsom	5,624
Rabbi Nosen	5,618
Rabbi Hillel	5,584

To the above ten Jewish authorities we add below five Christian authorities:

	YEARS.
Joseph Scaliger	5,833
Petan or Petavius	5,867
Usher (generally found in our Bibles)	5,887
Mursham	5,883
Isaac Newton	5,871
To the above I add my own	6,992

It will be seen that of the above sixteen authorities, no two of them agree.

It will be seen that my own calculation makes the age of the world more than 1,000 years longer than any of the above Christian writers, and 1.348 years longer than the date of our Jewish fellow-citizens, who are now celebrating their festivals. The learned writer of "Ordo Sæclorum" writes: "That the chronology of the Scripture history, both as a whole and in many of its details, is involved in much uncertainty no one who has given any heed to this subject can fail to be aware. Even in the New Testament, enclosed as it is in a richly historical era, the learned have never been able to agree upon the precise dates of its cardinal events; while in the Old Testament the authority of distinguished names is evenly balanced between schemes which, besides a multitude of minor discrepancies, vary in their large ranges by many centuries of difference. And, when one looks beyond mere tables, and considers the vast amount of learning and thought which must have been bestowed upon their construction, it is natural to infer from the wide discrepances of the results, that the elements of the problem must needs be very ambiguous or defective. Accordingly the subject is commonly pronounced to be one on which further inquiry is not only vain —since, if certainty were to be had, the question would have been settled long ago—but presumptuous too; for does it not betray an overweening temper to think of making discoveries in a matter which men of consummate learning have failed to bring to a satisfactory adjustment?" Introduction, page 1, sec. 1.

"When we survey the strange variety and discordance of the several systems of chronology, scarcely two of them agreeing, even in their fundamental dates, and all differing from each other more or less in the principles of their construction, and in the application of those principles, sometimes adjusting sacred chronology by profane and sometimes the reverse, without any settled rule or standard, we may naturally be led to despair of any solid or scientific improvement of the subject, especially at this advanced season, after the failure of so many of the greatest scholars, historians, mathematicians and astronomers, when no fresh documents can be expected, and when many valuable records to which the earlier chronologers had access are now lost and swallowed up in the abyss of time. A modern chronologer discloses: 'It is easy to pull down the system of chronologers; it is by no means so to build up in their room one that can support itself against all difficulties; I do not even believe it possible,' Sarcher, Herodite, Tom. 1, page 309, 1st edition. It is indeed 'easy to pull down,' as may appear from the foregoing section; but 'to bui'd up' is most difficult." Hale's Analysis of Chronology, vol. 1, page 265.

I have given the above quotations to show that I have undertaken no easy task, when I attempt to establish the true time which has elapsed from the date of the creation of Adam to the present time. All we can know of the past is from what has been recorded by those who have lived in the past. In regard to the date of the creation of Adam, the Hebrew writings are almost our sole reliance; indeed, with the exception of the Sothiac, or rather Sethic cycle, which crosses the Hebrew narrative at two essential points—the Exode and the Flood—we have no other record but the Bible to assist us in building up a true chronology from Adam to the present time. It may be well at the outset of this investigation to inform the reader that the Bible, in whole or in part, has been preserved to us in three different languages—namely, in Hebrew, Samaritan and Greek, and also that scholars differ very widely in their calculations. As they form their chronological tables from one or the other of these authorities, this difference arises partly from the mistakes of copyists and translators and partly from the wilful corruption of the text. We now place before the reader the chronology of each of these versions, from Adam to Abraham, and give our own opinion supported by the Sethic, and also by the Sabbatical and Jubilean cycles.

THE AGE OF	HEB.	SAM.	SEPT.	TRUE.
Adam at the birth of Seth	130	130	230	130
Seth at the birth of Enos	105	105	205	105
Enos at the birth of Canaan	90	90	190	190
Canaan at the birth of Malaled	70	70	170	170
Malaled at the birth of Jared	65	65	165	165
Jared at the birth of Enoch	162	62	162	162
Enoch at the birth of Methuselah	65	65	165	165
Methuselah at the birth of Lamech	187	67	187	187
Lamech at the birth of Noah	182	53	188	188
Noah at the Flood	600	600	600	600
Date of the Flood	1656	1307	2262	2062
The Flood lasted one year	1	1	1	1
Arphaxed born after the Flood	2	2	2	2
THE AGE OF				
Arphaxed at the birth of Sulah	35	135	135	135
Sulah at the birth of Eber	30	130	130	130
Eber at the birth of Phaleg	34	134	134	134
Phaleg at the birth of Ragan	30	130	130	130
Ragan at the birth of Serny	32	132	132	132
Serny at the birth of Nahor	30	130	130	130
Nahor at the birth of Terah	29	79	79	79
Terah at the birth of Abraham	70	70	70	70
Date of birth of Abraham	1949	2250	3205	3005
From the birth of Abraham to the Promise	..	..	..	85
From the Promise to Exodus	..	..	..	430
From Exodus to Vulgar Era	..	..	..	1590
From Vulgar Era to 1883, A. D	..	..	..	1882
From Adam to A. D., 1883	..	..	..	6992
From A. D., 1883 to 7000 from Adam	..	..	..	8
From Adam to the year A. D., 1890	..	..	..	7000

The flood according to Egyptian authorities took place on the 17th day of the third month of the vague year; and according to the Hebrew Bible on the 17th day of the second month; now, in the year A. D. 3048 (which is equal to year A. M. 2062) the 17th day of the Egyptian third month of the vague year fell on the same day as the 17th day of the Hebrew second month; as also did the 1st day of the seventh month of the Egyptian vague year fall on the same day as the 1st day of Nison of the Hebrew year in B. C. 1590. And this is further confirmed by the Jewish cycles of the Sabbatical and Jubilean years.

Jesus commenced his ministry in a Jubilean year; see Luke iv, 16-19, and this year was the 15th of Tiberius Cæsar or A. D. 29. The Jubilean cycle was a cycle of forty-nine years, and if the Exode took place in B. C. 1590 then the first Jubilean year was B. C. 1540, the thirty-second Jubilee was in A. D. 29, and the seventieth Jubilee, which also is the Great Jubilee, will commence with the Jewish new year A. D. 1890, before which time, I predict, the Jews will be masters in Jerusalem, for the time of Gentile rule over the Holy City will have ended.

I base the above predictions on the words of the Prophet Daniel, chapter 9, verse 11. The curse there spoken of must relate to their chastisement "seven times" for their sins. Seven prophetic times are equal to 365 years multiplied by seven, equal to 2,555 years of punishment for sins. The beginning of this period must have been when Esarhaddon invaded Palestine, carried the ten tribes into captivity and sent Manasseh, King of Judah, a prisoner in chains, to Babylon, all of which took place in B. C. 670. And if the beginning of the "seven times," or 2,555 years of captivity, commenced B. C. 670, they will end in A. D. 1886, at which date the "times of the Gentiles" will end and Jerusalem will be once more under Jewish rule. But if a Jubilean year will commence in September, 1890, a Sabbatical year will commence in September, 1889, and if so, then a Sabbatical year has just ended at the commencement of the present Jewish New Year—or, to speak more correctly, it ended just one Jewish month earlier, for the Jews, following the 19-year cycle, are just one month out of line this year, with all their feasts and festivals, while last year they held them correctly. This mistake has happened to them on account of their adoption of the Gentile method of regulating and bringing into harmony their lunar, with the true solar year, instead of following the more correct mode of their fathers. In other words they made the last year a leap year of thirteen months, when, according to the usage of their fathers, it would have been an ordinary year of twelve months, for they always commenced their religious or ecclesiastical year with that moon whose 15th day would happen after the sun had entered Aries. By following this rule their festivals would always be held by them at the proper time, instead of, as is the case this year, one month out of line with the true time for holding them.

If the reader will verify for himself that I have given the true date when the Egyptian vague year crossed the Hebrew year, he will then be sure that the date of the Exode was B. C. 1590, and the date of the Flood B. C. 3048. It will follow that the first Jubilean cycle was in B. C. 1540, and the seventieth Jubilean cycle will commence September, 1890, or 7,000 years from Adam.

In conclusion, there has been much said of late of Egyptian records running back into a very remote antiquity. It is fortunate that the Egyptians made an observation of the planetary configuration at the time of Menes' arrival in Egypt, and that it has been preserved for us on their temples and in their sacred writings even to the present day. We are at present already acquainted with sixteen temples and monuments, which exhibit a representation of this very planetary configuration of Menes. On the majority of them the ancient Menes stands opposite to the row of the gods, his only garment being a tiger skin; on others his person and his name are expressed by means of the crescent ⌣ i. e., the letters M N or Menes. The most concise expression of this planetary constellation is to be found on the Osimandyeum near Karnak from the year 1700 B. C. For a copy of this astronomical inscription and its explanation, see my "Berichtigungen der alten Geschichte," page 198. Each of the seven planetary gods is seated in a chair, together with one of the twelve gods in whose sign the planet happened to stand at the time. We find the sun in Cancer 0°, the moon in Scorpio, Saturn in Sagittarius, Jupiter in Aries, Mars in Sagittarius 10°, Venus in Cancer 10°, Mercury in Cancer 5°. This planetary configuration, which has occurred but once in history, has reference to the year 2781 B C. to the 16th day of the Julian July."—[Seyfarth's Chronology, page 94.

Thus we find that Menes entered Egypt 267 years after the flood, and we learn from Lyncellus that the shepherd kings conquered Egypt in 701st year of a sothiac cycle, or in the year B. C. 1670. The Israelites entered Egypt during their occupancy of the land, and were welcomed by them in B. C. 1805. When another king arose who knew not Joseph in B. C. 1670, the Israelites were enslaved for a period of eighty years, and were released by Moses in B. C. 1590. —*Globe-Democrat.*

ANCIENT RACES OF THE MISSISSIPPI VALLEY.

At the last meeting of the Chautauqua Circle, at St. Louis, Major F. F. Hilder delivered a lecture upon "The Ancient Races of the Mississippi Valley," but most of his attention was devoted to the remains discovered in southeast Missouri. It is in that part of this State the greatest number of well-preserved relics are found, and his collection embraces many valuable finds of this region. The most curious were used in illustration, particularly of his theory that there are not only connecting links between the mound-builders of this country and the ancient Asiatic people in their customs, but also that their languages were similar. The religion of the mound-builders was sun-worship, and traces are found in every mound uncovered of their ceremonies and rites in this worship. The pottery found among the dust of their chiefs and rulers bear signs and symbols peculiar to this religion in every nation of the world where it is practiced. He had but recently, with Prof. Campbell, succeeded in deciphering the inscription on a tablet which showed there were words of their language exactly like those of ancient Asiatic languages, and in some instances found in other forms in modern tongues. A vase found within six miles of Charleston, this State, he described minutely in a letter to Schliemann who was at that time before Troy digging for the relics of the Hellenic race. In reply Schliemann said his statements had been received with wonder, so nearly allied were all the characteristics he had mentioned, to ware found by him in his diggings. The position of the vase had been such as to warrant the belief that it had been buried 1,000 years.

ASTRONOMY.

GLOWING SKIES OF NOVEMBER AND DECEMBER, 1883.

The peculiar glowing appearance of the morning and evening sky since about the middle of November has aroused much scientific and popular curiosity all over the world, and we have received numerous letters and personal inquiries concerning it. For the purpose of giving our readers all the information possible upon the subject, we present herewith a letter from Prof. C. W. Pritchett, of Morrison Observatory, and also extracts from several articles that have appeared in our exchanges.—[Ed. Review.

Morrison Observatory, Glasgow, Mo., Dec. 17, 1883.

Editor Review.—For several weeks I have watched with much interest the special phenomenon referred to in the extracts you sent me. Its *persistence*, *intensity* and *duration*, have alike claimed my attention. On some evenings and mornings the appearance has not only been gorgeous but even startling. On the evening of December 14th, while observing the Comet Pons-Brooks in the northwestern sky, this red glow could be distinguished in the field of the telescope, as late as 6h. 30m. Valley Time. Investigations of the *causes* of the phenomenon, belong in part to meteorology, and in part to meteoric astronomy. In neither of these fields of inquiry am I an amateur. I can only subjoin a few notes, from my own observations.

I think it evident, that the phenomenon is due to some attenuated form of matter in the upper regions of the atmosphere. This granted, the question arises, *What* and *when?* We can scarcely think it is vapor, whose particles are so light and dispersive that they cannot be condensed into clouds; for the sky has been unusually free even from "haze," for days and nights together. Again, granting the existence of such masses of unrecognized vapor in our atmosphere, they would be local, or at least confined to certain zones of the earth. This phenomenon, however, has been widely observed over all North America and in Europe. Again, vapor in the attenuated form could not persist so long, nor could it have the *refractive* and *reflective power*, which morning after morning, and evening after evening it has revealed to the most casual observer. That these particles are at a *great height*, is evident from the fact that the glow frequently extended all around the horizon, to an altitude of 45°, and on several evenings it reached to the zenith—and all this in a sky perfectly cloudless, for days and nights in succession. One marked feature, which I have noted, has been a zone of *intense blue*, about 35° above the horizon, and most conspicuous directly over the place of the Sun, both morning and evening. Directly above this zone, and opposite the Sun, appeared a gathering darkness, in a pyramidal shape, with base toward the Sun. Nor has this last appearance been confined to twilight. I have had occasion on a number of the fine days of the last few weeks to observe the bright star Alpha Lyræ, when on the meridian, the culmination usually occurring about 2 o'clock of Valley Time. On two of these evenings, looking up, vertically, into the cloudless heaven, from the darkened transit-room, through the slit in the roof, this *same condensation* was obvious, following the Sun—as if there were myriads of faintly illumined and minute bodies in the upper atmosphere. The *conjecture* that this phenomenon is due to the presence of "meteoric dust" in the upper regions of air, is *not to be despised.* That the Earth's orbit intercepts various meteor streams is a well known fact in astronomy. It is *possible* that we may have passed through such a stream in daylight, and have only the slowly descending ashes of countless myriads of "shooting stars" to remind us of the fact. It is reported that explorers in the Himalayas have recently found on the ice and show, far from any human habitation, large deposits of this ferruginous dust. It has sometimes settled down on ships, far out at sea, and must either have come from the "upper depths," or else have been borne by wind currents hundreds of miles from distant volcanoes. But this whole subject needs numerous accurate observations and much patient investigation.

C. W. Pritchett.

Professor Brooks, of the Red House Observatory, while searching for a comet near the Sun, November 28th, discovered a wonderful shower of telescopic meteors, some of which were moving southward and others northward. Prof. Brooks believes that this display has some connection with the remarkable red light seen near the sun at sunrise and sunset for several days, and that the earth is passing through a mass of meteoric dust or is enveloped in the tail of a gigantic comet.

The *Scientific American*, noticing Professor Brooks' theory that it was caused by "swarms of meteors" in the upper sky, which the professor saw while looking tor a comet, says:

Assuming, then, that he really did see an extraordinary swarm of meteors, and remembering that meteors large enough to be visible without telescopes, and some of great size and brilliancy, have recently been unusually numerous, the suggestion that the red light seen in the sky for several evenings past, long after sunset, may be caused by reflection from clouds of meteoric dust in the upper portion of the atmosphere is not unnatural. There are several reasons for thinking that the strange light is the result of some such cause as the presence of meteoric dust rather than of differences of density in the atmosphere leading to extraordinary refraction.

In the first place the phenomenon has not only been visible over an immense extent of territory, but it has lasted several days, and has been seen in the east before sunrise, as well as in the west after sunset, so that any abnormal refraction in the atmosphere would have to be of almost incredible persistence in order to account for the observed appearances. Besides, during this time there have been considerable atmospheric changes, especially in respect to temperature. These remarkable sunset displays have also been accompanied by a notably hazy appearance of the sky.

It is well known that the earth is daily and nightly pelted with millions of meteors, the vast majority of which are almost instantly consumed by the intense heat developed as they dash into our atmosphere. The products of the combustion of these meteors filter slowly down through the air, and have been found in the shape of metallic dust on the snow fields in the Arctic regions, on mountain peaks in Europe and in other similar localities, being recognizable by their peculiar chemical composition. It is also known that the solar system abounds with swarms of meteors revolving around the Sun, and that the earth crosses the path of a number of these, occasionally encountering the swarms themselves. The vast majority of these meteors are very small, those that are seen weighing on an average probably only a few grains; and since the telescope reveals millions which escape the naked eye, it is reasonable to conclude that millions more are too small to be seen with telescopes—mere meteoric dust. Professor Brook's suggestion that the earth has encountered a cloud of meteoric dust is not, therefore, without foundation in probability. If the recent blazing sunsets have really resulted from such a cause, they are likely to continue, in a modified form, for some time, gradually disappearing as the dust sinks lower in the atmosphere. But although so many reasons can be advanced which give probability to the theory that meteoric dust is concerned in the production of these strange sunset effects, yet it cannot be considered as proved, and some better explanation may be offered. Whatever the true explanation may turn out to be, however, everybody seems to agree in the opinion that the red glare in the west during the last three or four evenings has been one of the most singular spectacles beheld in the sky for many years.

At a meeting of the American Astronomical Society, in New York, a few days ago, three theories were advanced. One would have it that the brilliant redness in the evening sky was caused by reflection from banks of clouds below the horizon. Another held that the curious appearance was produced by the passage of the sun's rays through strata of the atmosphere heavily laden with moisture, which absorbed the violet elements, but let the red go on. According to the third notion, which is that most generally accepted, the earth has just penetrated vast clouds of meteoric dust, which occasioned the phenomenon.

Within the last two weeks the strange red glow in the sky after sunset and before sunrise which attracted so much attention here last week has been witnessed across the whole North American continent, from California to Maine. The phenomenon seems to have been first seen on the Pacific coast on the evening of November 20th; and in San Francisco, just as in New York, a week later, people believed that the light was due to a great conflagration. It is a curious fact that while the dates of the appearance of this phenomenon at different places in the United States are such as to suggest that it advanced from west to east across the continent, it was seen in England as early as November 9th. The various descriptions given leaves no doubt that the strange illuminations beheld in England were of the same nature as those witnessed here. Besides, although the most conspicuous feature of the display here was the red color of the heavens, yet other peculiar optical effects were perceived which suggest a close resemblance in many respects between this phenomenon and the green sun and its accompanying appearances, seen in India and South America in September. The explanation offered of the strange color of the sky in India, namely, that it was caused by vapors emitted by the Javan volcanoes in their great eruption at the end of August, seemed reasonable enough; but there were great difficulties in the way of the acceptance of the same explanation of the South American phenomenon, one of the chief of which was the fact that the Sun appeared green in South America before it did in India. Nevertheless, the phenomena in the two countries were so similar that it was natural to ascribe them to a similar origin, and evidences of a volcanic outburst in South America like that in Java were sought for. But it now appears that no such disturbance has occurred in South America.

The likeness between the recent sunset and sunrise phenomena here and the appearances in South America and India just described also suggests a common, or at least a similar, cause. The suggestion that this cause may be the presence of meteoric dust in the atmosphere seems to fit all the circumstances better than any explanation yet offered, although it, too, encounters difficulties. The earth has within the last three weeks crossed the tracks of two meteor streams, and the number of brilliant meteors seen recently has been such as to attract special attention from observers of the heavens. These meteors have nearly all left long trails in their flight, and the latest investigations show that these meteor trails are only incandescent dust or vapor, like that into which the meteors themselves are entirely converted unless, as occasionally happens, they strike the earth before being completely consumed. On Thursday night a very remarkable meteor of this kind was seen in this city, and the observation by Professor Brooks on Wednesday evening of a wonderful shower of telescopic meteors adds to the mass of evidence that the earth has just been passing through a region rich in these cosmic particles, which, falling under its attraction, have plunged into the atmosphere in great numbers.

The suggestion has also been offered that the supposed meteoric matter may be the debris of the famous comet of Biela, which many years ago split in two and afterwards disappeared, leaving no trace of itself except a brilliant swarm of meteors, which came dashing out of the northern sky on the track of the lost comet in 1872. The earth crossed the orbit of this comet, which is believed to have been converted into a mass of meteors, on last Tuesday, the very day on which the most brilliant sunset spectacle was beheld here. At first sight this coincidence in time seems to lend strong support to the suggestion that the remains of Biela's comet furnished the meteoric matter from which the sun's rays were reflected in the higher regions of the atmosphere. But the apparent confirmation disappears when it is recollected that in California the same appearance was presented a week, and in England more than two weeks, before the earth reached the comet's path. Moreover, the meteors seen by Prof. Brooks, and those which for several weeks have attracted attention both in this country and in Europe, did not belong to the Biela swarm, which always approaches from a particular point in the northern heavens. It appears, then, that if an unusual quantity of meteoric dust has recently entered our atmosphere from outer space, it has come, not from any one of the several swarms of meteors which make their appearance at regular intervals, but from meteors which the earth does not regularly encounter, or perhaps from a cloud of mere cosmic dust.

Soon after the comet of 1812 was detected returning sunward last September, it exhibited a wonderful outburst of light, accompanied by an equally surprising and sudden increase of size. Later it faded again, and since then it has behaved in a normal manner, and is now just visible to the naked eye approaching the Sun. The appearances it presented in September suggested that it had had a collision with some other body, producing a sudden flare of light and expansion of volume, owing to the heat developed. In view of the evidence that the region of space through which the earth is now advancing abounds in meteoric masses, it is a curious question whether, if the comet had a collision, it did not run into a swarm of meteors.—*N. Y. Sun.*

DISCOVERY OF ASTEROID PALISA (235).

A cable dispatch has received last night, at Harvard College Observatory, announcing the discovery of a small planet, by Palisa, at Vienna. Its position was

Greenwich M. T.			R. A.			Decl.		
	H.	M.	H.	M.	S.	°	′	″
1883. November 28.	13	20	3	19	14	+15	52	17

Daily motion in R. A. —48s.; in Declination o. It is of the twelfth magnitude.

The planet was readily identified at Harvard College Observatory, and was observed by Mr. Wendell, as follows:

Cambridge M. T.			R. A.			Decl.	
	H.	M.	H.	M.	S.	°	′
November 30.	9	30	3	17	27	+15	51.1

—*Science Observer Special Circular No. 42.*

SUN AND PLANETS FOR JANUARY, 1884.

W. DAWSON, SPICELAND, IND.

On January 1st it has been ten days since the Sun passed Winter Solstice, where his R. A. was 18 hours. Increasing in R. A. at the rate of about four minutes a day, brings him on the 1st of January at noon to 18h. 47m.; and having declined northward nearly half a degree, makes his declination 23° 1′ S. He runs northward 5½° during the month, being in south declination 17° 24′ on the 31st; and R. A. 20h. 55m., on the last noon of the month. On the 1st, Sun is slow of M. T. by 3m. 44s. So, when he is on the meridian (exactly south) it is 12h. 3m. 45s. by mean or clock time, which is the right time to use in the common affairs of life. The least number of sun-spots observed during the past month is 12, on December 5th; the greatest number is 120, on December 12th.

Mercury is Evening Star till January 20th. It will be farthest east and best seen on the 4th, being then about half an hour below Venus, which is very bright. Both planets set a little north of where the Sun does. Mars rises on January 1st about 8 o'clock in the evening; and at 5 o'clock on the 31st. This planet retrogrades—goes backward, or east, among the stars—from R. A. 9h. 40. to 9h. 4m. during January. It is a few degrees northwesterly from Regulus, in Leo. Jupiter rises soon after 6 P. M. in the fore part of the month, and will be splendid for observation all winter. He will be in opposition to the Sun January 19th. Jupiter and Saturn are also retrograding very slowly. Saturn rises soon after 2 P. M. on the 1st, and of course, is three or four hours high at dark. It still holds its place a few degrees above and to the left of Aldebaran in Taurus. This is a worthy object for the telescope. The Moon will pass through between it and Aldebaran soon after midnight January 8th. Uranus is now in Virgo, nearly between the stars Beta and Eta of this constellation. Neptune is on the confines of Aries and Taurus, about 10° southwest of the Pleiades.

ARTS AND MANUFACTURES.

ON THE MANUFACTURE AND DURABILITY OF ROOFING-SLATE.

E. H. S. BAILEY, PH.D.

Slates suitable for working are found associated with many metamorphic rocks, especially those of the Silurian period. They are closely related to micaceous rocks and often graduate into them. That the lamination or slaty cleavage was produced by lateral pressure, and that, not at the time of bedding of the rock but afterwards seems to be abundantly proved. This pressure was frequently applied at right angles to the line of bedding. Wax and other plastic material can be made laminar in structure by means of lateral pressure. And Tyndall has shown that the same thing takes place in the ice of glaciers, at points where it is subjected to immense pressure, as at a narrow part of the valley. In the case of a slaty rock the clay might become laminated, while sand or limestone associated with it might show no such structure.

The largest European slate quarries are in North Wales, though it occurs also on the Continent. In this country, slate is extensively worked in Maine, Vermont, New York, Pennsylvania, and in the Peach-Bottom district of northern Maryland. It is found in several other States.

Its color varies in different localities, from drab through different shades of green and red.

Though essentially a silicate of iron and alumina, slate often contains other ingredients which we may term "accidental," that seriously affect its durability. A specimen of ordinary slate analyzed by M. Maumené contained of silica 48.6 per cent; alumina 23.5; sesquioxide of iron 11.3; magnesia 1.6; potash 4.7; water 7.6. A Scotch slate contained of silica 50 per cent; alumina 27; sulphate and oxide of iron 11; magnesia 1; potash 4; water 7. Among the accidental ingredients are carbonates of lime and magnesia, and iron pyrites or sulphide of iron. All of these substances are injurious and increase the tendency of the slate to disintegrate or fall to pieces by the action of the weather. One specimen examined by the above author contained 53.5 per cent of carbonate of lime. It is needless to say that it had been condemned because it would not weather well. Acid liquids readily decompose carbonates, and roofing slate is particularly exposed to the action of sulphurous fumes from the chimneys. These settle on the roof, become oxidized, and combine with the lime, setting the carbonic anhydride free, while the sulphate of lime is washed away, and thus the slate is decomposed.

In regard to the pyrites, which is often visible as bright, brassy particles collected in parallel lines, it is oxidized by action of air and moisture, and the resulting sulphate is washed out by the rain, hence its presence is detrimental.

Another accidental factor having an influence on the durability, is the porosity. Those slates absorbing the most moisture will be more subjected to the disintegrating effects of atmospheric agencies, especially rain and frost, and will soonest be destroyed. Dry slate treated with water absorbs from two ten-thousandths to twenty-five ten-thousandths of its weight. The American slate has a density of about 2.80.

The methods employed in quarrying, and in fact many of the managers and workmen engaged in the slate industry in this country come from Wales. The pit is often worked to a great depth. In the slate regions visited by the author, the rock is dislodged by blasting, the holes being drilled by a steam diamond-drill, or the slabs are split off by a line of wedges. Seams usually occur which greatly facilitate the quarrying. The pieces of, say eight feet in length by two in width and eighteen inches thick, are hoisted to the surface by the use of a tackle running on a stout guy-rope which extends to a lower opposite point of the pit. Occasionally pieces of more than three tons weight are hauled up. Slate one inch in thickness weighs about fourteen pounds to the square foot. The blocks, after being wet are separated into thinner slabs, and then skilled workmen split them by the use of thin iron wedges into plates of the required thickness. Others, paying special attention to the "ribbons" or lines that usually run diagonally across the pieces, cut them up into squares of convenient size. This latter operation may be performed by the use of a peculiar tool called a "sack" or "sax," or more expeditiously by the use of a pair of large spring shears run by foot power. Different sizes are cut from the same slab to economize the material. Roofing slate is sold by the "square" of 10x10=100 square feet.

This same material is being more extensively used than formerly in the manufacture of paving stone, steps, tables, billiard tables, blackboards, mantles, etc. In order to work it into the above forms, it is found most convenient to saw it by the use of a "gang" saw, the edges of which are set with black diamonds. These are soldered into the metal, and when the saw is drawn over the wet stone a groove is cut very rapidly. The slabs can afterwards be planed, the edges squared and the surface polished. Stone thus prepared, not polished, and an inch in thickness costs about thirty cents per square foot. It is a very durable material, and especially useful from the fact that it is so readily worked into any desired form.

UNIVERSITY OF KANSAS, December, 1883.

ST. LOUIS WHITE LEAD.

One of the leading industries of St. Louis at the present time is the manufacture of white lead. Of an estimated production of 80,000 tons for the current year in the United States, St. Louis is credited with 20,000 tons, a larger production than that of any other city. Even New York takes a second place, though it has made great pretentions as a producer of white lead.

The industry is represented here by four establishments, employing 600 hands and having an invested capital of $3,000,000. Including the production of red lead and linseed and castor oils, the value of the product is estimated to be $4,500,000 for the current year. Of the four works, two produce castor and linseed oils, one red lead direct from the pig, and one of the two making oils has lately entered upon the manufacture of pipe lead, and will soon add a sheet lead department. The production of pipe lead by thls one works is not considered, however, in any of the above estimates; and properly the production of oils should have been excluded from the estimated value of the annual product, for the making of oil is in fact a separate business.

The growth of the industry has been remarkably regular and steady in the last few years, the annual increase in business having seldom fallen below 15 or exceeded 20 per cent. The comparative nearness of the local works to the lead producing regions of this State and Illinois and those of Colorado gives the industry advantages which are not shared in by the white lead manufacturers of any other city in the Union. Cincinnati and Pittsburg, both farther away from supplies of blue lead, indirectly bear witness to the importance of these advantages, by the gradual decadence of their white lead industry. Latterly, however, the advantage of being near the lead fields of Illinois and Missouri is not so apparent as in former times, but a very small percentage of virgin lead being consumed at this time by manufacturers of white lead. Most, if not almost, the entire quantity of lead used by them is refined lead produced from bullion carrying silver by refining works at Kansas City, Omaha, Pueblo, and by the one large works here. The uncertainty of getting supplies promptly, and the impurities in the virgin lead, coupled with other causes, lead to the abandonment of it by manufacturers for the refined lead of Colorado and the far west, the supply and quality of which can be depended upon. Even in the great Joplin district in this State but a small part of the output is suitable for the manufacture of white lead, the old worked-out mines immediately around Joplin being the only producers of a proper lead. The lead of Short Creek and Galena production, while especially adapted to the manufacture of sheet lead and lead pipe, by reason of the presence of copper in, it is for this very reason unsuited to the making of white lead.

The export trade of St. Louis in white lead is quite large, but it should not be inferred from this that shipments are made to foreign countries, for the cheap product of England and continental Europe inhibits exports to markets outside the United States. But to all parts of the national territory shipments are made regularly, and the aggregate of exports from this market makes a very respectable showing. Below we give the exports for ten months in the current year from St. Louis:

	POUNDS.
January	2,815,324
February	2,854,741
March	3,282,557
April	2,918,231
May	3,279,054
June	3,222,407
July	3,271,102
August	3,421,088
September	3,268,364
October	2,574,286
Total	30,937,154

From this it will be seen that the average monthly exports in the current year have exceeded 3,000,000 pounds, from which it may be assumed that the record for the entire year will show a total exportation of something like 36,000,-

000 pounds. Taking the home consumption into consideration, which has been quite large this year, it will be seen that the estimated production of the local works (20,000 tons) is not far out of the way.—*Age of Steel.*

PRACTICAL ART SCHOOL FOR WOMEN.

The question of teaching women in America the Arts of Design has been solved by Mrs. Florence E. Cory, herself a practical designer. Mrs. Cory is a graduate of Cooper Union, and in 1877 taught in that Institute the first class in practical carpet designing ever established for women in this country. After leaving Cooper Union Mrs. Cory took a thorough course of instruction in practical design at the largest carpet factory in New York City. Afterward she visited a representative factory of nearly every art industry in the United States, studying in each the technicalities of the machinery and the practical requirements of design for these various industries, thus qualifying herself to be the best, as well as the first teacher in practical design for industrial purposes in America.

In 1881 Mrs. Cory established a School of Industrial Art for Women, having seventy-five pupils, at her residence, last year. She has now taken a large suit of rooms in the Grand Opera House, New York City, and proposes to establish free classes for women and girls in Industrial Design, the only requirements for an admission being a fair amount of intelligence, a taste and appreciation of the beautiful, and the need of such benefit, with the expectation of becoming self-supporting. Pupils have the privilege of selling their work made while under instruction, (several hundred dollars were so earned by the pupils of last year,) the only requirement being that one fourth the amount received for such work shall be retained towards a fund for an Art Library, samples, drawings, etc., needed by the school; also each pupil, at the end of the year, shall leave one drawing as the property of the school.

GUN-FLINTS, ARROWHEADS, ETC.

Articles occasionally appear in the periodicals of the day purporting to describe the methods of manufacturing the ancient arrowheads, knives, and other flint tools and weapons.

These accounts so far as I have seen are not only very indefinite, but often contradictory. As these implements must have been in common use on these western plains within the last half century, there should be many persons now living who have personal knowledge of the matter.

Again, it is but a few years since the old gun-lock flint gave place to the percussion cap. By whom, when and how were these gun-flints made?

I well remember they were very plenty and cheap (one cent each at retail,) at almost every little trading place in the country; showing that they were easily and cheaply manufactured; but where or by whom?

If any of your readers can give any real light on this subject, it may please others besides A. L. C.

METEOROLOGY.

TORNADO MYSTERIES.

CAPT. SILAS BENT.

ST. LOUIS, Nov. 28, 1883.—Your article of to-day upon the "Tornado Mystery" is so suggestive, and discusses a theory which I am so heartily convinced is correct, that I venture to offer you a communication sent to the *Courier-Journal* of Louisville some twelve months ago.

"I have read with much interest Mr. G. W. Tinsley's theory as to the cause of the "sun spots" published in your issue of the 26th inst. I shall not undertake to discuss that theory, but will beg your indulgence for a few comments upon that point in Mr. T's article wherein he assumes that the sun is enveloped in a flame of fire.

This I know is the accepted theory of astronomers, but it has never been satisfactory to my mind as being possible in the due order of nature; for in that order, the operations of physical laws are uniform whether on the sun or on the earth. A flame of fire means combustion, and combustion means the consumption of fuel. So, notwithstanding astronomers say that the combustion of the sun is fed by invisible bodies falling into it from stellar space, yet when we reflect that each of the fixed stars of the universe is itself a sun, as large or larger than our own, and that they are all governed and sustained by the same laws, it is incredible that there should be floating through space sufficient matter to keep these myriads of suns in perpetual combustion, without diminution or extinction, and yet be invisible to our telescopes, particularly as the computations of these same astronomers show that our whole planetary system would not keep up the combustion of the sun for more than fifty or a hundred years if fed to it piecemeal.

Again, if the sun is a ball of fire and radiates its heat for the sustenance of its planets, then the earth alone is just at that fortunate distance from the sun which gives it the temperature that sustains life in beings organized as the inhabitants of the earth are, and which beings so organized could not exist on any other planets, owing to their necessarily different temperature arising from their varying distances from the sun.

This would make the earth the only habitable planet for beings of like organization and intelligence as ourselves; for, since man is made in the image of God, then no other beings outside of heaven can be superior to man; yet man would die of heat on Mercury and of cold on Saturn.

Furthermore, if the heat from the sun is heat radiated from a burning body, the nearer we approach the sun the hotter it would be: yet this is not found to be the case, for the higher one goes on a mountain or in a balloon the colder it gets, until, if a point beyond our atmosphere in stellar space could be reached, the temperature would be found 500 degrees or more below the freezing point.

But to meet these difficulties let us suppose that our sun, and all other suns are centers of electric power; or, great electric machines, which throw out electric rays that emit light but yield no heat, until heat is generated by the friction of those rays as they pass through the resisting medium of our atmosphere; and that the heat so generated is in proportion to that resistence as caused by the greater or less density and humidity of the atmosphere.

The revolution of the sun upon its axis and through its orbit maintaining its electric power and luminosity without requiring material substances for its fuse, would go on shining forever and with unvarying brilliancy.

All planets, then, having atmospheres may have temperatures the same as that of the earth, whether they be as near the sun as Mercury or as remote as Neptune.

This electric hypothesis is sustained by other familiar facts, such as the striking resemblance in color and appearance of our electric light with the sun light, and by the sympathetic disturbance of the magnetic needle upon the earth whenever eruptive disturbances occur in the atmosphere of the sun.

The earth being ninety odd millions of miles distant from the sun, and light traveling at the rate of nearly 12,000,000 miles a minute, it takes about eight minutes for the light of the sun to reach the earth.

Therefore when the astronomer observes through his telescope a disturbance in the atmosphere of the sun he knows that that disturbance has actually occurred some eight minutes before it became visible to his eye; but simultaneously with his seeing the disturbance, the observer by his side notes a perturbed deflection of the magnetic needle, showing conclusively that the subtle influence from the sun that has thus disturbed the needle has either been sped upon the wings of light from the sun to the earth or else be one and the self-same thing as the light and heat of the sun, which I believe it to be."—*Cor. Globe-Democrat.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

During the period embraced in this report, from November 20th to December 20th, we have had dry cool weather, but owing to the very large rainfall in former months the humidity has been much higher than the rainfall of the month would warrant. Owing to the excessive humidity the sky has presented a peculiar appearance, especially in the morning and evening, before sunrise and after sunset. At these periods there has been a ruddy glow noticeable which often extended nearly to the zenith. The absorption of violet rays by water-vapor accounts for this, and for the same reason close observers have noticed that the Sun and other heavenly bodies presented a peculiar appearance. It does not appear to the writer that such phenomena are strange under the circumstances

The rainfall of the past year to date amounts to 39.68 inches distributed as follows: January, 0.50; February, 3.10; March, 0.81; April 1.60; May, 6.52; June, 7.05; July, 6.52; August, 4.17; September, 0.88; October, 6.14; November, 0.81; December, 1.58.

This is nearly one-third above the average at this place.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Nov. 20th to 30th.	Dec. 1st to 10th.	Dec. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min				
Max				
Min. and Max				
Range				
TRI-DAILY OBSERVATIONS.				
7 a. m.	32 2	33.9	24 3	30.1
2 p. m.	56.2	57.5	42.3	52.0
9 p. m.	36.6	40.6	27.7	35.0
Mean	41.7	41.2	31.4	39 0
RELATIVE HUMIDITY.				
7 a. m.	.92	.92	.98	.94
2 p. m.	.78	.72	.87	.79
9 p. m.	.91	.88	.93	.91
Mean	.89	.84	.94	.88
PRESSURE AS OBSERVED.				
7 a. m.	29.050	29.099	29.073	29.074
2 p. m.	29.034	29.131	29.210	29.125
9 p. m.	29.075	29.145	29.185	29.135
Mean	29.053	29 125	29.156	29.111
MILES PER HOUR OF WIND.				
7 a. m.	12.5	14.1	19.2	15.3
2 p. m.	21.2	17.9	14.6	17.9
9 p. m.	11.0	12.4	14.0	12.5
Total miles.	2688	2711	2516	7915
CLOUDING BY TENTHS.				
7 a. m.	3.9	4.11	6.3	4.8
2 p. m.	4.1	1.8	6.9	4.2
9 p. m.	1.6	2.5	3.6	2.6
RAIN.				
Inches.	0.11	0.28	1.30	1.68

BOOK NOTICES.

Legends of Le Detroit: By Marie Caroline Watson Hamlin. 12mo., pp. 317. Thorndike Nourse, Detroit, 1884. For sale by M. H. Dickinson.

This book is made up of some thirty tales based upon old French customs and traditions handed down by the descendants of the pioneers of the City of the Straits, who originally brought them from their native land of Normandy. They are quaint and fantastic, and the writer has fairly entered into their spirit and given us an attractive and instructive book. A descendant herself from one of the old families, it was her good fortune to hear many of them from the lips of ancestors whose memories extended back into the previous century, and she has made it her laborious but loving task to gather together in lasting form, the legends they delivered to her. While doing this, however, she has verified the historical points by studies of the best authorities, such as Charlevoix, La Hontan, Lambert, Le Moyne, the Pontiac Manuscript, Morris' Diary, Cass', Trowbridge's and Roberts' Memoirs, etc.

Among the legends we note particularly The Baptism of Lake Sainte Claire, The Bloody Run—a legend of Pontiac's siege, LeLoup Garou, The Feast of St. Jean, The Cursed Village, Captain Jean, The Eve of Epiphany. These, as well as all the others, in varying degrees, awaken interest and excite our sympathies, and the descendants of the old French settlers of this Missouri border will find among them many concordant tales that will arouse old memories and recall the stories told to them in their childhood.

To these tales Mrs. Hamlin has appended Hon. James V. Campbell's "Legend of L' Anse Creuse," and a brief account of a number of the old families of Detroit.

The work of printer and binder is well done, as also the illustrations, which are the work of Miss Isabella Stewart.

The Wonders of Plant Life: By Sophie Bledsoe Herrick. 12mo., pp. 248. Illustrated. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; $1.50.

Several of the chapters in this little book were first published in *Scribner's Monthly*, for instance, those upon The Beginnings of Life: Single-Celled Green Plants: Ferns: Physiology of Plants: The Microscope among the Flowers, and Insectivorous Plants. Those on Fungi and Lichens, Mosses, Corn and Its Congeners, and the Pitcher Plants are new. The whole, however, is more complete and the serial connection is more closely made out than before.

The tribute paid to the Microscope in the first chapter, is so just and eloquent that we cannot omit it: "The line of telescopic discovery, sweeping off into infinite space, might well bring doubt and despair to the mind which contemplates that alone; but there is another line of discovery more beautiful, more wonderful still. * * * * * This little instrument, then, (the microscope) has wrought a noble work for God and truth in the world. Not only has it revealed to us many secrets which make life easier, which soften the pangs of disease and diminish the anguish of bereavement, but it has helped to silence the voice which was delivering its message of desolation to the world in denying the Fatherhood of God. Not only does it show us the marvelous precision of inorganic nature, and the delicate adjustments of chemical, physical, and vital forces of organic, but it brings us into the very ante-chamber of that court where life holds its mysterious sway, almost into the presence of the subtle vital force which baffles analysis and laughs synthesis to scorn."

The wonders of plant-life under the microscope are shown in every chapter and upon every page of the book, and while technicalities are avoided the explanations are clear and full. It is written in popular style, yet an amateur can find as much of precision and minuteness as is necessary for all his purposes, at the same time that he is attracted by the curious and interesting facts detailed. The chapter upon Insectivorous Plants in uncommonly interesting and cannot fail to give much information to most readers.

The volume is very handsomely prepared and the illustrations are excellent.

BOND AND FREE: By Grace Lintner. 12mo., pp. 288. C. B. Ingraham, Indianapolis, 1883. For sale by M. H. Dickinson.

This is a tale of the South involving an account of life in the Southern States during the existence of slavery. It is well and earnestly written, and doubtless contains much truth, but whether it is best to revive the scenes of those days, even for the alleged purpose of perpetuating history, is questionable, especially when those scenes are portrayed under the veil of fiction.

PLASTER AND PLASTERING: MORTARS AND CEMENTS: By Fred T. Hodgson. 12mo., pp. 108. Industrial Publication Co., New York; $1.00.

This is intended by the author to be a complete guide for the plasterer in the preparation of all kinds of plaster, stucco, Portland cement, hydraulic cements, lime of Tiel, Rosendale and other cements, with practical information on the chemistry, qualities and uses of the various kinds of limes and cements, together with rules for measuring, computing and estimating plaster and stucco work. To this is added an illustrated glossary of terms used in plastering and a list of some of the best works on mortars, cements and plastering.

Everything in this little work is practical and useful, and it will be found of value not only to the mechanic but to the property owner desiring to build or repair buildings.

ABORIGINAL AMERICAN AUTHORS: By Daniel G. Brinton, A. M., M. D. Octavo, pp. 63. Philadelphia, 1883; Boards $1.00.

This is a novel contribution to the history of literature, being an extended review of the literary efforts of the red race in their own tongues and in other languages—English, Latin and Spanish. The work is founded on an address presented to the Congress of Americanists at Copenhagen in 1883, and will be found of most decided interest to ethnologists, linguists and historians. Beginning with an exposition of the literary faculty in the native mind, Dr. Brinton divides his subject into narrative literature, didactic literature, oratorical literature, poetical literature and dramatic literature, giving under each head accounts of native authors and their works that are calculated to arouse the interest of the reader in the subject and in many instances excite his surprise at the ability, talent and versatility displayed. He refers especially to the literary efforts of the Esquimaux, the Delawares, the Iroquois, the Creeks and Cherokees, the Aztecs, the Maya tribes, the Peruvians, etc., and points out many marked instances of skilled narrative, oratorical and dramatic writing by natives of various nations and tribes.

Dr. Brinton, who has published and is now publishing several works upon kindred subjects viz.: the Maya Chronicles, the Iroquois Book of Rites, the Comedy Ballet of Gueguence, American Hero Myths, etc., aims in this work to engage the interest of scholarly men, learned societies, enlightened governments and liberal institutions and persons of the United States, particularly, in the collection, preservation and publication of such monuments of the Nation's literature. He should not plead in vain.

ROUND ABOUT RIO: By Frank D. Y. Carpenter. 8vo., pp. 415. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson; $2.00.

To write a book of travels and combine in it accuracy of scientific observation and piquancy of description, and at the same time maintain in it a love story, is rather an unusual undertaking and one to be regarded as comprising some of the incompatibles; but all this has been done by Mr. Carpenter, who, likewise, throws in many dashes of sarcastic wit at the peculiar customs of the people he describes.

Mr. Carpenter held for several years the position of geographer of the Geological Survey of Brazil, and under these peculiarly favorable conditions he acquired the material which, returning to America, he has made the basis of his book. Valuable as is the work for its information, it owes still more to its literary treatment. The author's studies of Brazilian life and manners, and his method of presenting them, are unique, and his book occupies a place quite its own among works of travel. It has but little of dry narration and sober details of general information; and yet, with all its vivacity and variety, it is doubtful if there is anywhere to be found so good a picture of life and scenes in and about the great metropolis of the Southern Hemisphere—Rio de Janeiro. The observations and description of the the most interesting features of Brazilian flora and fauna are those of the trained naturalist, and are given with an imaginative faculty which selects only characteristic features, avoiding dry and wearisome details; while the thin veil of fiction thrown around the pictures adds a decided charm to the narrative.

No book, that we have seen lately, so well fills the *rolê* of a "traveler's companion" or a welcome relief to a tired brain.

A SYLVAN CITY, Illustrated: 12mo., pp. 508. Our Continent Publishing Co., Philadelphia: Fords, Howard & Hulbert, New York. For sale by M. H. Dickinson; $2.00.

This is a very interesting account of the quaint and picturesque features of the city of Philadelphia, both ancient and modern. It is exceedingly well illustrated by well known artists, and the various chapters are the productions of Helen Campbell, Louise Stockton, Elizabeth Robins, Edwin A. Barber, Eliza S. Turner and Frank Willing Leach. The first chapter is devoted, naturally, to William Penn, whose portrait serves as a frontispiece in the unusual garb of a soldier, which he actually was for a short time and which he remained so far as fighting the fight of faith and principle all his life. Fourteen other chapters follow, giving full descriptions of The City of a Dream; Old St. Joseph's; The Old Philadelphia Library; The Post-Office; The Public Schools; The Bettering House and Other Charities; Steven Girard, etc.

The subjects are all well chosen, and the illustrations, numbering nearly two hundred, are exceptionally good. To all Philadelphians and their descendants, this book will be a welcome visitor, as well as to all Americans who take an interest in the peculiarities of the early settlers of the country. The work of the bookmakers has been handsomely done in every respect and the volume presents an exceedingly tasteful appearance.

ART AND LITERATURE: Edited by Titus Munson Coan. 16mo., pp. 194. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; paper 25c., cloth 60c.

This is No. VI Vol. I of the Topics of the Time series, to which we have referred so often, and comprises the following articles: The Philosophy of the Beautiful, by Prof. John Stuart Blackie; Hellenism in South Kensington, a dialogue between Plato and Landor, by H. D. Traill; The Beginning of Art, by Stanley Lane-Pool; The Ancient, Mediæval and Modern Stage; The Impressionists, by Frederick Wedmore; Wagner and Wagnerism, by Edmund Gurney: all typical and able articles, furnished at a mere nominal rate.

This series can be subscribed for by the year at $6.00 in cloth, or $2.50 in paper.

THE COTTAGE KITCHEN: By Marion Harland. 12mo., pp. 276. Chas. Scribner's Sons, New York, 1883. For sale by M. H. Dickinson; $1.00.

Marion Harland's "Common Sense" books have gained her a wide celebrity among housekeepers, and this new one will in no respect decrease it. It comprises the whole list of cookeries and cookables and seems to combine hygiene with elegance and economy. No lady can have any tolerable excuse nowadays for poor, unwholesome diet and bad cooking.

ANTI-TOBACCO: By Abiel Abbot Livermore. 16mo., pp. 117. Roberts Bros., Boston, 1883. For sale by M. H. Dickinson; cloth 50c.

This essay of Mr. Livermore's is the substance of an able and comprehensive address delivered before the Meadville Temperance Union, and is accompanied by a lecture on Tobacco and Its Effects by Rev. Russell Lant Carpenter, and an article on The Use of Tobacco by G. F. Witter, M. D.; the whole making up as powerful an argument against the use of "the weed" as it is possible to conceive. It should be widely distributed by hygienic and temperance societies everywhere.

OTHER PUBLICATIONS RECEIVED.

Third Annual Report of the United States Geological Survey for 1881-2, J. W. Powell, Director, pp. 564. U. S. Fish Commission, Report of Commissioner for 1880, Spencer F. Baird, Commissioner, pp. 1060, Illustrated. Calendar of American History, 1884; compiled by Delia W. Lyman, G. P. Putnam's Sons. Mineral Resources of U. S., 1882-3, Albert Williams, Jr., pp. 813. Report of Commissioner of Education for 1881, pp. 840, Gen. John Eaton, Commissioner. Problems of Inter-oceanic Communication by way of American Isthmus, by Lieut. John T. Sullivan, U. S. N. quarto, pp. 219, with maps. Proceedings of Missouri Press Association, 1883, Secretaries Chas. T. McFarland and Jos. H. Turner, pp. 68. *The Library Journal*, Vol. 8 No. 11, Publisher T. Leypoldt, 31 and 32 Park Row, New York, monthly, $4.00. *The Homiletic Monthly*, Vol. 8 No 3, I. K. Funk, D. D., Editor, pp. 59, $2.50. *The English Illustrated Magazine*, Vol. — No. 3, Macmillan & Co., N. Y., $2.50. *Humboldt Library*, Money and Mechanism of Exchange, by W. Stanley Jevons, Part I, pp. 94, 15 cents. *The Art Interchange*, Vol. 11, No. 12, semi-monthly, $3.00. Time-Keeping in London, by Edmund A. Engler; D. Appleton & Co. N. Y. Christmas Literary Bulletin of Houghton, Mifflin & Co. Third Annual Report of Kansas City Provident Association for 1883. *The Irving Library*, 1883, Vol. 1 No. 1, weekly, $25 a year; John B. Alden, Publisher, N. Y. *Industrial News*, Vol. 4 No. 11, quarto, pp. 20, published monthly by Inventor's Institute, N. Y., $1.50. *Travel*, Vol. 1 Nos. 4 and 5, monthly, published by American Exchange in Europe, 162 Broadway, N. Y.. 50 cents. Notes on Literature of Explosives, Chas. E. Munroe, U.

S. N. A., pp. 21. Sixteenth Annual Report of State Board of Agriculture, pp. 179, Secretary J. W. Sanborn. First Annual Report of Associated Charities of Cambridge, pp. 27, Secretary Wm. F. Piper. Seventy-Second Annual Catalogue of Officers and Students of Hamilton College, 1883–4, pp. 80. Chart and Supplement to Pilot Chart of North Atlantic for December, pp. 11, Commander J. R Bartlett, U. S. N. *Johns Hopkins University Circulars*, Vol. 3 No. 27, 10 cents, pp. 27. *The Pansy*, Mrs. G. R. Alden, Publishers, D. Lothrop & Co., Illustrated, pp. 40. *Scientific Proceedings of Ohio Mechanics Institute*, Robert B. Warder, Editor, Vol. 2 No. 3, published quarterly, $1.00. *Scandinavia*, published 20 N. Clark St., Chicago, Ill., monthly, $2 00. The Childhood of Religion, by Edward Clodd, F. R. A. S., No. 47, 15 cents. Local Government and Free Schools in S. C., by B. James Ramage, A. B., published by Johns Hopkins University. *Bulletin of Essex Institute*, Vol. 14 No. 1—12, pp. 59.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Automatic Cut-Out for Telephones.—The object of a device recently patented by Messrs. C. D. Wright and C. A. Fisher, of Petersburg, Ill., is to provide an attachment for telephone instruments so improved that all the telephones on the line, between any two given instruments of this nature, may automatically be thrown out of circuit, thereby greatly shortening the same and decreasing the resistance to the current in a degree corresponding to the number of instruments cut out.

A mechanism of clock-work is released by means of an electro-magnet, when the current passes, and a lever resting upon a peculiarly notched wheel of the mechanism, is virtually brought in contact with one of the binding-posts, through the medium of a spring. The current is thus short-circuited, passing through the instrument without passing through the transmitter and receiver.

The necessity of removing a telephone, should a subscriber from any cause not desire to operate it for any length of time, and the considerable expense of putting one up again in the same room, for another subscriber, seems to be cheaply obviated in a very simple and efficient manner by the device.

RARE FISHES

A large number of rare and curious specimens of deep sea fishes have just been received by Prof. Gill, of the Smithsonian Institution. They were caught by the crew of the Fish Commission steamer Albatross, the latter having just returned from an exploring expedition in mid-ocean. The Albatross was absent two months, during which time fish were captured representing thirty new species, twenty new genera, and three families. The British exploring steamer Challenger during a three years' cruise only secured specimens representing fourteen new genera. The wonderful success of the Albatross is therefore emphasized by scientific men in this city. The fish are caught by means of a dredge or net, which is sunk very often to a depth of 3,000 fathoms.

Among the strange denizens of the deep caught during the cruise are the following: The *Anchenichthy*, or fish with a neck. This specimen resembles an eel, has a well formed neck, and was caught at a great depth. The *Gastrostonius Bairdii* (named after Prof. Baird). This odd looking fish was described in the *Popular Science Monthly* as "the wonder of the deep sea." It is a variety of the devil fish. The jaw bones are seven times as long as the cranium, and are attached to wings resembling fine black silk, which come together, forming a broad pouch. The fish swims about with its pouch open, acting in the capacity of a seine. Small fish are caught in the latter, and transferred to the mouth by means of suction. The "Baird fish" resembles a leather-wing bat in some particulars, and has a long and scaly tail. The *Cryptopsaras*, or "angler with concealed rod," is a most remarkable specimen. It has a very large mouth, and extending from a concealed rod on the back is a baited line, which floats above the body. Small fish nibble at the line, and are captured by the "angler." The bait is a ball of jelly-like matter, which is so sensitive that instant notice is given when a fish touches it. Another member of the "angler" family is perfectly blind. It is known as the *Typlopisaras*, or "blind angler." This remarkable fish fisher was never heard of until the recent cruise of the Albatross, and it is said to inhabit the sea 2,000 fathoms below the surface. The *Hypercharistus Tanneri*, or fish with upper pectoral rays or finger separate, is a queer-shaped and vicious little fish. It inhabits deep water and is named after Capt. Tanner, of the Albatross, whose hand the little creature tried to bite when landed on the deck of the steamer with the deep sea seine. It is jet black, and has teeth like a circular saw. The *Neurichthyids*, or snipe eel, is a genuine curiosity. Its body resembles that of an ordinary eel, while the head is a fac simile of that of the common marsh snipe which abounds in Maryland and Virginia. The tape fish is another interesting fish. It is of the size and thickness of ordinary tape, and when in the water is perfectly transparent and can only be seen by its little red eyes.

There are several other remarkable specimens. They are kept in jars of alcohol in Prof. Gill's office, and will appear in the illustrated annual reports as fish discovered thousands of fathoms below the surface of the Atlantic by the United States Fish Commission. They will also probably be placed upon exhibition in the national museum or Smithsonian.—*National Republican.*

EDITORIAL NOTES.

THE mortality among scientists recently, seems to have greatly exceeded the average rate. We note the following deaths within the past three or four months: Victor Alexandre Puiseux, the French Astronomer; Dr. Conrad Bursian, a distinguished German Philologist; M. Joseph Antoine Plateau, an eminent Physicist, of Ghent; Prof. Oswald Heer, Palæontologist and Botanist, of Switzerland; all in September; Prof. J. Lawrence Smith, Chemist, of Louisville, Ky.; M. Alfred Niaudet, of France, Electrician; Prof. M. F. S. Cloez, Professor of Physics in the school of Fine Arts; Mr. Louis Bregnet, of France, distinguished as an Electrician; all in October; Prof. C. W. Siemens, of London, noted as an Engineer and Electrician, and Dr. John Le Conte, one of our most eminent American Entomologists, both in November; Prof. E. A. Sophocles, of Harvard College, in December.

THE water-works at Rich Hill, Mo., just completed, have been tested by the city authorities and found satisfactory, having thrown four fire streams more than 100 feet high. There are two Blake Duplex engines, each of one million gallons capacity in twenty-four hours, and two boilers for same.

DR. ENGELMAN recently read a meteorological paper before the St. Louis Academy of Science giving the mean temperature of the summers, winters and mean annual temperature for the past forty-eight years, the same being accompanied by a chart illustrative of the subject. It appears that the mean winter temperature during this time has averaged 33.4; the mean summer temperature, 76.8, and the mean annual temperature, 55.4. The Doctor stated in his paper that he had hoped to have discovered some law of the variation of the mean temperature from year to year, but in this respect he had been disappointed, as the variations were irregular and without any law. The variations of the mean temperature of winter were greater than of the summer. One remarkable thing was the return of the periods of six or seven years when the mean temperature was nearly normal. The observations tended to show that there was little data for predicting the temperature or prognosticating the weather. The coldest winters were 1856, 1857, 1872, 1873, 1881. The warmest summers were 1838, 1850, 1854, 1874 and 1881.

THE Observatory of Washington University has just received from Mr. George Partridge a present of a very valuable and costly meridian transit instrument, with all the appliances for accuracy and convenience of work. The instrument was made by Fauth & Co., of Washington, the best makers of such instruments in this country. The telescope has an aperture of three inches and a focal length of over three feet. The axis carries two 12-in circles, one reading to ten seconds, the other to single minutes. The fine circle carries the latitude level so the instrument can be used as a zenith telescope. A very delicate striding level serves to determine the level of the axis. The instrument is mounted upon a heavy iron base which is placed in a solid stone pier and is furnished with reversing apparatus and mercurial basln and with delicate adjustments in level and azimuth. The bearing surfaces of the pivots are of agate. The instrument is one of the largest of its kind in the West, and is in every way a credit to the University and to the donor, Mr. Partridge. Its cost in the shop was $1,000.

A COMPLETE set of the philosophical transactions of the Royal Society of England, has been presented to the Rose Polytechnic Institute, Terre Haute, Indiana, by the President of its Board of Trustees. There are but three or four such sets in this country.

THE recently discovered comet of 1812, ean be seen clearly defined in the northwest sky without the aid of a glass. The observatory people reported some time ago that it would scarcely be seen with the naked eye until the last of the month, but it is now plainly visible, being equal in brightness to a star of the fifth magnitude, or as bright as Halcyone, the largest star in the Pleiades. The wanderer is near the bright star of Vega or Alpha Lyræ in the constellation of the Harp, and about an hour behind it, right ascension. By January 15th the stranger will be wholly visible to the unaided vision. The tail of this comet in 1812 swept athwart the sky nearly 90°, but it has been very much shorn of its glory and will not present by any means the beautiful spectacle of the comet of 1881.

THE President has appointed a board of officers of the army and navy to consider the question of sending an expedition to the relief of Lieut. Greely and party, and to recommend to the Secretaries of War and Navy, jointly, what steps the board deem advisable be taken for the equipment and transportation of a relief expedition, and suggest such plan as to its control and organization of its personnel, as seems best adapted to a complish its purpose. The board is composed of the following officers: Brigadier-General W. B. Hazen, Chief Signal Officer, United States Army; Capt. James W. Greer, United States Navy; Lieutenant-Commander B. H. McCulla, United States Navy, and Captain George W. Davis, 14th Infantry, United States Army. The board met in Washington the 20th ult.

IN Washington City the telephone company has been required to run its wires underground, and it is expected that within a short time the various telegraph companies will also do so, as the Postal Teleraph Company was not permitted to come within the city until after it had agreed to such conditions. The district authorities say that the telephonic communications are much more distinct than before, and note with satisfaction the absence of the buzzing sound so annoying formerly.

THE latest railroad scheme is that of a line across America, Asia and Europe, by way of Alaska, Siberia and Russia; the plan involving the bridging of or tunneling under Behrings straits. De Lesseps might turn his attention to it, after he performs the trifling jobs now in hand.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Art Interchange* for 1884 is a thoroughly practical, intelligible, inexpensive art journal. It is devoted to decorative, household, and pictorial art, home art work, literary and art news, and notes and queries. It is handsomely illustrated with leading examples of American art, besides giving full-size working patterns of standard decorative designs, for the use of amateurs and professional art students, and workers in ceramics, art needlework, and the kindred minor decorative arts.

Instructions and suggestions in art needlework, painting on textiles, wood, china, and glass; wood-carving, mural decoration, art-furnishing, modeling, etching, drawn work, sketching on linen, tapestry painting, brass hammering, etc.

Notes and Queries give expert advice, supplying readers with information that it would be difficult to obtain in any other manner.

Full-Page color studies by such masters of color as Messrs. Francis Lathrop, H. M. Lawrence, Walter Satterlee, Associated Artists, Misses Rosina Emmet, Dora Wheeler, Caroline Townsend, and such authorities on decoration as the Boston, Philadelphia, and New York Decorative Art Societies, appear with every other issue. $3.00 per annum.

THE *Popular Science Monthly*, now in its twenty-fourth volume, has always maintained a high standing among readers of all classes. Its contents for January show that this standard is to be maintained as fully for 1884: The Classical Question in Germany, by E. J. James, Ph. D. Early Colonists of the Swiss Lakes, by F. A. Forel, (illustrated). The Morality of Happiness, by Thomas Foster. Female Education from a Medical Point of View, II., by T. S. Clouston, M. D. The Control of Circumstances, by William A. Eddy. Religious Retrospect and Prospect, by Herbert Spencer. The Iguanodon, (illustrated). Defective Eye-Sight, by Samuel York At Lee. The Chemistry of Cookery, by W. Mattieu Williams. Catching Cold, by C. E. Page, M. D. The Source of Muscular Energy, by J. M. Stillman, Ph. B. Idiosyncrasy, by Professor Grant Allen. Etienne Geoffroy Saint-Hilaire, (with portrait). Correspondence. Editor's Table. Literary Notices. Popular Miscellany. Notes.

THE *North American Review* for January presents the opposite sides of the question of "Ecclesiastical Control in Utah," set forth by two representative men: President John Taylor, the official head of the Mormon Church, and the Hon. Eli H. Murray, Governor of the Territory of Utah. Senator John I. Mitchell writes of the "Tribulations of the American Dollar," insisting that it is our imperative duty to-day to settle the question, whether we shall have dollars of unequal commercial value in circulation. In an article entitled "Theological Re-Adjustments" the Rev. Dr. J. H. Rylance insists upon the necessity of eliminating from the formularies of belief and from the current teachings of the churches, all doctrines and all statements of supposed facts which have been discredited by the advance of energetical scholarship, and by the progress of natural science. Senator Henry W. Blair, taking for his theme "Alcohol in Politics," advocates the submission to the people of an amendment to the Constitution prohibiting the manufacture, sale and importation of intoxicating liquors. "Evils Incident to Immigration," by Edward Self, is a forcible statement of the mischiefs wrought by the importation into our social and political life of an enormous and continual contingent from the lowest stratum of the population of Europe. Finally, the subject of "Bribery by Railway Passes" is discussed by Charles Aldrich and Judge N. M. Hubbard. Every one will read Gail Hamilton's second chapter of "TheDay of Judgment."

THE December (Christmas) *Magazine of American History* is one of the most attractive issues of this excellent periodical that has yet appeared. It contains four historical Essays on Christmas and its observances in various parts of early America and among different nationalities, by John Esten Cooke, Norman McF. Walker of New Orleans, John Reade, F. R. S. C., of Montreal, and Mrs. Lamb, Editor of the Magazine. Then comes an article by the learned and scholarly Horatio Hale, M. A., "A Huron Historical Legion"; an exceptionally interesting sketch of "Colonel David Crockett, of Tennessee," by General Marcus J. Wright, of Washington; and a paper which will be widely studied by specialists and antiquarians.—"Quivira, A Suggestion"—by Dr. Cyrus Thomas. The other departments—Notes, Queries, Replies, Societies, and Book Notices—are, as usual, overflowing with good things. This Magazine is deservedly recognized in every part of the country as one of the best historical publications ever offered to the public.

PROFESSORS ORMOND STONE and Wm. M. Thornton, of the University of Virginia, announce a new mathematical journal as a successor to the *Analyst*, to be called the *Annals of Mathematics*. It is to be a bi-monthly, quarto in size, and to comprise at least twenty-four pages. It will commence February 1884, at $2.00 per annum. It is designed to be a medium of communication between teachers and students of mathematics, and the standing of its editors is a guarantee of its own high standing among collegiate journals.

Harper's Magazine for January is a worthy sequel to the brilliant Christmas Number of that periodical, as the following table of contents shows:

Portrait of John G. Whittier. The Quaker Poet.—Harriett Prescott Spofford, with ten illustrations, by Harry Fenn. At Mentone, I.—Constance Fenimore Woolson, with sixteen illustrations. The Old Packet and Clipper Service, with fourteen illustrations, G W. Sheldon. Ensnared, A Poem —Maurice Thompson. The Birth of a Nation.—T. W. Higginson, with six illustrations. James Buchannan.—William C. Prime, with Portrait. What was Seen by Juan Valdez in Saltillo, A Story.—Thomas A Janvier. Judith Shakespeare, A Novel, I.—William Black, with two illustrations by Abbey. Hidden History.—Rose Hawthorn Lathrop. Nature's Serial Story, I.—E. P. Roe, with five illustrations. City Athletics.—H. C. Bunner. Cassy's Christmas-box, A Story.—A Working Girl. Editor's Easy Chair. Editor's Literary Record. Editor's Historical Record. Editor's Drawer.

THE next issue, now due, of the unique *Library of Aboriginal American Literature* edited by Dr. D. G. Brinton, Philadelphia, will be "The Comedy of Gueguence," a play written and acted by the natives of Nicaragua. It dates from the 17th century, and is written in a curious dialect, half Aztec and half Spanish.

THE *Atlantic Monthly* for 1884. The conductors of the *Atlantic Mouthly* indicate herewith a few of the noteworthy feature for 1884, and need not assure its readers that it will continue, as it has been beyond question, the foremost of American magazines, in all features and varieties of literary excellence. Mr. Crawford's serial story "A Romance Singer," will run through the first six numbers of the volume for 1884 This story has attracted marked attention by its vigor and freshness. Oliver Wendell Holmes will write exclusively for the *Atlantic* during 1884. The mere announcement of frequent contributions by him is more welcome than almost any other announcement could be. Dr. Weir Mitchell, has written for the *Atlantic* a striking serial story, entitled "In War Time." This will begin in January. Henry James will contribute several short stories and sketches of Continental travel. W. D. Howells will furnish several papers of European travel. Charles Dudley Warner will contribute Essays on literary and social topics. The Contributors' Club will continue to be one of the most agreeable features of the *Atlantic*. New books receive more attention in the *Atlantic* than in any other magazine in the English language. Terms: $4.00 a year, in advance, postage free. With a superb life-size portrait of Hawthorne (new), Emerson, Longfellow, Bryant, Whittier, Holmes, or Lowell, $5 00. Each additional portrait $1.00 Remittances should be made by money order, draft or registered letter to Houghton, Mifflin & Co., 4 Park Street, Boston, Mass.

THE title of *New Remedies* has been changed to the *American Druggist*. It has also been changed in form, enlarged, and the number of pages increased. It is still edited by Dr. Frederick A. Castle, and Chas. Rice, Ph. D. We regard it the best publication of the kind in the country. It is published by Wm. Wood & Co., New York, at $1.00 per annum.

THE meeting of the Kansas City Academy of Science, for December, was held on the evening of Friday, the 21st. The paper of Dr. R. W. Brown, upon "Memory," was well written, admirably illustrated by means of original drawings and demonstrations from the human brain, and well received by his audience.

KANSAS CITY

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A MONTHLY RECORD OF PROGRESS IN

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VOL. VII. FEBRUARY, 1884. NO. 10.

ASTRONOMY.

THE TRANSIT OF VENUS IN NEW ZEALAND.

PROF. H. S. PRITCHETT.

A year has elapsed since the last transit of Venus, and as yet no definite announcement has been made of the results of the work of the different parties sent out by our Government. This delay is unavoidable in the discussion of such a large amount of data as was contained in the observations of the transit of 1882. At the time of observation it was generally understood that individual observers would make no independent publications of their observations. At this time, however, it will not be out of place to speak in general terms of the work of the parties and the probable results.

The United States sent into the field eight parties, four to the northern and four to the southern hemisphere. These parties were equipped in a very different manner from those of any other nation. The American parties not only observed contacts but they were provided with the apparatus and chemicals for obtaining pictures by the use of the horizontal photoheliograph.

Photography was first employed in observations of the transit of Venus in 1874. At that time the astronomers, both of Europe and America, were very hopeful of obtaining exceedingly accurate results from the photographic method. There was a radical difference of opinion, however, as to the form of instrument to be employed. The Europeans used a photoheliograph made after the Kew pattern, having an objective of 3.4 inches aperture and 50 inches focus, and giving an image of the Sun of about half an inch in diameter which is enlarged by a secondary magnifier to about four inches in diameter. American astronomers contended that such instruments would be affected by troublesome errors due to the secondary magnifier and that position angles could not be obtained from it with sufficient accuracy. The Americans adopted the horizontal photoheliograph which is essentially a huge camera of long focus mounted accurately in the meridian and horizontal. The objective is a five-inch aperture and about forty feet focal length, giving images of the Sun upon the sensitive plate, of about four inches in diameter. A plain glass mirror guided by clock-work is used to throw the Sun's image upon the sensitive plate. The sensitive plate is mounted upon a solid pier enclosed in the photographic house.

The result of the discussion of the photographs of 1874 was a complete vindication of the American methods. The European photographs turned out to be valueless, while those obtained by the American parties yielded excellent results. It is much to be regretted that the publication of the results of the American photographs was so long delayed. It was only when the preparations for the transit for 1882 were well advanced that these results were made known. In the meantime an international congress of astronomers was held at Paris to consider how the transit of 1882 should be observed. The United States was not represented at this conference, and guided by their own experience alone, the European astronomers decided that the photographic method was a failure and should not be tried again. It is almost certain that had the success of the American photographs been known their action would have been altogether different. Thus it happened that the astronomers of America and Europe differed widely as to the best method of utilizing one of the most important astronomical events of the century. The Europeans rejected photography and trusted to observations of contacts only; the Americans observed contacts because it involved but little additional cost and labor, but looked to photography for the most valuable results.

During the summer of 1882 Congress was in session till late in the summer, and the appropriations for the transit of Venus were not passed till some time in August. In consequence the preparations for the transit were somewhat hurried and there was little opportunity for the photographers to practice.

The parties which went to the southern hemisphere were stationed at the Cape of Good Hope, Santiago in Chili, Santa Cruz in Patagonia, and New Zealand. The New Zealand party was one of the first to leave Washington, having a long journey to perform. The party, consisting of two astronomers and photographers, sailed from San Francisco September 24, 1882, in one of the Pacific Mail S. S. Company's steamers. The voyage to New Zealand was a very smooth and pleasant one, occupying twenty-one days. On the way the ship touched at Honolulu and passed through the Navigator Group of Islands.

Auckland, the port of landing for the American-Australian steamers, is one of the most picturesque places in the world and is probably the most flourishing city in the colony. It has a magnificent harbor and is the commercial metropolis of the northern island. A fine volcano stands on an island in the harbor, and another rises just back of the city. The latter, called Mt. Eden, has a magnificent crater, perfectly complete. It is in the form of a huge bowl. The island here is only about six miles wide, and there is a good harbor on the western side opposite Auckland. From the summit of Mt. Eden the winding bays and inlets of both harbors lie spread out before the eye, forming one of the most beautiful pictures in the world.

The city of Auckland has a population of about 40,000, and is a well built and well governed city. The streets are broad, well paved and lighted; fine parks have been laid out and the public buildings are of a most substantial character.

The Maoris, the aborigines of New Zealand, are to be seen about Auckland and adjacent territory better than anywhere else in the colony. At one time they were nearly all nominal Christians, but at the present time they have lost most of their religious observances and rapidly learned all the vices of Europeans. They are fast dying out, and another half century will probably see them reduced to a few scattered remnants.

Nothing could have been more hospitable than the welcome we received from the Government and people of New Zealand. Every facility of the Government was put at our service, and every citizen of Auckland was anxious to do anything in his power to help along the work of the expedition. For various reasons Auckland was selected as the point of observation. A good site was found in the "Domain," a public park in the outskirts of the city. Permission was at once given for its use and for the erection of suitable buildings. These consisted of three small wooden buildings, one for the transit instrument, one for a photographic house and a building for the equatorial. These buildings were commenced as soon as an accurate meridian line could be obtained and the grounds properly laid off. The completion of the buildings was, however, a very tedious matter. In New Zealand nobody is in a hurry. The carpenters who worked for us came about nine in the morning, took an hour at noon for lunch and stopped work at five in the afternoon, and always took a half holiday on Saturday. It was impossible to hurry them much, but the buildings were all finished, and all instruments were in adjustment two weeks before the transit.

From this time on the party took regular practice with the photoheligraph, till each man became thoroughly familiar with his duties and could go through them in routine order. Photographs of the sun were taken every day and the adjustments of the instruments tested by every possible means. During the latter part of November a magnificent sunspot appeared, of which many good photographs were obtained.

As the day of transit drew nearer a feverish anxiety began to be felt in regard to the weather. Only the last half of the transit was visible in New Zealand, and this gave only about two and one-half hours for effective work. If the early morning should be cloudy all would be lost. This anxiety seemed to extend itself to the most insignificant citizen of Auckland. The New Zealanders seemed to feel that the honor of New Zealand was involved in the matter, and that if a clear day was not forthcoming the fair name of the colony would suffer. Large numbers of people visited the station to express their interest in our success and their firm confidence in Auckland weather. Among the visitors were some who asked some very curious questions. One of the most common ones was this, "Will the transit occur at night or in the daytime?" On the night preceding the day of transit half the population of Auckland sat up to look out for the weather, and the American Transit-of-Venus party did very little sleeping. Every instrument had been put in perfect adjustment, instrumental errors determined most accurately and everything was in perfect readiness. At 12 o'clock it was perfectly clear, with every indication of a fine morning.

At 4 o'clock in the mornting the party was at the station ready for work, and their feelings may be better imagined than described when it is stated that a heavy bank of clouds covered the entire eastern sky, and apparently all the labor and expense of the past few months were to be thrown away. By 5 o'clock necessary adjustments were made and each man was at his post ready for work. The look of silent despair on the countenances of the various members of the party was said by the citizens of Auckland to have been the most heartrending spectacle ever seen in New Zealand.

At half past five the clouds broke away and photographing was commenced. Seventy-five photographs were obtained when the clouds again closed down and stopped work. Some of these photographs were taken while slight clouds covered the Sun, and these are too thin for measurement, but the most of them present sharp, round images of the Sun and Venus, and can be measured with great accuracy. Unfortunately one of the astronomers of the party was sick and unable to take part in the work, so that the observations of third contact, which was the only one of value, which we could see, depended on my own observations alone. My observations of third contact were much more satisfactory than I had anticipated. The phenomenon was much sharper and much more capable of accurate observations than I had expected from experience in observing the transit of Mercury. Thin clouds covered the Sun at the time so that a shade-glass was not necessary, and Venus came up to the limb presenting a perfectly sharp black disc. The contact took place without any distortion or any appearance of the various phenomena included under the name of "black drop." I felt sure of the time to within one or two seconds. The images were exceedingly steady and sharp.

It is hardly possible to give any definite statement as to the results of the work of the entire eight parties. A large number of photographs were obtained and satisfactory observations of contacts at most of the stations. It is altogether probable that the photographs will give a good determination of the solar parallax. It is stated that the images of the Sun in many of the pictures obtained by two of the southern parties are elliptical instead of being truly circular as they should be. It is very difficult to see how this could occur.

It is to be remembered that the transit of Venus is only one of the methods used in obtaining the parallax of the Sun, and no one expects the solar parallax to be determined finally by this method alone. This determination will not be final till the results obtained from trigonometric, gravitational and photometric methods agree, and this will require the work of many years to come.

WASHINGTON UNIVERSITY, January 5, 1884.

ASTRONOMICAL NOTES.

PROF. W. W. ALEXANDER, KANSAS CITY, MO.

The nocturnal skies during this month (February,) present an almost unsurpassed field of beauty and attraction, four of the largest and most resplendent planets in our system being visible in the early evening. First in the glittering array is Venus, situated in the southwest quarter of the heavens. Her motion during the month will be north and east. Seen with a telescope her disk will be gibbous, like our Moon at ten days past new; diameter on the 1st will be 12″; on the 29th, 15″. It makes almost a bound north in declination, going from 7° S. to 6° 30′ N. This planet moves around the Sun at a mean distance of sixty-seven millions of miles. Its orbit is more nearly circular than that of any of the other principal planets. It is very nearly the size of the earth, its diameter being about four per cent less than that of our globe. Next to the Sun and Moon, it is the most brilliant object in the heavens; by the last part of the month it will cast a distinct shadow of any opaque object on a white surface, such as a sheet of paper. It never recedes more than about 45° from the Sun, and is, therefore, seen by night only in the western sky in the evening, or the eastern sky in the morning, according as it is east or west of the Sun. There is, therefore, seldom any difficulty in recognizing it. When at its greatest brilliancy, i. e., by the end of the month, it can be clearly seen by the naked eye in the daytime, provided that one knows exactly where to look for it. It was known to the ancients by the names of Hesperus and Phosphorus, or the evening and morning star, the former name being given when the planet was east of the Sun and seen in the evening after sunset, and the latter when west of the Sun, it was seen in the east before sunrise. It is said before the time of exact astronomy Hesperus and Phosphorus were supposed to be two distinct bodies, and that it was not until their motions were studied, and the one was seen to emerge from the Sun's rays soon after the other was lost in them, that their identity was established. To the unaided eye she presents the appearance of a mere star, distinguishable from other stars only by its intense brilliancy.

We next come to Saturn. This magnificent planet is situated high up in the heavens; it will be on our meridian in the evening twilight. It is in north declination 19°, this makes an elevation of 70° from our southern horizon, or 20° south of our zenith. Referred to the stars, its position will be in the constellation Taurus, midway between and in line with the Pleiades and Hyades, two beautiful groups of small stars in this constellation; the principal stars of the latter are arranged in the form of the letter V, one extremity of the V being formed by Aldebaran, a red star ranked as of the first magnitude, but not so bright as some others. The Pleiades, or "seven stars," as the group is commonly called, is about 10° farther west. Really there are only six stars in the group clearly visible to ordinary eyes, and an eye which is good enough to see seven will be very likely to see four others, or eleven in all. A telescope of two inches aperture will show 120. Being elevated high above the horizon, this month will be a very favorable time for the most refined and delicate observations of this planet. It is to the rings that most of the interest of this planet attaches, the southern surfaces are opened out full to the view, the earth having nearly attained its maximum elevation above the ring plane. We may well imagine how sorely puzzled the earlier observers, with their very imperfect telescopes, were, by these strange appendages. The planet at first was supposed to resemble a vase; hence the name Ansæ, or handles, given to the rings in certain positions of the planet. It was next supposed to consist of three bodies, the largest one in the middle. The true nature of the rings was discovered by Huyghens in 1655.

There is nothing more encouraging in the history of astronomy than the way in which eye and mind have bridged over the tremendous gap which separates us from this planet. By degrees the fact that the appearance was due to a ring was determined; then a separation was noticed dividing the rings into two; the extreme thinness of the ring came out next, when Sir William Herschel observed the satellites "like pearls strung on a silver thread," then an American astronomer discovered that the number of rings must be multiplied we know not how many fold. Next followed the making out of the transparent ring by Dawes and Bond, in 1852; then the transparent ring was discovered to be divided as the whole system had once been thought to be; last of all comes evidence that the smaller divisions in the various rings are subject to change, and that the ring-system itself is probably increasing in breadth, and approaching the planet. The breadth of the entire system is 37,570 miles. In spite of this enormous breadth, the thickness is not supposed to exceed 100 miles. Of what, then, are these rings composed? There is great reason for believing that they are neither solid nor liquid; and the idea now generally accepted is that they are composed of myriads of satellites, or little bodies, moving independently, each in its own orbit, around the planet; giving rise to the appearance of a bright ring when they are closely packed together, and a very dim one when they are most scattered. In this way we may account for the varying brightness of the different parts, and the haziness on both sides of the ring near the planet, which is supposed to be due to the bodies being drawn out of the ring by the attraction of the planet. Although this planet appears to resemble Jupiter in its atmospheric conditions, unlike that planet, and like our own Earth, its year, owing to the great inclina tion of its axis, is sharply divided into seasons, which, however, are here indicated by something else than a change of temperature; I refer to the effects produced by the presence of the strange ring appendage. To understand these effects, its appearance from the body of the planet must first be considered. As the plane of the ring lies in the plane of the planet's equator, an observer at the equator will only see its thickness, and the ring, therefore, will put on the appearance of a band of light passing through the east and west points and the zenith. As the observer, however, increases his latitude north or south, the surface of the ring-system will begin to be seen, and it will gradually widen, as in fact the observer will be able to look down upon it; but as it increases in width it also increases its distance from the zenith, until in latitude 65° it is lost below the horizon, and between this latitude and the poles it is altogether invisible.

Now the plane of the ring always remains parallel to itself, and twice in Saturn's year, that is, in two opposite points of the planet's orbit—it passes through the Sun. It follows, therefore, that during one-half of the revolution of the planet one surface of the ring is lighted up, and during the remaining period the other surface. At night, therefore, in one case, the ring-system will be seen as an illuminated arch, with the shadow of the planet passing over it, like the hour-hand over a dial of a clock or watch; and in the other, if it be not lighted up by the light reflected from the planet, its position will only be indicated by the entire absence of stars. But if the rings eclipse the stars by night, they can also eclipse the Sun by day. So in latitude 40° there occur in Saturn morning and evening eclipses for more than a year, gradually extending until the Sun is eclipsed during the whole day—that is, when its apparent path lies entirely in the region covered by the ring; and these total eclipses continue for nearly seven years; eclipses of one kind or another taking place for eight years 292 days. This will give us an idea how largely the apparent phenomena of the heavens, and the actual conditions as to climates and seasons, are influenced by the presence of the ring. The year of this planet is as long as thirty of ours, hence it follows that each surface of the rings is in turn deprived of the light of the Sun for fifteen years.

Passing on along the same line that would connect Venus and Saturn, we will find at a distance of four hours (or 60° east of the latter) the giant planet Jupiter, by far the largest planet of the system. Compared with the earth it is 1,280 times larger; it is bright enough at present, in spite of its great distance, to cast a shadow like Venus. Its apparent sidereal place will be in the constellation Gemini, nearly in a line with Castor and Pollux, at a point 9° south of the latter. This planet is surrounded by an atmosphere so densely laden with clouds that of the actual planet itself we know nothing. What are generally known as its belts, are dusky streaks which cross a brighter background in directions generally parallel to its equator. And for the most part, the largest belts are situated on either side of it, in exactly the same way as the two belts of "Trade-Winds" on the earth lie on either side of the belt of Equatorial calms and rains.

Outside these, again, we get representations of the Calms of Cancer and Capricorn, although these are not so regularly seen, the portion of the planet's surface polewards of the two belts being liable to great changes of appearance, sometimes in a very short time. The portions of atmosphere representing the terrestrial calm-belts sometimes exhibit a beautiful rosy tint, the equatorial one especially. The variations of this cloudy atmosphere lend great variety to the appearance of the planet at different times; the belts are sometimes seen in large numbers, and extend almost to the pole. Besides the belts, sometimes bright spots, sometimes dark ones, are seen, which have enabled us to determine the period of the planet's rotation, which, we know is very rapid—so rapid, that on the equator an observer would be carried round at the rate of 467 miles a minute, instead of seventeen as on the earth. It is easy to understand how this rapid rotation would break the cloud surface into belts more than with us. Although all astronomers do not agree that the surface of the planet is never seen, there are many strong reasons why it should not be seen. In the first place, Mars and the Earth, whose atmospheres are nearly alike, have nearly the same densities, while in the case of Jupiter and Saturn—the belts of which latter planet, as far as we can observe them, resemble Jupiter's—the density, as calculated on the idea that what we see is all planet, is only about one-fifth that of the Earth; and as the density of the Earth is five and a half times that of water, it follows that the densities of the the two planets in question are not far from that of water. Now, if we suppose that the apparent volume of Jupiter (and similarly of Saturn) is made up of a large shell of cloudy atmosphere and a kernel of planet, there is no reason why the density of the real Jupiter (and the real Saturn) should vary much from that of the Earth or Mars, and this would save us from a water planet hypothesis. Moreover, a large shell of cloudy atmosphere is precisely what our own planet was most probably enveloped in, in one of the early stages of its history.

In addition to the changing features of this wonderful planet itself, the telescope reveals to us four moons, which as they course along rapidly in their orbits, and as those orbits lie nearly in the plane of the planet's orbit, lend a great additional interest to the picture. In the various positions in their orbits the satellites sometimes appear at a great distance from the primary; sometimes they come between us and the planet, appearing now as bright and now as dark spots on its surface. At other times they pass between the planet and the Sun, throwing their shadows on the planet's disk, and causing, in fact, eclipses of the Sun. They also enter into the shadow cast by the planet, and are therefore eclipsed themselves, and sometimes they pass behind the planet, and are said to be occulted. Of this appearance I give below a partial table embracing only a few of the most notable that occur during the month; time used is "central" or standard:

On the 2d at 9h. 52m. 20s., Ganymede is eclipsed and reappears.

On the 6th at 9h. 41m. 57s., Io is eclipsed and reappears.

On the 16th at 9h. 44m. 40s., Callisto is eclipsed and disappears.

On the 17th at at 11h. 59m. 00s., Europa is eclipsed and reappears.

Following the same lines connecting Venus, Saturn and Jupiter, 15° farther east, we find Mars; it is in the constellation Cancer, and will be in the evening twilight, in the northeast quarter of the heavens at an elevation of about 20°, and the same distance north of east.

This is the fourth planet in order of distance from the Sun, and the next one outside the earth's orbit. Its mean distance from the Sun is about one hundred and forty-one millions of miles. It is easily recognized with the naked eye when near its opposition, by its fiery red light. It is much more brilliant at some oppositions than others, the present is not a very favorable one to see it, but yet it will exceed an ordinary star of the first magnitude. The variations of its brilliancy arise from the eccentricity of its orbit, and consequent variations of its distance from the Earth and the Sun.

Mars has been an interesting object of telescopic research from the fact that it is the planet which exhibits the greatest analogy with our Earth. The disk, even with a small telescope, can be seen to be divided into light and dark portions, which some observers suppose to be continents and oceans. Around each pole is a region of brilliant white, supposed to be snow. It must be said in favor of these suppositions, that if our Earth were viewed at the distance at which we view Mars, and with the same optical power, it would present a similar telescopic aspect. But it is also possible that if the optical power of our telescopes were so increased that we could see Mars as from a distance of a thousand miles, the resemblances would all vanish as completely as they did in the case of our Moon. This is the only planet besides the Earth of which we can be sure that the time of axial rotation admits of being determined with entire precision; it has been found to be 24h. 37m. 22.73s., this is correct within three or four hundredths of a second. The Equator is inclined to the plane of its orbit about 27°, so that the vicissitudes of the seasons are greater there than on the Earth in the proportion of 27° to 23½°. Owing to this great obliquity, we can sometimes see one pole of the planet, and sometimes the other, from the Earth.

Comet Brooks, so closely identified with the one of 1812 (i. e. Encke's) as to leave but little doubt that it is the same, was first observed September 3, 1883. It was then in the constellation Draco; it moved from this into Lyra, passing only a few degrees north of Vega in the latter part of November, it entered the Milky-Way and Cygnus, thence through the eastern edge of Vulpecala. On December 29th it entered Pegasus, passing from this constellation into Pisces on the 10th of January, and on the 15th it was on the boundary line between this and Aquarius, at this time it had attained its maximum brilliancy and was 118 times brighter than it was when discovered, and plainly visible to the naked eye. On the 22d of January it will enter Cetus, and by February 1st will be in Sculptor; its brilliancy will have faded about one-half; by the 12th it will be below the horizon all the time. The only time it will be possible to see it will be during the first week of the month, and a telescope or opera glass will be required. It will be nearly due southwest, and elevated from 10° to 15°.

SUN AND PLANETS FOR FEBRUARY, 1884.

W. DAWSON, SPICELAND, IND.

The Sun is approaching the Vernal Equinox—its R. A. being 21h. 0m. on February 1st; and 22h. 48m. on the 29th. During the month he moves northward from 17° 7′ south declination, to 7° 37′ S. This change makes February 29th one hour and eight minutes longer than February 1st; the latter being 10h. 2m. in length, and the former 11h. 10m. long.

Solar spots are waning somewhat, though they exist in very clever numbers yet, (January 17th).

Mercury is Morning Star and will be at greatest elongation west about the middle of February, when it can easily be picked up with an equatorial telescope. It will be too far south to be conspicuous to the naked eye. The very bright Evening Star in southwest is Venus, and it is now quite worth looking at. The same of Jupiter, north of east,—still forming a row with Castor and Pollux. Mars is some distance northeast of Jupiter, and may be known by its fiery redness. Its opposition to the Sun on the 1st of February will be appreciated by those who have access to very large telescopes, as being a favorable opportunity for seeing its tiny moons. Saturn is between Aldebaran and Pleiades—crossing the meridian at 7:20 P. M. February 1st, and about four minutes earlier each day afterward. Uranus is in the southwestern part of Virgo; about 4° west of the star Eta. Neptune is still about 10° southwest of Pleiades.

The 1812 comet re-discovered by Professor Brooks, September 13, 1863, has moved southeast, so as now (January 17), to be in the southwestern sky; and it is a fine little naked eye comet. It presents a grand appearance in the telescope —a large and very bright nucleus surrounded by a beautiful crown of dense hazy light, with a splendid tail 2° long from the side opposite the Sun. It will probably disappear in the southern horizon about the end of February.

GEOLOGY.

THE FOSSIL FIELDS OF SOUTHERN OREGON.

CHAS. H. STERNBERG.

In August, 1877, while working in the Loup Fork Group of northwestern Kansas I received orders from Prof. E. D. Cope to go at once to Oregon, to a new fossil deposit; I was to keep the locality a secret from all. A day or two after I was on the west bound train and there met Mr. S. W. Williston, one of Professor Marsh's collectors. He seemed to be on his way to a new locality, and refused to tell me of his destination. I thought he might have told the conductor, and therefore on my first chance asked that gentlemen where Mr. Williston was going, and he told me at once that W. had learned of a rich locality where fossil bones of huge proportions were found, in Cañon City, Colorado,—I immediately wrote to Professor Cope, and had the satisfaction of learning a few months later that he had sent a man to this rich field about the same time that Professor Marsh had, and helped reap a rich harvest of those new and unique remains of extinct animals, great land Saurians and Dinosaurs, some of which reached a height of twenty five feet and a length of sixty feet.

On my arrival at Reading, California, I took the stage for Fort Klamath, Oregon. That stage ride was one long to be remembered, and carried me through some of the grandest scenery in America. We traveled up to the head of the Sacramento River, through virgin forests of magnificent pine, spruce, etc., that lifted their heads 150 feet in the air: long festoons of moss hung down from the branches trailing on the ground; every turn in the road showed us some new feature in mountain scenery, and at last, towering 4,000 feet above the surrounding mountains, Old Mount Shasta stood revealed in all her snow-clad greatness, a perfect cone, the most sublime of mountain forms, filling my expectations of what a mountain ought to be.

Near Denver the Rockies look like a mass of bluffs, all about the same height, while Shasta stood out alone, overlooking and master of the mighty Cascade Range that lay at his feet. They are indeed the Alps of America. Farther north Mount Hood stands guard over Oregon, and farther on Mount St. Helen rules over Washington; these cone-shaped mountains are all extinct volcanoes, and have living glaciers in their deeper cañons. Another grand piece of Nature's handiwork we passed on the route, was Castle Rock, a huge pile of gray rock which from a fancied resemblance to an ancient castle has received its name. On my arrival at Fort Klamath I was cordially received by the Commander, who took me into his home while I was at the post, and whose kind hospitality I shall not soon forget. While here I prepared the skeleton of a large grizzly bear that a gentleman had killed a short time before; this bear had killed a number of his sheep. One night he heard a commotion in his sheep pen, and seizing his Winchester rifle went out of his tent to see Mr. Bruin walking leisurely along a few feet from him; taking aim he fired and fortunately broke the bear's neck.

Here I also caught a large number of mountain trout. They are as savory as our eastern trout, but are not as gamy. It is no trouble to catch them, I baited a hook with a worm, and standing near a deep hole in which numbers were gathered, threw in my line: they bit quickly, in sight of me, and I caught a dozen or more in this one place.

At Klamath I hired an assistant and bought my riding and pack animals. The Government supplied me with saddles, tent, etc. I could get no guide, so trusting to a Government map, we started for Silver Lake. My map traced Sprague River that emptied into Lake Klamath, near the post, to its head in Silver Lake. My plan, therefore, was to follow up the river. As I was crossing a large Government bridge on Williamson River a number of Indians came up to me and demanded $2.00 toll, this I refused to pay. I learned afterward that these Indians made a living by collecting toll from people crossing this bridge. After following Sprague River for about fifty miles I found it rose in a small range of hills and I was at my wits end as to what to do; my only guide had proved false. At last, I resolved to go north. I was in a country only occupied by Indians and wild animals. I came to a place where the trail I was following forked, one going directly north and was but little traveled, the other, a well beaten trail, led a little west of north. While debating as to the best course to pursue, an Indian boy came along driving two pack ponies, or cayuses, as they call them. He took the large trail, I asked him where he was going and he told me to Sican Valley to a sheep ranch. I had been told that I would go through this valley and by a sheep ranch on my way to Silver Lake, I therefore followed the Indian. After going about five miles the trail came to an end in a thick forest, at an Indian encampment; a number of braves in war paint came out and told me I was lost, and that they would show me the road for $2.00. I was so indignant at having been cheated so that I refused to pay them anything, and started east. Fortunately, just as the sun went down we found the trail we had left. Here we ate the last of our provisions, as the night before an Indian had stolen our bacon that we had packed under a lot of tinware in the bottom of a box near the head of our bed, and the bread had fallen off our pack and was lost. Next morning, bright and early, we started without breakfast in hopes of reaching the sheep ranch, which we luckily did just before dark, very hungry and tired; here a good cup of coffee, some hot bread and mutton-chops soon made us forget our past hunger and dangers, and we were glad to learn that another day's journey would bring us to Silver Lake, which we reached next day. Here we heard all about the wonderful bone-yard that had been discovered by a stockman in a desert twenty-eight miles from here.

Next day, accompanied by the postmaster as guide, we started for the fossil fields and reached a house eight miles from the locality that day, where we camped for the night. It took all next day to reach our destination, as we had to find our way through a sage brush desert. We had a wagon along and it was slow work. The fossils we were in search of were of quite recent species, some in fact, were of existing ones. The bones lay scattered around a small alkaline lake and were all exposed, resting on a bed of clay. They had been covered with loose volcanic sand and ashes which the wind had drifted away and piled in great heaps sixty feet or more in height. These sand drifts were covered with wind-marks and looked like newly harrowed fields. There were numerous hillocks, from a few feet to eighteen or twenty feet high, the summits of which had been protected by a patch of sage brush and the sides laid bare and rounded by the wind. We pitched our tent and hitching our pony to a sage brush hauled it into camp, and so repeated this till a large pile was gathered. Early next morning we were busy gathering together the loose bones and placing them in piles; we put them on our pack-horses and carried them to camp. They were well preserved;

but unfortunately none of the skulls were preserved; they had been broken beneath the feet of countless deer and antelope that had come to the lake for water. We got a great many teeth and bones. They were all scattered. One party under Prof. Condon, of the State University, had been at the locality before us. The mammalian bones were three species of the Horse; three of the Llama; one new species of a sloth, *Mylodon;* the elephant; a beaver-like animal, and some carnivores. We got great quantities of fishes that varied in size from a trout to a salmon or larger; also a great many bones of birds in size from a sand-piper to a stork. Among them was the Canadian goose. There were piles of land-shells that looked like snow-drifts. The bones were but little petrified and were of the pliocene age. The animals had all doubtless perished under a storm of volcanic ashes and sand from an active volcano near by.

We found numbers of arrowheads, polished and made from volcanic glass or obsidian. We had thought at first that they might be contemporaneous with the bones, but I found near the deposit, between some huge sand banks, in the remains of an old Indian village, near which one arrow-maker had his abode, great quantities of chips of obsidian, perfect arrowheads and those partly finished, with drills, knives, pestles and mortars, and a pile of whitened rabbit and other bones. We found part of an Indian skull also. One peculiarity I noticed in the desert was that all the springs were on the tops of rounded knolls, which led me to think that perhaps water would come to the surface from artesian wells. If that be the case, this country will one day become a fertile land. We got over a thousand pounds of fossil bones from this locality, all of which have been described by Prof. E. D. Cope in the Bulletins of the U. S. Geological Survey.

FLINT CHIPS.

G. C. BROADHEAD.

In the January number of the REVIEW Dr. Child asked about "gun-flints," I therefore thought I would chip off a few notes concerning *flint* and other somewhat similar rocks.

Flint is a uniform impure variety of silica allied to chalcedony. It is cryptocrystalline and of opaque dull colors, generally grayish, smoky-brown and brownish-black; is easily broken and breaks with a flat conchoidal fracture and sharp, cutting edge. It is feebly translucent, of a homogeneous texture, bears polishing but possesses little lustre.

The flint of the chalk formation largely consists of the remains of *infusoriæ* and sponges, and recent investigations have in a great measure confirmed the theory that most flint concretions and chert concretions are remains of sponges. —the fossil *spiculæ* of sponges; they have in fact been classified and assigned to genera and species.

Hornstone resembles flint but is more brittle. Chert is a variety of hornstone and is very abundantly interstratified with the rocks of Missouri. Although much of it is flint-like and is even called flint, still it is scarcely proper to apply the term "flint" to our Missouri chert beds, but they may sometimes be termed hornstone.

The upper carboniferous incloses chert of different colors and varieties. At Kansas City and other places where the same strata occur, we find beds of black chert and also of light brown chert. Some of the beds being quite silicious, inclose some pretty fcssils whose composition is often a milky looking chalcedony.

The lower carboniferous includes many chert beds. The gray Keokuk limestone beds include numerous white chert concretions. The upper Burlington beds consist near the top of seventeen to twenty feet of alternate beds of white chert and red clay. The Chouteau beds occasionally inclose concretions of white and bluish chert.

The Magnesian limestone series of southeast and southern Missouri abound in concretionary chert beds which (in the second magnesian limestone) are bedded in shaly strata separating them from the limestones. In the third magnesian limestone occur some thick chert deposits which sometimes can be traced many miles. Such beds I have found along the Osage and Gasconade. These are generally of a white or gray color, sometimes a grayish blue and rarely a flesh color: they are sometimes beautifully banded forming coarse agates. The concretionary chert beds often assume curious forms. The concretionary chert beds or beds of concretions generally occur along a well defined line either connected or separated from each other but arranged parallel to the inclosing limestone strata. These lower magnesian limestone beds also inclose many pretty öolitic chert beds, the öolites are often as small as the roe of a herring.

We also often find very pretty round concretions which when broken show that they were formed in parallel concretionary bands, the bands sometimes are of different shades of color. The interior, though generally solid sometimes contains clay. Our fossil woods are generally of some variety of chert, hornstone or chalcedony. Some from Colorado and Idaho are a variety of opal. Beautiful chalcedonic wood is found in Colorado. Moss agate in western Kansas and Colorado. The fossil silicious wood of the carboniferous is generally of a black color, which is due to the presence of carbon. This is also further traversed by chalcedonic veins, and small cavities are sometimes lined with minute crystals of quartz.

The cretaceous formation in England incloses rounded nodular masses of chert of various sizes and shapes and colors, white and black. These are sometimes formed in concretionary bands of black and white, and exhibit markings derived from organic bodies.

When flint is calcined it becomes white, hence its color is attributed to organic matter derived from inclosed fossils. Quartz has been formed by organic agency, for example, from spiculæ of sponges or from plants; it is also formed by the agency of water as flint concretions, or by plutonic agency.

Potter's clay is chiefly composed of silica.

Flint was formerly employed in the manufacture of finer varieties of glass, which was termed "flint-glass."

Flint is used in the manufacture of fine earthenware, being for this purpose first calcined, then thrown into cold water when it is easily broken, and it is then ground into powder.

It has long been known that flint would strike fire with steel, and it has been thought that during the process a chemical combination of silica and iron takes place, causing great increase of heat. Pliny informs us that Clias was the first to strike fire with flint or to utilize it.

Before matches were invented, flint with steel and tinder were used for making fires, and the use of gun-flints immediately preceded that of percussion caps. Percussion caps began to be used with fire-arms between 1820 and 1830, and were entirely adopted by the British army by 1840.

When a boy, I owned a gun with a flint-lock which my father had altered to a percussion lock. That was between thirty and forty years ago.

The material of which gun-flints were made was chiefly derived from the English chalk beds. In the selection of gun-flints the best nodules were chosen, selecting those whose form was more nearly globular. They should have a greasy lustre, be particularly smooth and fine-grained. The colors were some shades of brown and uniform throughout. The translucency should be such as to render letters legible through a slice one-fiftieth of an inch thick, and the fracture smooth and uniform, and slightly conchoidal, the last property being very essential.

We copy from Ures' Dictionary of Arts and Sciences the mode of working the flint. The tools used were:

1. An iron hammer of one to two pounds weight with a square head—a steel hammer being harder would shatter the iron too much.

2. A well hardened steel hammer of ten to sixteen-ounce weight having two points, the handle being so inserted that the points of the hammer are nearer the hand of the workman than the centre of gravity of the mass.

3. A disc hammer, or roller, being a small steel wheel two and one-third inches in diameter, and twelve-ounce weight, having a handle or axle six inches long passing through its centre.

4. A steel chisel.

5. A steel file to sharpen the chisel.

The process of making flints was as follows:

1. The workman seated upon the ground places the nodule of flint upon his left thigh and with slight strokes of his square hammer he divides it into pieces of about one and a half pounds weight.

2. The workman holds the lump in his left hand and strikes with his pointed hammer upon the edges of the great planes produced by the first breaking. Scaly portions are thus detached nearly one and a half inches broad, two and a half inches long and one-sixth of an inch thick, and slightly convex below.

3. The workman fixes on a border for the striking edge, then the two sides

that are to form the lateral edges, as well as the part that is to form the back. It is placed on the edge of the chisel in such a manner that the convex surface of the flint which rests on the forefinger of the left hand is turned towards that tool. Then with the disc hammer he applies slight strokes to the flint just opposite the edge of the chisel underneath and thereby breaks it exactly along the edge of the chisel.

6. The stone is then turned and the edge of its tapering end is placed upon the chisel, and the process of trimming and sharpening is completed by five or six slight strokes of the disc hammer.

The whole time of making a gun-flint occupied less than a minute. If the flint balls are good a workman will manufacture 1,000 flints in a day, but if the quality is poor about 500.

I do not know whether there have been any manufactories of gun-flints in the United States; certainly they were manufactured in Europe, especially in England.

The worked "flints" of the stone age, although generally termed "flints," were made of various kinds of silicious rock including common flint, chert, hornstone, quartzite, chalcedony, agate, porphyry, jasper, and obsidian.

The California Indians readily manufacture glass bottles into arrow-heads.

The arrow points found in Missouri are of quartzite, chert, hornstone, and porphyry, but chiefly of chert, generally of a white color, but sometimes reddish tinted, others are brown, black, or gray, or bluish and white.

I have found localities where evidently a number had been made, for the flints were in every stage of perfection; some very perfect, others from which only a few flakes had been chipped off. Pits have been found where the prehistoric people had probably quarried flints, for they did not seem to be old mineral shafts, no mineral at present being found there.

NOTE ON A NEW MINERAL TO CENTRAL KANSAS.

WARREN KNAUS.

In November, 1882, while in Saline County, my attention was called to a crystallized mineral supposed to be a form of gypsum. I took a specimen to the Agricultural College and it proved on analysis to be *Celestite* (Sulphate of Strontia)—a mineral then little known in the State, and not found in Prof. Mudge's Catalogue of Kansas Minerals.

The locality in which the mineral is found is the SE. ¼ of Sec. 30, T. 14 S. and R. 2 W., being on the extreme western edge of the Permian Group, bounded at this point by the Smoky Hill River.

The Celestite occurs in crystals, in the strata of the limestone, dipping at some points to the surface of the water, and rising at other points from ten to twenty feet above the surface. The mineral also occurs in massive nodules in the bottoms of ravines, but is less free than the crystallized forms. The crystals are of all sizes, varying from needle-like points to crystals one and a half inches in length and a half inch in diameter. Many of the crystals are perfectly transparent, others are opaque.

There are, I believe, but two other localities in the State in which this mineral is found: one near Manhattan, where it occurs in the massive form, the other locality is near Valley Falls.

CHEMISTRY.

KAW WATER AT LAWRENCE, KANSAS.

PROF. E. H. S. BAILEY.

A sample of the water from the Kansas River was taken on October 13th, one day after a rain, at a point one-half a mile above the bridge. A sample was also taken on the same day from a well in West Lawrence, at a point near the river bank. The river water was turbid, and was allowed to stand till the sediment was deposited, so that an analysis of the clear water was made. For the execution of the following analyses, I am indebted to Mr. T. W. Miller, a student in the Chemical Labratory of the University. The amounts are expressed in grains per gallon:

	River Water.	Well Water.
Silica, (sand)	1.370	0.211
Chloride of Sodium, (salt)	6.677	10.859
Sulphate of Lime	2.440	9.498
Bicarbonate of Lime	16.122	29.908
Bicarbonate of Magnesia	3.527	8.183
Bicarbonate of Iron	Trace.	0.593
Bicarbonate of Soda	Trace.	Trace.
Organic Matter	0.770	7.873
Total Solids	30.906	67.125

It will be noticed that the well water has more than twice as much residue or mineral matter as the river water. This residue is not considered as necessarily injurious; but from an economic point of view, the river water is much superior, as these solids in this case make the well water much harder than that of the river. Carbonate of lime and magnesia render water "temporarily hard," that is, the water can be cured by appropriate reagents. Sulphate of lime, on the other hand, makes the water "permanently hard." The well water contains twice as much carbonates as the other, and four times as much sulphate of lime.

Well water therefore uses up much more soap than river water. As an instance of the saving in this item of soap, it was estimated that $180,000 was saved annually in the City of Glasgow, after the introduction of the pure water of Loch Katrine.

But it may be urged that only cistern water is used for washing. This, however, very often fails, especially in a dry season, when well water must be substituted.

I believe the suggestion has been made that water be pumped from a well near the river bank, so that river water may be used, and yet it may be filtered. The suggestion is, in the main a good one, but the well must be literally on the bank, or the hard water will filter in through the surrounding rocks, and the water will thus be deteriorated. If a convenient place can be found either on the south or north bank of the river, where there is a sandy shore, the wells might be dug in this and a supply of filtered water be thus obtained. Essentially, this plan has been carried out with success in many cities. The unfiltered water even, is for many reasons, superior to our well water.

A word upon the quality of the latter. Many of these wells, I am informed, have been tested by a competent chemist, and have been pronounced unfit for domestic use on account of so much organic matter. Furthermore, a well that is good this year, may be bad the next, for there is a constant menace in the fact it is not possible to tell how soon the surrounding soil will be permeated with filth and contaminate the well. It is not necessary to enlarge on this point, for it is everywhere conceded that there is constant danger of the spread of zymotic diseases through the medium of impure water.

It will be noticed that the well water examined contained 7.873 grains of organic matter, while the river water contained only 0.77 grains, an immense difference in favor of the river.

Cistern water is often very impure, because the rain washes into it the decaying matter from the roof. Of course, if collected from slate or tin roofs it has hardly any superior in regard to purity.

Of the various sources of water supply at hand, the river, therefore, seems to be the safest, and will in time prove the most economical. As to its purity, there is no danger of injury to the water from sewage from towns above, for water happily purifies itself from such material in running a few miles. A distance of five miles produces a marked change in the character of the water in a swift running stream.

Lawrence is much more favorably situated in this particular than very many cities. Boston water contains 0.81 grains of organic and volatile matter; Philadelphia, 1.2 grains; New York, 0.67; Chicago, 1.06; London, 0.87; Paris, 1.00.

In regard to total solids, the amount in the waters of the cities above mentioned varies from 3.11 grains to 16 grains. It is to be expected that the Kansas River would have an abundance of these substances, fed as it is by water that has flowed over our extensive limestone deposits.—*Lawrence Morning News.*

WONDERS OF PHOTOGRAPHY.

Twenty years ago, to have one's likeness taken was a trying ordeal. The patient to be operated on was placed in as strained an attitude as the ingenuity of the photographer could devise; his head fixed in something resembling a vise; he was cautioned not to wink for a length of time which seemed to depend on the state of the photographer's temper; and then in the course of a few weeks he received pictures of a staring idiot supposed to be himself. All who were at all proud of their personal appearance—all women and most men—were disgusted with the art. Now all is changed; the operation is generally over in a second or two; freckles, pimples, and cross-eyes are improved away, and everybody is surprised how comely he is. This rapid progress in the art of photography is to some extent due to improvements in lenses and various mechanical appliances, but more especially to the discovery that the salts of silver in combination with gelatine yield a far more sensitive plate than could ever be obtained by the old collodion process.

Within the last two years some remarkable photographs have been taken which show the wonderful perfection to which the art has attained. Likenesses of restless children, crying or laughing, are now so common as hardly to need mention; even the act of kissing, transitory as it is, is sufficiently prolonged to enable a photograph to be taken, the momentary rest, when lips meet lips, are enough for the artist's purposes. But movements far more rapid than the act of kissing (which, after all, is often not so very transitory) are now seized by photography. Athletes performing in mid-air, birds flying, the course of projectiles, waves breaking on the coast, have all been photographed with a definition and clearness that leaves little to be desired. Photos of the Irish mail, rushing along at the rate of forty-five miles an hour, show the outlines perfectly defined, while the spokes of the engine-wheels are plainly delineated, proving the operation to have been so rapid that the wheels had not time to move any appreciable distance. Perhaps, however, the most remarkable photographs of moving objects are those obtained by Mr. Muybridge of horses running and jumping; in these, positions of the limbs are shown which are far too transitory for the human eye to detect; what the eye sees in watching a horse running is an average of the successive positions assumed by the horse's legs; photography alone can give an accurate idea of their position at any definite point of time. The attitudes shown in photographs seem at first sight to be absurd, and certainly differ very much from representations by engravers and painters; photographs show the real positions at certain moments of time, while painters depict, and rightly too, the apparent positions.

To the astronomer the art is invaluable, and some of the most remarkable discoveries in astronomy have been made by its aid. Large photos of the Sun are taken every day it is visible at Greenwich and elsewhere, and thus a permanent record of the exact size and shape of every sunspot is obtained; these, when compared with electrical and other meteorological conditions, will help to settle the question whether and in what way the sunspots affect the weather. To such a perfection has the manufacture of gelatina-bromide of silver attained, that M. Jansen, of Paris, photographs the Sun in less than one two-thousandth of a second. Again, the solar corona, as to the nature of which such varied speculations have been rife, is only visible during the very few minutes that a total eclipse of the Sun lasts, and the observations that can be made in so short a time are necessarily very imperfect. Recently, however, Dr. Huggins has succeeded in photographing the corona without the intervention of an eclipse. The corona is especially rich in violet rays; now, the eye is less sensitive to small variations in the violet rays than it is to the other colors of the spectrum, whereas the violet is just what photography deals with most effectively. By cutting off the other rays, Dr. Huggins has succeeded in photographing the corona by means of its own violet light, and that, too, at a time when hitherto observations have been impossible. When his method is perfected, astronomers will be able, with the help of the camera, to study the corona and solar protuberances at their leisure.

The recent transit of Venus afforded a fine opportunity for calculating the distance of the Sun, and it is expected that, with the assistance of the hundreds of photographs obtained, the distance of the Sun from the earth will be calculated to within 300,000 miles. The numerous comets, too, have not been allowed to pass without leaving their images behind, which show their shapes and positions far more perfectly than has hitherto been possible. But perhaps the most remarkable achievements are the photographs of spectra of stars and nebulæ. Not long ago it was hardly possible to photograph stars of the fourth or fifth magnitude, and even the brighter nebulæ shone with far too faint light to enable photographs to be taken. But, recently, not only have the fainter nebulæ and stars, as low as those of the fourteenth magnitude, which are only visible through most powerful telescopes, been photographed, but their light, even when dispersed by the prism, has still been strong enough to leave its impress on the sensitive plate. Dr. Huggins and Professor H. Draper have each succeeded in photographing spectra of nebulæ and stars of the twelfth magnitude, and thus determining some of the elements contained in worlds so distant from us that their light, travelling 186,000 miles per second, has taken thousands of years to reach us. Such photographs are especially useful, because they show the faintest lines in the spectra which have hitherto escaped the most practised eye.

Hardly less remarkable are some of the discoveries of Captain Abney, the prince of photographers, in his experiments on the infra-red of the spectrum; he has recently shown that between the earth and the Sun, and quite outside our atmosphere, there exist accumulations of benzine and alcoholic derivatives. Alcohol in temperance drinks, alcohol in rainwater, *alcohol in space*, alcoh l everywhere.

Again, in meteorology the art of photography will prove to be of immense use. A regular system of photographing the clouds by means of a specially made cloud-camera, which acts automatically, has just been commenced. The form and disposition of clouds have always been regarded as an index to the weather, and weather records compared with cloud-photographs will doubtless afford valuable information and assistance in weather prognostications.

To the geographer and ordnance surveyor the camera will soon be regarded as an indispensable part of their outfit. The tedious operations of making sketches of a district will be obviated, and perfect pictures with hardly a chance of error will easily be obtained.

To the medical man too, and the chemist, photography is found to be a valuable assistant. At the Glasgow Medical School the successive stages of surgical operations, sections of tumors and diseased structures, and in fact any remarkable forms of disease, are photographed, and the prints shown to medical students and distributed among the profession to assist in the diagnosis of rare forms of disease. Dr. Lennox Brown and Mr. Cadett have recently got some wonderful photos of the interior of the larynx. By an adjustment of mirrors in the mouth and the electric light to illuminate the throat, they obtained perfect pictures of the various positions of the laryngeal muscles *during the act of singing;* and we may expect that such photos will be found of great value, not only in the teaching of classes of medical students, but as aids to the study of the mechanism of the voice. Further, Dr. Koch has recently got some remarkable photographs of bacteria and bacilli by the aid of the camera and microscope; and here, again, such pictures may be made of incalculable value in disseminating a knowledge of these minute but most formidable enemies of mankind.

In medical jurisprudence, when it is stated that the crystals formed by the one-thousandth of a grain of arsenic have been successfully photographed, it will easily be seen that, in cases of poisoning, photography may prove a very valuable assistant in the detection of crime. A novel use of the art is now being made in the Municipal Laboratory of Chemistry at Paris; photographs of chocolate, tea, coffee, pepper, milk, cheese, etc., as seen through the microscope, are taken and distributed; and, by comparing samples of such articles with photos of the pure article, an easy method is afforded, even to non-professionals, of detecting adulteration.

Photography is utilized by the microscopist in other directions. Accurate views have been secured of the most minute objects, just as they appear under the most powerful microscope. Photos of minute diatoms, polycystina, infusoria in motion, bacilli, and trichini have recently been obtained by the writer of this article under a power of 1000 diameters. The cilia of animalculæ, blood corpuscles, the microscopic structure of bone and tissue are shown most distinctly, and details are seen easily which often escape the eye in microscopic examinations. A large photo, six inches in length, of a small fly's tongue measuring about one-seventieth of an inch, shows the hairs and various markings with remarkable clearness. A simple calculation shows this photograph to cover an area 176,000 times as large as the original object. Again, views of the internal structure of wood show conclusively whether the wood is weak or strong; in strong wood the concentric rings appear close in texture, while the radial plates are numerous, broad, and thick. It has even been suggested that such photos migh be used as trade advertisements. The internal structure of metals, too, has been examined by the joint aid of the camera and microscope; laminæ of the metals are reduced to extreme tenuity by the action of acids, and when sufficiently translucent are photographed through the microscope; gold and silver are said to have a fibrous structure, while tin is granular.

Till recently, no one would ever have dreamed of applying photography to acoustics; but it is now possible to photograph sound, or, speaking more accurately, sound-vibrations; and Professor Boltzmann is now announced as the discoverer of what at first might well be regarded with incredulity. The sound-vibrations are communicated to a thin platinum plate, and the movements of the plate, after being magnified by a solar microscope, are reflected on a screen and photographed by rapidly drawing a sensitive plate across the image. Every letter when pronounced gives a separate and distinct impression, the vowels showing regular undulatory vibrations, while the consonants give curves and lines of very varied forms. The uses of an arrangement like this may be innumerable. We can almost imagine that when the process is perfected, eavesdroppers and spies will have a very easy time, and need to run no risks in order to obtain secret information; a small instrument secretly placed in a room, and acting automatically, may copy down every word spoken; nay, it is far more chimerical to expect that photography may one day take the place of short-hand reporters.

But besides all the varied ways in which photography has been utilized in science, it has miscellaneous uses without number, and especially noticeable are the ways in which the British and foreign governments have found it serviceable. No army is now ever despatched on service without a full equipment of photographic requisites. In reconnoitering and surveying the enemy's positions and intrenchments, it was formerly necessary to have sketches made; considerable time was needed, many dangers incurred, and after all, important details were often accidentally omitted. Now the photographer accompanies the reconnoitering party, and in a second or two he secures views which show the exact positions of the enemy's works, without a chance of mistake. Such photos were found of great use in the recent war in Egypt.

Again, during the last siege of Paris, it is well known of what enormous value the pigeon post was. The beleaguered Parisians were able to keep up correspondence with their friends outside, in spite of the German army. Letters and despatches were printed on a large sheet which was then photographed to a very small scale on pellicles of six by two centimetres in dimensions; and these, being tied to the legs of trained pigeons, were carried over the heads of the Germans safely to their destination. The small photos had then only to be placed in an enlarging lantern, the letters transscribed and sent to the various addresses. The Germans have now established a regular system of pigeon-post in all their large towns, in the event of war.

At the government dockyards, when experiments were being made with torpedoes, the aid of photography was invoked. Rapid views of the torpedo explosions were taken, showing the upraised fountain of water and registering the exact height to which it was thrown. Views of rocks, buildings, or old vessels being blown up by dynamite, show the fragments as it were suspended in the air, the artist being able to expose his plate precisely at the moment required. At Shoeburyness a regular staff of artists was employed in photographing the effects of artillery experiments against iron and steel armor-plates. Again, in many of our prisons, portaits of all prisoners of a certain class are regularly taken, and, if necessary, produced by hundreds and distributed throughout the country. The detective camera, a small instrument which can be held in one hand, may be of incalculable use in obtaining portraits of any suspected persons in the streets, and in this way identification of criminals might be much facilitated.

Recently, quite a novel use has been found for photography. The Chinese, who in their own way are an extremely enterprising race, are troubled with a language which is a stumbling-block not only to foreigners but even to themselves. The number of signs or letters is so great that an ordinary printer's compositor would be perfectly bewildered; his type case would be a wilderness of boxes; in fact, to print a newspaper in Chinese would be nearly impossible. An enterprising publisher, however, has recently hit on the plan of having one copy of a newspaper written out and then multiplying the copies by photography, using one of the many mechanical photographic printing processes.

But to enumerate all the wonders of photography is impossible: one more must suffice. It has been found practicable, under certain conditions, to photograph *invisible* objects. It is well known that in the spectrum of white light there are rays which are quite invisible to the human eye: we refer to the chemical rays beyond the violet end and the ultra-red or heat rays. But the eye is far from perfect, and the rays that it cannot see can still be rendered perceptible by other means; for instance, bisulphate of quinine placed in the invisible chemical rays is at once rendered fluorescent. In a similar way, Captain Abney finds that the bromide of silver used by the photographer can be so modified as to become sensitive to the invisible ultra-red rays; and we are told by Mr. Proctor that he has "taken the photograph of a kettle of boiling water *in the dark* by means of its own radiation." In some of the photographs of the great nebula of Orion are clearly seen traces of certain dark bodies in space, while they are invisible through the telescope; and it is at any rate not within the region of absurdity to suggest that photography may some day reveal to us the existence of worlds enveloped in perpetual darkness—suns, perhaps once as bright as ours, but whose light has been dimmed by the lapse of millions of years; stars and systems which are no longer visible, but which still move in space in accordance with the unfailing laws of the universe.—*Cornhill Magazine.*

PROGRESS IN ARTIFICIAL LIGHTING.

The vast improvements which have taken place in the production of artificial light in recent years—improvements which bear to a considerable extent upon the hygienic aspect of the question—make it especially desirable to bring the subject before the public. The introduction of the electric light has had the result of stimulating invention in gas lighting, and there have been recently introduced new methods of gas lighting which bid fair to retard the introduction of the electric light for domestic use. Every form of matter when sufficiently heated has the power of emitting rays of light, and thus becomes self-luminous. This condition is termed incandescent, and the self-luminous worlds, as the Sun and fixed stars, are, doubtless, in a condition of intense incandescence.

All artificial sources of light depend upon the development of light during incandescence. For the illumination of our streets and houses at night we have hitherto made use of a combustible gaseous combination of carbon and hydrogen, which forms the chief constituent of ordinary coal gas. When this hydrocarbon burns—that is to say, when its elements unite with the oxygen of the air—it undergoes partial decomposition and evolves heat. Carbon is separated in the solid state, and floats, in a finely divided and incandescent state, in the interior of the burning vapor, and this constitutes the flame. The presence of these particles of carbon may be easily shown by holding any non-combustible body in the flame, when the carbon in fine powder will be deposited upon it, forming a layer of soot. The combustion of the particles of carbon takes place at the border of the flame, where they are first brought into contact with the oxygen of the air, but if the supply of oxygen to them be insufficient in quantity, they escape in a partially unburned condition in the form of a dark cloud, and the flame is said to smoke. The brightness of the flame is owing to these solid incandescent particles, for the burning gas itself possesses only a feeble illuminating power. It would, moreover, appear that the luminosity of a flame is due to the heat of the flame, and Dr. Frankland has shown us that hydrogen or carbon monoxide, when burned with oxygen under a pressure of from 15 to 20 atmospheres, yields a luminous flame.

No doubt the Bunsen burner gives a smokeless and non-luminous flame, although it cannot be said that the flame of the Bunsen burner is in any sense less hot than a luminous gas-flame. In the Bunsen burner ordinary gas conducted through India-rubber tubing streams into the tube of the burner. Air enters, however, through two openings, and mixes itself with the gas in the interior of the tube. If the mixture issuing from the tube be ignited, it burns with an extremely feeble flame, which deposits no soot on bodies held in it, for new oxygen is admitted not only to the border of the flame, but throughout its whole mass, and the carbon is accordingly burned into carbonic acid before it can separate in the solid form, so that the flame is composed of incandescent gases alone. Its illuminating power is very feeble. The feeble illuminosity of the Bunsen flame appears to be due to a number of causes. We have, first, a rapid oxidation of luminiferous material to gases of feeble illuminating power by the oxygen in the admixed air; in the second place, we have the presence of diluted gases, which, of themselves, reduce the illuminating power; and, thirdly, we have heat withdrawn by the indifferent gases, as nitrogen, and the products of combustion, carbon dioxide and water.

We cannot say that the loss of luminosity is due to any one of these causes acting singly. On the other hand, in consequence of the more perfect combustion that takes place, it is used as a heat-producing flame and its temperature can be still further raised by a short conical chimney, supported on six metal arms arranged in the form of a star. If a solid body be introduced into this feebly luminous flame, such, for instance, as a piece of a platinum wire, the incandescent metal glows with a brilliant light, and, inasmuch as it is smokeless, it will not act destructively on the platinum in the same manner as a smoky gas flame will do. The luminosity of a Bunsen burner can be restored by shutting off the entry of air, either by closing the holes with the finger or by the rotation of a slide which covers them. The light then becomes much more brilliant, with abundant formation of smoke.

The flames of candles and lamps, whether the substance burned be tallow or wax, rape oil or petroleum, do not differ essentially from that of an ordinary gas burner. The same hydrocarbon which is the essential constituent of common gas is the source of light to them. The hot wick which draws up the fluid material about to be burned plays the part of a small gas factory, the produce of which is used on the spot, the only difference being that coal gas is always purified before it is consumed, whereas the extemporaneous gas of a candle or lamp is consumed without being purified at all. On the other hand, the tallow, wax and oil contain the carbon and hydrogen in a purer and more concentrated form than the coal from which ordinary coal gas is made. The flames of candles and of lamps all owe their luminosity to the incandescence of particles of carbon floating in them, and the reason why one description of candle or lamp is more smoky than another is because the supply of air in the smoky one is not sufficient to produce adequate combustion.

A petroleum lamp burns, in the first instance, with a dull, murky flame, giving off a large quantity of smoke, but it acquires a high degree of luminosity when the glass chimney is applied, for the presence of the chimney causes a strong draft, supplying the air requisite for the thorough combustion of the gas with which it was previously intermingled. The brilliancy of a petroleum flame is thus materially exalted by an increased supply of air, while that of a Bunsen burner, as has just been seen, is almost abolished by the same means. The contrary effects observed in these two cases admit of an easy explanation. In the latter instance, the amount of air supplied is so great that scarcely any of that separation of the particles of carbon takes place which is so necessary in order that a bright light should be produced. But in a petroleum lamp the introduc tion of a moderate quantity of air, by effecting the combustion of the superfluous particles of carbon, causes a higher degree of heat, and consequently a more lively incandescence and illumination of the still remaining particles. From this it is obvious that in order to obtain the highest illuminating power of a flame in which hydrocarbonaceous compounds are undergoing combustion, the regulation of the supply of air is essential. The more perfect combustion is also essential to the maintenance of the purity of the air of the room. In a hygienic aspect it is also essential that the compounds used to produce light should be as pure as possible, and during the last twenty years vast improvements have taken place in the methods of purifying gas, so that now the London gas is almost entirely free from sulphur and its compounds.

We will now proceed to consider in what way candles, oil lamps and gas, as sources of artificial light, affect the air of a room. The effect caused on the air of a room by combustion is, first, to diminish the oxygen, and, secondly, to increase the carbonic acid and produce water and ammonia. If the combustion is imperfect the effect is also to create carbonic oxide and soot, as well as to disperse into the room any impurities which the material which is used for illumination contains, besides the carbon and hydrogen which are necessary for purposes of illumination. If we look back at the graduations of improvements which have taken place in artificial lighting, we find that each successive step has been of advantage to the purity of air. Probably the earliest known means of lighting was the torch, cut from pitch-pine, and sticky with exuded rosin. It gave a large red flame, and volumes of smoke which condensed into small particles of soot, colloquially termed "blacks," which adhere to faces and clothes with surprising determination, and may give some idea of the eminent discomfort experienced in a hall lighted, like the Walhalla, with pine splinters. Substituting a rope for a splinter, and saturating this with pitch or rosin, we have the link that still, in foggy weather connects us with the past.

The lamp of the type found in Pompeii probably succeeded these cruder means of lighting. The wick of oakum, or flax, or cotton, dipped in oil or bitumen, gave a smoky flame, because no effort was made to bring a sufficient current of air to the wick to assist the combustion. These lamps were often fed with scented oils, which are said to have rendered the air heavy with their perfumes, which shows that they gave out a considerable amount of impurity. You may imagine the state of a room the morning after a symposium, when, perhaps, a dozen lamps had been burning for six hours, smoking fearfully, without the least appliance for the escape of the heavy carbonaceous fumes. Indeed, it was one slave's recognized duty to go round in the morning wiping the sooty pictures and statues. The Argand burner with its chimney, and the air brought so as to increase the combustion of oil lamps, was a great step in advance, and effected a most marked improvement in the purity of the air of a room.

Candles with a wick made of the pith of rushes covered with wax or tallow are mentioned by Martial and Juvenal. These must have resembled the smoky rush-light of our more immediate ancestors, and the tallow candles which many of us remember as of yesterday diffused impurities in the air far greater in proportion to the light they afforded than any modern form of light. The last fifty years have witnessed vast improvements in the wicks and in the materials of candles, so that their smokiness has been gradually much reduced. Indeed, as regards the contamination of the air of a room, it may be accepted as an axiom that the more imperfect the combustion in any source of artificial light, the more deleterious the effect on the air of the room. We complain of gas, but if we were satisfied with the same amount of light in the case of gas which we obtain with candles or lamps, we should not find the vitiation of the air more convenient with one than the other.

An experiment mentioned by Mr. Clegg in his treatise on the manufacture of gas may be mentioned here in illustration of this. The flames of several combustible bodies that give an amount of light equal to it, were burned separately in given quantities of atmospheric air, and the times were noted at which the flames were extinguished by the contamination of the air. The following were the results:

	Minutes.
Colza oil was extinguished in	71
Olive oil was extinguished in	72
Russian tallow was extinguished in	75
Sperm oil was extinguished in	76
Stearic acid was extinguished in	77
Wax candles was extinguished in	78
Spermaceti candles was extinguished in	83
Coal gas (13 candles) was extinguished in	98
Cannel gas (28 candles) was extinguished in	152

The preceding numbers may be taken to indicate the comparative salubrity of the several illuminating materials, from which it appears that the atmosphere of a confined room lighted by cannel gas would support life twice as long as the atmosphere of the same room lighted equally with tallow candles. Nor does the complaint that is frequently made of the heat of rooms heated by gas afford much better foundation for an objection to gas lighting than its assumed insalubrity. The fact may be true that a room lighted by gas is hotter than when lighted by candles, but the cause is to be attributed, not to the greater heat-giving power of the gas, but to the greater illumination when gas is employed. If persons would be satisfied with the same dim light to which they are accustomed when burning candles, or if they would increase the number of the latter so as to equal the light of the gas flame, the heat given out would be found less when burning gas than when burning lamps or candles. It has, indeed, been proved by experiment that the combustion of colza oil produces nearly twice as much heat as the flame of cannel gas of the same standard of luminosity, and that in comparison with ordinary 13-sperm-candle gas the proportionate amounts of heat are as 78 to 68. A room lighted by a large moderator lamp burning colza oil is perceptibly heated quite as much as by a gas flame that gives a larger amount of light.

The conditions which affect the purity of the same air of a room are, however, not all the same in the case of lamps or candles as those which prevail when gas is used. In the case of the lamp or candle, the wick either draws up the hydrocarbon on which it depends for its light by capillary attraction, or else this hydrocarbon is forced up the wick at a uniform rate by an equable pressure. In the case of gas it is usually different. The gas comes from a street main, in which the pressure is constantly varying, partly in consequence of the continual variation which takes place in the number of lights in use. For instance, if a large shop suddenly lights up its establishment, a sudden decrease of pressure would occur in the neighboring houses. In order to obtain sufficient light in a neighboring house, it might be necessary to turn the cock of the burners full on. When the lights in the shop are extinguished, the pressure would be suddenly increased, and the gas would be forced through the burners more rapidly than it could be consumed, consequently, much impurity might be forced into the house in the shape of unconsumed gas. It is therefore necessary to regulate the pressure at which the gas reaches the burners and many of the complaints of the impurity of the air of a room, caused by gas, arise from this want of regulation of pressure. The pressure can be regulated by the use of a governor placed either at the meter or in proximity to the light itself. From these various considerations it is apparent that the more perfect the combustion is in the artificial light, the less it will affect the purity of the air in a room; but so long as the light is burned in contact with the air of a room, the air will be more or less affected.—*Builder.*

ARCHÆOLOGY.

RECENT ARCHÆOLOGICAL DISCOVERIES IN NEW MEXICO.

J. C. COOPER, TOPEKA, KANSAS.

Traveling in New Mexico a few weeks ago, I had the pleasure of meeting Mr. Amado Chaves, Superintendent of Public Schools for the Territory of New Mexico. He resides at San Mateo, in Valencia County, and I incidentally learned from him that he had made an archæological discovery that appears to me to be a very interesting one.

His home, San Mateo, is situated twenty-five miles north of Grant Station on the Atlantic and Pacific R. R. About a mile from his house there is a large sand-hill, which he has ridden over hundreds of times, and it had not appeared to possess any special interest, until a few weeks before I met him, he was passing over it, just after a severe wind-storm, and was surprised to see a portion of a stone wall exposed to view. His curiosity was excited and he immediately set to work investigating it, and he has found the wall, on the side where he has been at work, extending two hundred feet, built of stone, laid up with lime mortar, three feet thick and very solid. He has cleared five rooms, one of them twenty-five feet long and twelve feet wide, with the interior corners rounded. The other rooms are small. The large room was evidently used for some special purpose. The building was two stories in height. It appears to be a quadrangular structure with a placita in the centre. In the rooms he found a number of stone hammers and axes, with a depression cut around them to fasten them to a handle with a withe—corn-cobs and the hard, woody stubs of squashes, pottery, turquoise beads and beads of red coral, which must have come from some distant country, also some black ornaments, apparently of ebony set with turquoise, and a perfect skeleton of a woman with fine, light chestnut hair.

He found all the doors walled up from the outside so neatly that only from the inside could he tell where the doors had been.

Mr. Chaves is a pleasant, intelligent gentleman, an enthusiastic educational worker, and well informed in the prehistoric history of that section of our country, and he says that the character of the workmanship of these building is different from any that he knows of or has heard of. The timbers that supported the roof have been burned, but the walls are in a good state of preservation.

In the spring Mr. Chaves designs to try and trace out the whole structure, and he will put roofs on some of the best rooms and utilize them. He thinks this was unquestionably a town inhabited by subjects of Montezuma. When that monarch found himself hard pressed by the Spaniards and their allies, he called all his children together. They being loyal and obedient subjects, at once started for Old Mexico, leaving their houses well closed, hoping to return as soon as they had destroyed the Spaniards,—but fate decreed otherwise and they never returned. Afterwards the Apaches came, took possession of the country and burned the town. In course of time the winds have eddied the dust and sands of the plains about it and buried it completely.

I regret that I had only a few minutes to talk with Mr. Chaves about his wonderful find, but I hope to have an opportunity to visit the locality and get fuller particulars about it.

MASTODON REMAINS IN MISSOURI.

A. M. STALNAKER.

On the 18th of October, 1883, there were found at Springfield, Mo., in digging a well, two pieces of a tusk of a mastodon, the two pieces making about four feet, one of them being the point and the other a section from the middle; but they did not fit together, showing that there was a piece gone from between them. On the 24th the piece three and a half feet long, now in possession of the Academy of Science at Kansas City, was found together with another piece one and a half feet long. This short piece was from near the point and the large piece appears to be the base of the tusk, as one end is more decayed than the other, evidently showing that this part had been in the mouth and not covered by as perfect an enamel as the other portion. These two pieces did not fit together, and there appeared to be a part missing from between them. The last two pieces lay side by side and but three or four inches apart with the broken ends both pointing the same way. The first two laid in a right line and about a foot apart, and about three feet away from and above those found on the 24th.

The well shows about eight feet of earth and then seven feet of solid rock. Below this rock is a bed six feet in depth of soft mud mixed with gravel. This was once a subterranean stream, the cavity being only six feet wide and walled with solid rock. In clearing out this mud that ran into the well from this cavity the tusks were found, they not being in the well but about three back in the cavity. Just where the tusks were found the rock overhead ended, apparently, showing that at some time the mouth of the spring (which now comes to the surface a hundred yards down the hill) was at this point and had been a watering-place for the huge animals of that remote time.

PROCEEDINGS OF SOCIETIES.

MEMORY.

DR. R. WOOD BROWN.

[*Read before the Kansas City Academy of Science, December 21, 1883.*]

Mr. President, Ladies and Gentlemen:—There is no subject of Nature so interesting as psychology. Man, ever since his creation, has been trying to penetrate the mystery, mind, and after thousands of years the subject is just as obscure as it was to the first investigator. The physiologist alone has been rewarded, the psychologist is still striving to wrest from Nature this her most subtle secret.

We shall, this evening, show how memory acts from a physical standpoint, also the theories advanced explanatory of the action of the mind. We may say that memory is an attribute of the mind, but it would be more correct to say that they are synonymous, and that thought and imagination are attributes of memory.

Science has not been able to explain the causation of memory, but her votaries have done much toward explaining physically the action of it. It must be remembered, that while the data are voluminous, and the number of nerve fibres and cells estimated, the conclusions arrived at are in many cases hypothetical as regards the action of memory. The metaphysician has done but little, the physiologist almost everything.

The most succinct definition of memory I find is Ribot's. He says that: "Memory is the retention of certain states, their reproduction and their localization in the past." We certainly cannot wish for a more clear analysis. Physiologists have located the intellect in the gray matter of the brain, a thin crust one-tenth of an inch thick and composed of convolutions and sulci. It has been estimated that there are about 300 square inches of gray matter upon both hemispheres. This crust is supported by white matter which is a mass of nerve fibres, and makes by far the largest part of the brain. The gray matter is composed of cells and fibres, which according to Mr. Bain, number about one billion and five billions respectively. These cells and fibres are the factors of memory, and for distinctiveness at this time I will denominate them memory-cells.

An acquisition is a certain thing acquired or learned, and in a richly endowed and highly retentive mind of, say, two hundred acquisitions, each grouping would require five thousand memory-cells and twenty-five thousand fibres. It must be remembered, that the brain, besides having memory-cells and their associated fibres, is also a sort of battery to furnish power for movements of muscles, acts of energetic volition, and also of feeling.

The causation of memory is just as mysterious as that of life. Memory exists and that is the sum total. Life was brought into existence, either from a fortuitous combination of oxygen, nitrogen, hydrogen and carbon, making protoplasm, which became animated, or by a special divine act of creation. Scientists generally agree that all life must have antecedent life, which to my mind is the only proper solution of biology.

The two most plausible theories which account for memory physically, are the residua and vibratory. According to the former theory, when an impression is received by a cell, a residuum is left, the result of a chemical change or decomposition of its protoplasm. When we look upon a pear, certain cells respond to the excitation of the impressions of contour, color, size, and stem; the result of this responding is a residuum. If these impressions are repeated often enough a permanent residuum is formed and we have a memory-cell. Decomposition is the act of separating the constituents of a compound. These constituents would be elementary bodies, but in the above cells, the decomposition is said to leave a residuum, but no explanation is given, as regards the action of the residuum after it is formed. I am at loss for any logical deduction whereby I can understand the action which goes on in the cell after it has been completely decomposed and a permanent residua has formed, which under this theory I would call a memory-cell. The residua theory leads us to the time when the cell becomes permanently changed, but does not enlighten us upon its subseqent action.

The vibratory theory explains the physiological action of memory in a very satisfactory manner. If we look at the pear, certain cells vibrate from excitation, resultant from the impression. We do not have, in this instance, any decomposition or residuum, simply a vibratory movement. The cell remains the same, except the molecular arrangement. When the impression ceases, the cells cease to vibrate, and obtain a period of rest which is essential to memory. It will be noticed that the vibration of a cell is clear to the mind, because it acts in its entirety, rest, and vibrates again to the same impression; each vibration fixes permanently its peculiar movement, and we have a cell which vibrates to no other impression, and the result is a memory-cell. This is much better than the residuum theory which leaves a residuum after every cell vibration and eventually a permanent one.

When an impression is received upon the retina, tympanum, tongue, fingers, or olfactory bulbs, it is conveyed by proper nerve filaments to cells in the gray matter of the brain. These cells vibrate from excitation, and undergo a change, say, that of molecular arrangement. If this impression is repeated often enough the molecules are permanently changed and we have memory-cells and remember the impression. If, on the other hand, the impression is made but once, and then not violently, the cells assume their first condition and we forget the impression, it passes from our mind. In this connection let me say that in the true sense, we do not see an object, hear a sound, feel a substance, smell an odor, or taste edibles; we simply become conscious of the impression, when they irritate to vibration the cells in the gray matter. These impressions cause different cells to vibrate the same to the same excitations, which allows differentiation, and memory is the result. If different cells responded to the same impression, there would be no permanency, consequently no cognition.

Why do the same cells vibrate to the same impression? The most plausible explanation is molecular change. If we strike a bar of steel upon the end with a hammer, we can produce a magnet. The blow causes a change of mole cules in the steel, and polarizes them. Whether the molecules of a cell are simply changed, or polarized, is hard to determine, but that some change takes place by vibration is evident from the fact that we remember more easily where the impression is received many times.

If the molecular theory is correct, and every substance is composed of molecules, the whole body cells in the gray matter would be no exception Some men of learning say, that the molecules of the body are polarized in health, and when disarranged disease is the result. If this is true, and nervous force electricity, and the brain the battery, why not say that the change in a memory-cell is molecular?

Why does the same cell vibrate to the same impression? Force or motion travels in the direction of the least resistance. When an impression is carried along a nerve fibre, there is a certain amount of resistance, and every impression weakens its power to resist, and each succeeding impression travels along the fibre which is attuned to it and has the least resistance. If the same impression is carried on the same nerve fibre, it must necessarily reach the same cell, which vibrates according to its molecular change and we become conscious of the impression. I would, in this connection, say that repeated impressions are not always necessary to produce a memory-cell. A sudden violent excitation will cause a permanent change in a cell. We all have experienced sudden impressions which we have never forgotten, and never have felt but once.

To remember is to recur almost instantly without exertion of will, to recollect is to recall by associations, to gather ideas step by step until the impression sought is brought to mind. We recollect by association, by a group of cells vibrating which excites another and so on. According to Bain there are about one billion cells and five billion fibres. These fibres connect cells and consequently groups. It will be readily understood how this occurs, if we bear in mind how we think; how one thought brings another into consciousness. We smell a rose, its odor excites certain cells; through fibre connections other groups are excited to vibration, and we are conscious of events where the rose assumed a prominent part. We see a face which recalls the name and peculiarities of the possessor. We see a house and recollect the persons living therein. The house causes an impression which excites to vibration a group of cells, which in turn brings other groups into activity and we know the occupants. Most of our thought is through association, comparatively little that is instantaneous.

In remembering, time and space are of little value, but they are essential to recollection. When we indulge in retrospection, memory carries us back weeks, months and years. We cannot recollect without time and space. The time is the present, space the period between the occurrence and the present moment.

We have a conscious and organized memory. When we perform an act with a distinct end in view it is the result of conscious memory. When a beginner is learning to play upon a piano, every note is struck by the effort of the will and therefore conscious. In setting our watch, we do it consciously, we have found the correct time and our mind is on the act, and we turn the hands carefully until our aim is accomplished. Therefore every act of will power is the result of conscious memory.

Intensity and duration are indispensable to conscious memory. If one of these conditions be wanting or any other unknown to us, then consciousness (a part of the whole) would disappear, and that which would remain of the fact is organized. Intensity is a degree of concentration which may vary, owing to the striving of our states of consciousness to supplant one another, and victory results either from the superiority of one or weakness of the other. Duration is the period between the impression and consciousness of it. Ribot says it requires 0.16 to 0.14 of a second to hear; 0.21 to 0.18 of a second to touch, and 0.20 to 0.22 of a second to see. This would indicate that the expression, "quick as thought," is a mere figure of speech.

The acts of organized memory are performed unconsciously, involuntarily. The odor of food will sometimes cause an increased flow of saliva. When we were learning to walk our steps were taken with hesitancy and deliberation,—consciously; now we walk without knowing it, our conscious memory through continual repetition, has become organized. If we meet an obstruction on the sidewalk we unconsciously move it to one side to avoid it. This is the result of experience. We know intuitively that if we do not turn, we will run into the obstruction. Intuition and organized memory are to my mind synonymous. We raise food to our mouth without consciousness, this is the result of habit. Habit is resultant from frequent repetitions which produce organized memory. Upon reflection we will find that comparatively few of our acts are conscious. Consciousness is a narrow wicket through we are connected with the outer world.

I spoke of a group of cells always vibrating to the same impression, and another argument in favor of that statement is the weariness which ensues upon protracted vision, hearing, taste, etc. If different cells responded to the same impression there would be no weariness. Cells do become tired and refuse to act. If we look upon one color continually it becomes blurred, one continual sound becomes indistinct, the odor from a flower is at first acute, afterwards less fragrant. This would indicate two things: first that the same cells respond to the same impressions; second that memory-cells must have rest. This rest is given by exercising different faculties and by sleep. But even in sleep this result is not always attained, for we often dream, and dreaming is cell activity during sleep. This is proven by the fact that we never dream of anything but past events.

Physiologists have proved that during sleep, the brain is pale from want of blood, but if the sleeper dreams it is a brighter red. This would indicate an activity of the brain during dreaming. One of the peculiarities of dreaming is the extreme brief period which is required, also it takes no note of time or space. A drop of water has caused a dreamer to travel thousands of miles, to drown in a lake and to wake him up. A gentleman in this audience once dreamed "that he was walking through a street, and stopped before a hardware store in which were stoves arranged in tiers one above another; while looking at them they fell with a terrific crash to the floor." Another student throwing a box down stairs caused this dream and awakened the dreamer at the same time. Dr. Carpenter relates the case of a clergymen who fell asleep in his pulpit, awaking with the idea that he had slept for more than hour; but on referring to his hymn book, he found that his sleep had lasted through the singing of a single line.

As the hour is getting late I will omit any remarks on imagination, emotion and somnambulism. I wish to thank Col. Case and Mr. Warren Watson for the use of their libraries, also Dr. E. R. Lewis, Dr. J. T. Mitchell, and Mr. E. A. Cwin, for procuring the human brain which I will now demonstrate.

METEOROLOGY.

THE WEATHER SPHYNX.

C. A. SHAW, OF ERIE SIGNAL SERVICE STATION.

[*A Lecture before the Natural History Society of Erie.*]

When the proposition was made to me to give a "chalk talk" upon the weather, I appreciated the compliment implied, but I questioned the possession of the requisite qualifications for the duty. It was desired to have presented to the audience the methods employed by the Signal Service in the formulating of their weather predictions. It was implied that being in the service I should be acquainted with the *modus operandi*. And yet I am not. I merely know, generally, in regard to meteorological data, and the general application of certain principles; but the chief office neither discloses nor, so far as I know, has it any recondite special methods. When they get hold of a capable man with a genius for the profession, a man with a knowledge of celestial mathematics, natural philosophy and cautious common sense, they set him to the task and in two or three years turn out an assistant "prob." But how he separates the essential facts of the weather reports from the non-essentials is never made public and probably is only learned by experience.

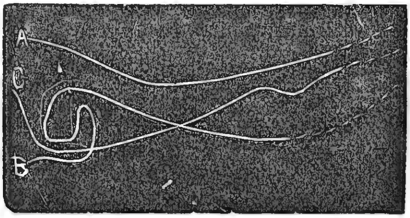
I think, myself, that the service is hampered and hampers itself by an unnecessary collocation of foreign materials and duties. Facts of natural history, recondite analyses of principles, of chemistry, of astronomy, of ornithology, etc., interesting in themselves, valuable in the sum of human knowledge, but not of present importance to meteorology. Not to speak of the military accompaniments, there is a terrible loss of time, money and energy and good feeling, in the lack of concentrating the intelligence of the members of the corps upon the few essentials of actual weather prediction and letting everything else go.

As the sergeant sinks the man of originality in the routine of his rank, he loses that very quality of intellectual alertness that makes him most valuable to the office he is expected to serve. Perhaps I should say there should be no one in the service lower than a commissioned officer, only that implies the knowledge of military duties.

That there is an antagonism between military and scientific duties, I feel so strongly that even the loss of any rank would I think be preferable. I do not think a meteorologist is at all benefitted by knowing that a general outranks a major, or that there is a difference between closing up a regiment and shutting up a book.

" Areas of low barometer " have been so frequently referred to of late years that it is not required of me to make an extended reference to them, although technical terms in every science deserve to be frequently analyzed that their special application may be borne in mind. In meteorology "an area of low barometer" is merely the space over stations where, in any extended survey of the pressure of the atmosphere, the barometer shows the least height. Stations of like barometric reading being connected a series of rings is usually formed about the space of least pressure and this space as it moves over the country produces an imaginary line (generally imaginary, though in some cases, as a cyclonic disturbance, the track is apparent enough) which line is usually in a direction from the southwest to the northeast (to the Gulf of St. Lawrence) or easterly from Manitoba (with a southerly bend over the lakes) to the same point.

The following diagram, though rude, may serve to illustrate the tracks of low barometer during July, 1883. This month is chosen because of some curious "twists" made over that portion of the country included in Colorado, Nebraska and Kansas, which can only be explained by considering the position of antagonistic areas of high barometers at this time:



From Manitoba to the Gulf of St. Lawrence there were four tracks, nearly similar. The curve marked "A" represents them, as a whole.

From Colorado four others were charted. Three of these (marked "C") passed off the coast near the same point as those from Manitoba. One (marked B) took a southeasterly direction, after going nearly directly north, to Yankton, and left the coast at Norfolk, Va. This turned northeasterly over the ocean, however. The dates were as follows:

From Manitoba: No. 1 on the 1st and 2d; average velocity 39 miles per hour. No. 4, on the 9th and 10th, average velocity 42 miles. No. 5, on the 11th, 12th and 13th; average velocity 24 miles. No. 6, on the 13th and 14th; average velocity 28 miles.

From Colorado: No. 2, on the 2d, average velocity 41 miles; this moved first northeast, then took a backward twist southwest and then went northeast again. No. 3, from the 4th to the 7th; average velocity 30 miles. At first the motion was slow and due east—rate 100 miles a day. Then it raced northeast at nearly a thousand miles per day pace. No. 7, from the 15th to the 17th; average velocity 28 miles. (This is marked C.) No. 8, on the 20th to the 24th; average velocity 18 miles (marked B).

Nearly every one of these latter was deflected and delayed at that portion of its course which is indicated by the twist in the diagram but it was No. 8 (B) which is especially to be noticed.

This one was near Santa Fe, N. M., on the 20th; it was fifty miles south of Dodge City at midnight, and 300 miles north, between Deadwood and Yankton, the next morning; then it took a retrograde and southerly direction, passing westward, near W. Las Animas. Thence (by a curve to the eastward,) northerly into Dakota again on the 22d; on the 23d directly eastward to Dubuque, and southeasterly on the 24th.

This was not an area of marked depression, which partly explains why its course was so variable. But to really understand the reasons for its wandering we must picture to ourselves an area of high barometer checking and preventing its eastward movement, just as a king, in the familiar game of checkers, drives or embarrasses the movements of a "man" in his attempts to get into the king-row, or the double (dodge) corner.

It is so usual to speak of areas of low barometer and assign to them the cause of associated storms, to speak of their tracks and predict their courses, that it will at first strike the hearer as paradoxical to deny the actual existence of an area of low barometer at all. Yet why should this seem paradoxical? We do not deny the existence of the phenomenon. We merely ascribe it to a more remote and more completely satisfying and logical cause. We speak of cold as a positive condition in familiar enunciation, yet in scientific formulas it is accepted as a purely negative condition, the absence of heat. The magnetic needle was once believed to point to an attracting pole, yet now it is known that it merely exhibits the quality of any balanced piece of steel to take up a position at right angles to currents of electricity flowing about it. The world has these currents moving from west to east. The needle consequently points north and south, and its variation is not the shifting of a pole but the shifting of equatorial lines of magnetic movement.

Suppose I should say that I think that the cause of the easterly direction of areas of low barometer arises from the slow undulation northward of areas of high barometer.

Perhaps many here are familiar with the appearance of the ocean and have studied its motions along our coasts. The ground swell will illustrate my theory of high barometer.

This swell has been not inaptly compared to the slow breathing of a huge marine monster. Sometimes its presence is almost imperceptible to the eye and to those upon its bosom. But one standing upon the shore will see a rock become slowly submerged and then as slowly be made to appear, while the swell, reaching the land will send one long encroaching wave far up the beach. Suppose this swell from the southeast. A practiced eye looking off upon the sea might be able to see that a fleet of vessels would successively betray a trough running toward the northeast. The deflection depends upon the character of the shore, the result no doubt of a partial retardation of the shore end of the swell so that the long waves do not continue parallel to each other.

We know that there is a greater barometric pressure over the parallel of latitude 32°, than at the Equator or at 64°. It is assumed that from latitude 32°, and from the poles, the suction of the atmosphere is towards each other. The meeting place may be at latitude 64°, theoretically, but by reason of terrestrial influences this meeting point may be considerably south of that, in fact may be over a debatable ground between parallels 40° and 60° of North America, but higher over the Atlantic Ocean. This would make the cause of low barometer, and the resultant of the force exercised by two areas of higher barometer. For if a wind, blowing at the rate of twenty miles north meets a wind blowing at the rate of twenty miles west, there will be produced either a wind which shall be in proportional direction and velocity to the two causing it, or else it will produce a system of vortices in the direction resultant of the two, but of no fixed velocity, especially if these winds are believed to decrease in power as the distance from the originating area increases.

In dealing with such an elastic medium as the air and with the imperfect data at our command it is impossible to say how the no doubt daily reinforcement of wind pressure from the originating lands should provoke a disturbing area about once in three days along their meeting line.

If instead of actual motion from latitude 32° and from the poles we think of two undulations (deflected by the rotary motion of the earth, the one to the east the other to the west), I think we have a basis upon which a theory of the cause of low barometer may be formed capable of arithmetical calculation as to force and direction. I do not wish to seem to explain too much in one argument nor yet to suggest too recondite a system of weather predictions, but upon some such grounds as these must, I think, the future meteorolgist stand who will pretend to be able to foretell, more than a few hours in advance, changes and conditions.

Whether atmospheric pressures can ever be formulated into such mathematical precision that weather conditions can be predicted as certainly as astronomical changes I am inclined to doubt. I fear meteorology will always remain an empiric rather than an abstract science. With the accumulation of facts general principles are formulated, but they more and more take the form of contingencies. As in our judgment of men we trust more to experience and comparison than to an ideal scale of possibilities, so, in weather knowledge, short views and cautious application of general laws are more frequently correct than more pretentious forecasts. It is only with casual phenomena that practical meteorologists care to deal, and of these temperature is the one of most popular interest. This subject is next in order to be considered.

TEMPERATURE.—It may be hardly necessary to say that outside of the Signal Office at Washington, with its tables and charts at hand, and its corps of trained assistants, no one can expect to make a weather prediction which shall be more than probably correct, and that for only a brief period in advance. Even without the special training and facilities of the central office there is a tendency to rely too exclusively on merely local appearances, which, at best, may prove deceptive.

Perhaps of weather predictions that in regard to temperature is the safest, or at least most frequently desirable in a remote locality.

Still, even for this there must be weather bulletins, and it is almost as necessary to see such bulletins, either in a daily paper or in a convenient place to study them, as it is to have eye-sight to get any ideas from a book.

Weather charts are undoubtedly the best form in which these reports can be presented. Several skeleton charts have been invented. One by Mr. Isaac P. Noyes, of Washington. But he can get no newspaper proprietor to take hold of it and make it *go;* and though I tell him to advertise it and make its value apparent to the public, as a "long felt want," he has not yet made it available to the world.

The bulletins issued by the Government at stations have the disadvantage that few care to stand up in a public place and study, for any length of time, the somewhat confused programme there presented to view. A studious man wants things comfortable—an easy chair, a quiet library, security from interruption and especially an arrangement of stations geographically adjacent.

Taking such a bulletin, or one as near it as a person can get hold of, if he wishes to find whether it will be warmer or colder during the next twenty-four hours, he regards attentively the point from which the wind is blowing at his own station, and following this direction, backward, notes how far the same wind-direction continues and, incidentally, the wind-velocity, and the difference in barometric pressure. In nine times out of ten the wind will bring the temperature of the place from which, in a certain number of hours, the wind is blowing, at its reported velocity. But there is one exception. The temperature falls as we rise above the earth's surface at about the rate of one degree to every 300 feet, or 20° to a mile. Warm air rises and cold air rushes in to fill the space left, and when air from a higher elevation comes to the surface of the earth it brings that lower temperature with it. Such change usually occurs after an area of low barometer passes. The cold northwest wind that generally follows does not, necessarily, come from a long distance. It may come from overhead. Guarding agalnst this contingency, we will say:

The laws governing temperature act more uniformly and are more easily applied than those relating to barometric changes. They may be formulated as follows:

The temperature of a place, at any time, depends upon the actual amount of heat received from the sun, influenced by the prevalence of a warm wind (generally) from the south or a cold wind (generally) from the north, or a situation protected from either of these influences.

The first cause—actual heat received—is the effect mainly of latitude; the second is the result of areas of low barometer, producing if the track is north of a station, wind from the south; and wind from the north if the track is south of the station.

As the atmosphere is a very poor conductor of heat the change at any station is solely the result of bodily movement of air from one place to another. Thus, if the temperature of a place 400 miles northwest of us is twenty degrees lower than it is here and the wind is twenty miles an hour from the northwest, it will take twenty hours for the temperature to fall those twenty degrees; and supposing the wind to blow only ten hours at the rate mentioned, the temperature will fall only to that point which a station half of the distance northwest had at the time it started.

This, stripped of all interfering circumstances, is the philosophy of areas of heat and cold. These interfering circumstances are, however, so numerous as to make the application of any abstract rule impossible, without many reservations.

It is not always true that a southerly wind is warmer than a northerly one. Very much depends upon the country over which the wind has passed. There may be fields of snow to the south and none to the north. There may be open bodies of water, forests, or even the modifying influence of large cities. Then, too, the wind we get from the south may not have come from a point very far south, but only deflected from a northerly direction. "The cold end of a south wind" is a proverb familiar to all.

But without entering into too many qualifying details, we may for the present take the following table of actinometry as approximately representing the difference in temperature for every ten degrees from the equator to the pole in the northern hemisphere; it shows the actual temperature due to the reception of heat from the sun:

Latitude	0	10	20	30	40	50	60	70	80	90
Summer	58	59	60	63	66	67	68	66	64	62
Winter	38	36	32	28	24	22	18	14	5	0
Mean	48	48	46	46	45	44	43	40	35	31

Taking latitude 40 (nearly that of Erie) we will have, in winter, a lower temperature of about 1° for every 200 miles we travel north and an increase of about 1° for every 200 miles we travel south. If, therefore, the temperature falls very low in the northwest at a place that is on a parallel 600 or 800 miles north, we do not expect as low a temperature here, but one which shall be from 5° to 10° higher, as belonging to a lower latitude. And this again is modified by local conditions and the actual starting point of the wind which brings with it the temperature experienced. The wind would have to blow all day at forty miles an hour to bring us the actual low temperature of stations a thousand miles northwest of us. Usually forty-eight hours at half that velocity is an exceptional occurrence.

Similarly, if it should blow from the sonth with like continuance, we should have tropical weather as a result.

So much depends upon the mean direction of the wind that the usual tracks of low barometer can never be omitted from our calculations. At Erie about half pass to the north and half to the south, so that the mean direction is about equally divided. Places considerably south of us have the wind so generally from the south that their temperature is far above the average produced by actual heat receiving conditions, while in British America, to the north, the opposite effects are produced. These tracks are lower over America than over the Atlantic Ocean, where they go very far to the north, either from Gulf stream influences or other causes, and a higher temperature prevails on the same parallel, than over this continent.

The line of mean temperature is also affected by local causes so as to form a very irregular curve. Take the May mean, for example, which at Erie for 1883 was 54°. This passed through Portland, Maine, and west of us, Cleveland, Toledo, south of Chicago, Dubuque, Yankton, and then in a southwesterly curve to Santa Fe, a point nearly 5° south.

The isotherm of June included Burlington, Vermont, Oswego, Erie, Port Huron, Chicago, St. Paul, Huron, Dakota, Bismarck, and Fort Buford. It was colder both north and south of Dakota than in Dakota itself, during that month.

In July the mean temperature was the same at Newport, Rhode Island, Portland, Maine, Albany, Erie, Detroit, Chicago, LaCrosse, St. Paul, Huron, Dakota, Fort Bennet, and down to Denver.

It may well seem almost impossible to average such variable lines, and yet, taking these for a number of years, there is seen to be a tendency to a slight northerly curve west of Erie, and then, beyond Chicago, a northwest direction in summer and a southwest direction in winter.

In other words we have during the summer temperature similar to Dakota and in winter that of Colorado.

Taking the charts of the mean temperature lines for any month we have a partial guide for determining what temperature we will ourselves experience; for, generally, the temperature that is reported west of us, upon the line appropriate to the special month considered, reaches us in due time, (three or four days) with a fair degree of regularity, through all seasons,—interrupted, of course, by those areas which override these general rules and come with actual wind velocities from exceptional distances.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The first ten days of January gave the coldest weather of the season to this date. The very low temperature of –22.5° was recorded on the morning of the 5th, and the effects of this were greater owing to the low temperature which prevailed through the last eight days of the previous month.

Robins have been seen here in the latter part of December and during the first decade of January in spite of the cold weather.

The red glow at sunset and sunrise still continues, though less noticeable, perhaps, than in December.

The comet during the past ten days has been distinctly visible to the naked eye, and its position is 30° above the horizon at 8 P. M. in the W. SW.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Dec. 20th to 30th.	Jan. 1st to 10th.	Jan. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	15°	-22.5°	-4.0	. .
Max	42.0	38.0	53.0	. .
Min. and Max	28.5	30.3°	28.5	. .
Range	27°	60.5°	57.0	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	21 0	—.55	17.0	14.15
2 p. m.	34.5	12.4	37.4	28.1
9 p. m.	25.0	3.4	24.3	17.6
Mean	26.6	5.08	26.23	19.97
RELATIVE HUMIDITY.				
7 a. m.	.98	.89	.83	.90
2 p. m.	.93	.80	.80	.84
9 p. m.	.94	.82	.82	.85
Mean	.95	.84	.81	.86
PRESSURE AS OBSERVED.				
7 a. m.	28.912	29.251	29.210	29.124
2 p. m.	28.942	29.231	29.190	29.121
9 p. m.	29.130	29.272	29.225	29.209
Mean	28.961	29 255	29.208	29.151
MILES PER HOUR OF WIND.				
7 a. m.	10.7	11.0	9.3	10.3
2 p. m.	11.2	18.2	24.5	17.9
9 p. m.	10.9	11.6	14.8	12.4
Total miles.	2777	3272	3896	9945
CLOUDING BY TENTHS.				
7 a. m.	6.0	8.0	5.0	6.3
2 p. m.	7.1	6.2	3.8	5.7
9 p. m.	4.9	4.0	2.7	5.8
RAIN.				
Inches.	0.25	0.15	0.25	0.65

A NEW THEORY OF DEW.

PROF. B. F. NIHART, A. M.

Investigations which Prof. Stockbridge has made at the Amherst Agricultural College, upon the comparative temperatures of the soil and air, and the deposition of dew upon the earth and plants, have led him to conclusions very different from those commonly received in regard to the formation of dew. It is usually held that dew is the moisture of the air, condensed through contact with objects of a lower temperature, and that it does not form till radiation has reduced the temperature of the earth and other objects below that of the atmosphere. The experiments referred to seem to indicate that as regards objects in the immediate vicinity of the earth at least, the process is the converse of this; viz., that the dew is the result of condensation by the air of warm vapor as it rises from the soil. The course of experiments from which this novel scentific theory was deduced is as follows:

The basis of the theory is the discovery that in summer the average temperature of the earth at night is greater than that of the atmosphere. The temperature of the earth in an inclosed space on a level with the surrounding soil, and the temperature of the air were taken at the warmest time of day and the coldest time of night for several months, and the average temperature of the air for the season was found to be 72.94°, and that of the soil 72.061°; but the average temperature of the air at night was 49.664°, and that of the soil 56.37°, the earth thus averaging at night over 6° warmer than the atmosphere. The temperature of the soil and air at night was also taken at various points within ten miles of the college, on all kinds of grass land and bare soil, and in the forest, and the same facts were obtained, the soil being at all times warmer at night than the air.

These results led to experiments on dew-fall. Two boxes, each of a cubic foot capacity were filled with soil without disarranging its strata, one receiving absorbent, retentive loam, and the other peat. These boxes were placed in a trench in an open field level with the surrounding ground and exposed to the weather. Through the month of June they were weighed night and morning, and, unless there was a rain in the night, they uniformly weighed less in the morning than at night, the loss being from one to three ounces for the loam and one to four ounces for the peat. This Prof. Stockbridge thought indicated that the soil at night gave forth water, and that the moisture found on the surface of a field in the morning came from a deeper soil rather than from the air. Other similar experiments followed. In one a cabbage plant was enclosed in an air-tight tin case. Where the stem of the plant protruded through the top of the case, wax was used to make it impossible for moisture to escape through the leaves. The can was first kept within doors and weighed night and morning, when it always showed a loss during the night of from 1.21 grams to 1.78 grams. When left out of doors at night, with the can wrapped in cloths to prevent moisture reaching it, the loss was from .55 grams to 4.23 grams, showing a loss even when there was moisture or dew on the leaves.

These experiments, continued through the season, gave Prof. Stockbridge these proofs of his proposition, that the dew on the ground in the summer is the condensation of vapor that rises from the earth. 1. The vapor of the soil is much warmer at night than the air, and would be condensed by it. 2. Vapor from the soil is soon diffused and equalized in the whole atmosphere, but in largest proportion when evaporation is taking place near the surface of the soil; and, other things being equal, plants nearest the earth have the most dew. 3. Dew under haycocks, boards and like objects on the ground could receive it from no other source.—*Industrialist.*

ENGINEERING AND MINING.

STREET PAVEMENTS.

WM. B. KNIGHT, CITY ENGINEER.

In the interesting article on the subject of "street pavements," which appeared in the January number of the REVIEW, I notice some criticisms on the method of putting down wooden pavements in this city which, I think convey, despite of a limitation noted, the impression that a very important detail of the construction is not sufficiently provided for, or carried out—namely, the complete filling of the interstices between the blocks so as to prevent the surface water from reaching the bottom of the blocks. I wish, therefore, to state that I always fully appreciated the importance of keeping the surface water on the surface, as a matter which adds largely to the life of the wood.

The specifications for all this work, which I drew nearly two years ago, provide in explicit terms for all the interstices between the blocks to be first filled with gravel of approved quality, to be screened and entirely free from sand, and of such size as to fall freely into the holes, being not less than one-quarter nor more than three-quarters of an inch in diameter. The gravel to be well rammed in with proper tools until the spaces are compactly filled to the surface.

This, in practice, requires twice sweeping the gravel over the blocks, and is followed by a ramming after each loose filling.

Asphalt paving cement is then poured (*hot*) into the spaces and joints until they are full, and the asphalt flushes to and runs over the surface. In practice the average quantity of asphalt used is about one and one-half gallons to the square yard of pavement, sometimes requiring much more, depending mainly upon the closeness with which the blocks are laid; on the average size of gravel used, and on the degree of compactness attained in ramming it.

As to the execution of these provisions of the specifications, the system of inspection, and the quantity of asphalt actually used per square yard (only a very small proportion of which remains on the surface) indicate a substantial compliance.

From practical tests, afforded when street pavement has been taken up for various purposes, I have, as a rule, found that the asphalt had penetrated to the bottom of the blocks, and completely filled all the voids between them—forming in fact, as intended, a bituminous concrete in the interstices, and binding the blocks together.

The surface of the blocks as laid, slope each way from the center of the roadway to the gutters on each side, and are maintained smoothly and uniformly in this position by the concrete foundation on which they rest, so that the water flows quickly off the surface and down the gutters to sewer inlets. There is, consequently, much less liability of the water working into the interstices than is the case in a wooden pavement as commonly laid on boards, or imperfect foundations. This ordinarily wears in flat places and depressions which retain the surface water and produce not only more rapid decay of the wood but aid in its general destruction, besides being very objectionable from a sanitary point of view.

Under all the circumstances I question the advisability of spending more money between the blocks. I think that the principal improvement of the present methods and materials is in the line of improved wearing surface. The round, white cedar block combines more good qualities for the money than any wood at present available. I should prefer, generally, a rectangular-shaped block. This is not obtainable in white cedar, and would be about fifty per cent more costly if of any other suitable wood, according to the best of my present information.

It is not improbable that we may get an oak or a pine from the new Memphis R. R. that will be suitable in quality, and can be delivered sawn up into blocks at a cost which would make it advisable to use it.

The cedar block is now being tested here under entirely new, and more favorable conditions than it has ever been before, and the experience of other cities afford, to my judgment, but very little information as to its durability as laid here. It is mainly from the actual results to be obtained here, in the practical test of wear and time, that a really satisfactory answer can be obtained to the question of how far is it advisable to go in the matter of first cost for a wooden wearing surface for street pavements in this city.

On the general subject I will only now say that in considering the questions involved, and endeavoring to reconcile and understand the accumulated experience of all cities in this matter, it is, in my opinion, primarily essential, in order to arrive at a correct conclusion, to divide the pavement into two parts—the foundation and the wearing surface. This division simplifies the subject in a natural way; affords an easy explanation of many apparent inconsistencies, and aids very materially in extracting the grain of instruction contained in all failures and successes with street pavements.

THE STREET PAVING QUESTION.

COL. R. T. VAN HORN.

WASHINGTON, Jan. 4.—I am in receipt of the Kansas City REVIEW for January, and find in it two very important papers—one by Engineer Chanute on the sewerage question as applied to our city, and the other by the editor, Col. Case, on pavements, which ought to be read by every tax-payer. My own views upon these questions are well known to some of our people, and it is not my purpose here to urge them, or even endorse what is said in these papers on either subject. It is for a different purpose.

I want to say to our people that there is no city in this country, nor do I think there is one in any other, where the problem of paving can be so advantageously studied as in Washington. And the reasons lie upon the surface. In almost all cities the situation is alike—the kind of pavement and its quality is, from the form of city government, more or less dependent on the wants of contractors—here it is not the case. Where the city council has any control their election generally governs their votes, and contractors elect or defeat in many cases as they choose. In this city the engineer is detailed from the engineer corps of the army and is perfectly independent. The executive authority is a commission appointed by the President and confirmed by the Senate, and is independent of ward politics and contractors. Congress appropriates part of the money and exercises supervision through the district committee—the Government paying for its frontage the same as private individuals.

It will thus be seen that the highest skill is available; discretion is lodged in a perfectly independent executive, and the dangers of corruption reduced to almost absolute immunity. To do bad work or defraud the taxpayer requires both a dishonest engineer and board of commissioners.

The result of all these guards is that Washington is the best paved city in the world. Then, again, men who have patents are anxious to have a sample laid in this city and it has been the practice to afford opportunity for all valuable improvements to be so laid. You can thus find all sorts of wood pavements tested here; all kinds of stone pavements; all varieties of concretes; all patents of asphalt, both sheet and block,—in fact there is hardly a known variety of paving material or method of laying that has not been tested and results attainable. And under the admirable engineering system, the city is under the eye constantly of the highest skill, and is also seen by the leading engineers of the world, who are visitors to the capital. In this way the very best workmanship and the most thorough methods have been employed, and when you find a piece of pavement it is always the best of its class, whatever may be the material used.

Now what ought the people of a city like Kansas City, just entering upon a system of street improvement that is to cost a great deal of money, to do? It seems to me that they should investigate the matter for themselves. Not to see whether the stone men or the wood men shall lay their pavements, but to study the whole question, and determine what is the best for Main Street, what will answer for Walnut, what will best supply the needs of Twelfth, and so on.

If an engineer like Mr. Chanute, able and conscientious, with two or three practical men of high character, were to come here and spend a week or two making a personal examination of the streets of Washington, and consulting with the engineer department and the District commissioners as to cost, methods of construction, durability and desirability of the various kinds of pavements in use here, they would be able to give our people practical advice, that would ensure first-class streets at the lowest possible cost.

I do not know anything of immediate importance to Kansas City that would pay so large a return to her people at the little expense this would be.—*Cor. Kansas City Journal.*

SEWERAGE SYSTEM OF MEMPHIS.

Since the adoption of the Waring system of sewerage, the City of Memphis is one of the best drained cities in the United States. From the reports and exhibits of Maj. Niles Meriwether, engineer in charge of sewers, we gather the following interesting information:

The city occupies the summits and slopes on both sides of a valley, which is drained by a stream known as Bayou Gayoso. The main sewers are located on each side of the bayou, and as near to it as found practicable. There are altogether about thirty-eight and six-tenths miles of sewers, of which four miles are mains, located along the bayou, and discharging into the river by one outlet; the remainder are laterals, draining into these mains, except about four and one-tenth miles of sewers constructed before the present system was adopted, and discharging into the Mississippi by other outlets. The mains are ten, twelve, fifteen and twenty inches in diameter. Of the laterals, about 85 per cent are six inches in diameter, and the remainder eight inches, except a few short lengths, which are ten inches. The mains, for the most part, are laid with a grade of two inches in 100 feet, which is the minimum. The minimum grade of the six-inch laterals is six inches in 100 feet. At the upper end of each lateral is located one of Rogers-Fields' automatic flush tanks, which discharges one hundred and twelve gallons in about forty seconds. This tank discharges its contents as often as it filled, but it is considered that once in twenty-four hours is sufficient. The system is with manholes freely distributed on the mains. No surface or roof-water is permitted to enter the sewers, the system being designed and proportioned for house sewerage only. The house drains are all four inches in diameter, and no trap is permitted on the main drain, each fixture being provided with a separate trap. The soil pipes are of cast-iron with lead joints above the ground, and extend four inches in diameter above the roof. Each house drain is consequently a ventilator for the public sewer. For the purpose of removing the subsoil water, agricultural drain tiles are laid in the trench with each lateral on the grade of the sewer, or below it, which discharge, not into the sewers, but into the bayou. Additional lines of tile have been laid in the streets in which no sewer is located. A large portion of the trenching was done by contract, but the pipes were laid by hired labor. The prices paid for excavating and brick filling were:

Trenches 6½ feet deep, 25c; 6½ to 9 feet, 30c; 9 to 12 feet, 45c; 12 to 15 feet, 75c, per lineal foot. The pipe laying, including laying drain tile in the same trench, also the cost of the cement, sand, oakum and tile paper is estimated at seven and six-tenths cents per foot. The flush tanks cost, completed, about $45 each, including $10 royalty. The six inch pipes, although draining houses on both sides in some cases, for a distance of 3,000 feet, have never been overcharged, and have seldom been found running half full. No trouble has been caused by sewer gas, and the sewers are believed to be comparatively free from it. Some of the six inch pipes have occasionally been obstructed by sticks, bones, etc., becoming fixed across the diameter of the pipe, all of which have been promptly removed. Twenty-one cases of such obstruction have occurred, which have been removed at an average cost of $13.50 each.

Some deposits have been found in the mains, which have been rapidly and inexpensively removed by the passage of hollow metal balls through them. These balls are less in diameter than the sewers, and being lighter than water are pressed against the top of the sewer, and are rolled along by the force of the current. The velocity of the ball is less than that of the water, which in passing it is deflected against the bottom and sides of the sewer so as to thoroughly cleanse it. A portion of the mains have been cleansed four times since their construction; the laterals not at all. Pipe laying was commenced about the 20th of January, 1880, and on July 1st, of the same year, about twenty miles had been laid. The first house connections were made about the 1st of March of the same year. On the 13th of June, 1882, hourly observations showed the greatest depth of flow fourteen inches, at 11 A. M.; least depth, ten and one-fourth inches, at 4 A. M. Floats in the same sewer gave a surface velocity of two and six-tenths feet per second, the depth being twelve and one-fourth inches.

The following is a statement of the connections made with this system, but does not include those made with the old sewers, discharging by other outlets:

Water closets	4,715
Sinks	3,224
Urinals	179
Bath tubs	334
Wash basins	308
Privy sinks	34
Cellar drains	24

This system of sewers gives entire satisfaction both to the city government and citizens generally.

Dr. Thornton, President of the Board of Health, in his last report, has the following to say of the workings of the sewerage system described above:

"The practical working of the sewer is giving entire satisfaction, and, as far as I know, fully answering the ends claimed for it by its projector. The chief advantages of this system over the ordinary sewers of other cities are the economy in first cost, the prevention of sewer gas to its minimum, the exclusion of storm or surface water, and their facility in cleansing themselves, or in the prevention of the deposit of sewage matter in any portion of the pipe. The periodical flushing by an automatic arrangement of a flush-tank, placed at the head of each lateral six-inch pipe, when it discharges, cleanses the pipe of all deposit, should there be any, thereby preventing any decomposition in the sewer."—*Journal.*

THE ARLBERG TUNNEL

The boring of the tunnel through the Arlberg (the Eagle's Mount), a branch of the Rhætian Alps, has been completed.

The Arlberg Tunnel ranks only after the Mont Cenis and Mount St. Gothard tunnels among great modern engineering works of its class in Europe. The object of the new line is to shorten the distance between Western Austria and Eastern Switzerland, create a direct traffic between the two countries, and render them independent of the South German railways over which it has been heretofore conducted. The new line is divided into two sections—the first running from Innsbruck to Landeck, the second from Landeck to Bludenz. The former, which is forty-five miles in length, passes along the right bank of the Inn. Its construction presents no extraordinary engineering difficulties. The construction of the stretch between Landeck and Bludenz has been much more difficult and costly. It is a mountain line from first to last. In the Valley of Rosanna the gradient is one in forty. The road crosses the Valley of Panznau on a viaduct of three arches, each having a span of 197 feet. The length of this stretch is thirty-five miles, and the total estimated cost 11,784,000 florins, or $5,892,000.

At St. Antoine, 1,721 feet above Landeck, is the beginning of the great tunnel on which work has just been completed. The point fixed upon by the Austrian Government for commencing this work is not the one that was chosen by Gen. Nordling, who first surveyed the ground. The tunnel, had his scheme been adopted, would have been higher up the mountain, shorter, wide enough only for single rails, and, therefore, less expensive than the one finally fixed upon. But the Government, believing that the Arlberg Line will some day be one of the most important in Europe, decided that it was expedient to provide every facility for a great traffic. The gradients were made as easy as possible, even though the tunnel should be a little longer, and the line will be double-railed throughout its length.

The work of boring the tunnel began on the Austrian side in June, 1880, and in September operations were begun on the Swiss side of the mountain. The work proceeded at a speed which affords a striking illustration of the improvements that have lately been effected in the art of mountain tunneling. The Mont Cenis Tunnel was bored at the rate of 3,537 feet a year, the St. Gothard at the rate of 5,474 feet, and the Arlberg was pierced at the rate of 7,080 feet a year. The Arlberg engineers also profited by the experiences of their predecessors in the matter of cost, for while the outlay on the Mont Cenis Tunnel was $2,000 per running meter—thirty-nine and one-half inches,—and on the St. Gothard $1,250, the expense of making the Arlberg did not exceed $750 to the meter. In this regard, however, the tunnel last named benefited by its shortness, since the longer the tunnel, other things being equal, the greater is its relative cost.

An interesting experiment was made in the Arlberg Tunnel with a new sort of perforator. The perforators used in the Mont Cenis and St. Gothard tunnels consisted of a series of chisels (not diamond pointed, as has sometimes been stated), driven with a quick, hammer-like action by compressed air, the machines for the production of which were actuated by turbines at the two ends of the galleries. This system was the one in use on the eastern, or Austrian, side of the Arlberg. The chisels cover a space of seven square meters, and make twenty to twenty-five holes at one time, each from one and a half to two meters deep. These are then filled with dynamite and the mine exploded. Every blast lengthens the drift by about one and a quarter meters. The perforators move forward on wheels, and the air, compressed to a pressure of five atmospheres, is supplied through flexible tubes. On the west side drills are employed of a diameter of seventy millimeters, to which, by means of a water pressure of from sixty to one hundred atmospheres, a rotary movment is communicated. Six or eight of these drills are as effective as twenty or twenty-five of the atmospheric perforators, and the holes they make are so much wider that equal results are produced with lighter charges of dynamite.

The greatest difficulty in Alpine tunneling consists less in quarrying out a passage than in getting rid of rubbish. After every blast the outcome of it, in the shape of loose material, must be removed before boring operations can be resumed; and when an atmosphere already close and impure is still further fouled by the smoke of an explosion, the labor of removal becomes dangerous as well as difficult. Fatal accidents sometimes happen. The leading miners in the Arlberg Tunnel, when engaged in this work, cover their mouths and nostrils with sponges which have been steeped in vinegar, an expedient which has been found singularly efficacious in neutralizing the bad effects of the poisonous air they are often compelled to breathe. The important part which the removal of rubbish plays in these undertakings is shown in the fact that of the time required for the making of the Arlberg Tunnel fully one-half was devoted to the carrying away of loose material.—*N. Y. Herald.*

MINING IN COLORADO IN 1883.

Following is a summary of the coal output of Colorado for the year 1883:

	Tons.		Tons.
Mines near Erie and Canfield	80,000	Mines near El Moro	277,341
Mines at Louisville	103,321	Mines near Durango	12,000
Mines at Langford	45,500	Mines at Rico	2,500
Mines near Golden	19,899	Mines at Crested Butte	75,983
Mines at Franceville	53,757	Mines at Castleton	14,846
Mines at Sedalia	1,500	Other mines	3,500
Mines at Como	58,391		
Mines near Cañon City	272,103	Total product of Colorado	1,114,040
Mines near Trinidad	93,339		

The value of the product, 1,114,040 tons, at $2.25 per ton, is $2,506,590.

Colorado Coal and Iron Company.—During the year 1883, this company mined the following amount of iron ore from its various mines:

	Tons.
South Arkansas Mine	19,646
Hot Springs Mine	25,938
Placer Mine	1,512
Total	47,106

This ore was treated at the Company's works at Bessemer, and converted into the following manufactured products:

Merchant bar-iron and mine rail	4,647	tons of	2,000
Pig-iron	25,706	"	2,000
Casting	1,378	"	2,000
Steel rails	16,246	"	2,240
Muck-bar	3,184	"	2,240
Nails	66,724	kegs of	100
Spikes	9,841	"	100

The mining product of this State for the year 1883—gold, silver, copper, and lead—is estimated by the Denver *Republican* as follows:

County.	Amount.	County.	Amount.
Boulder	$400,000	La Plata	128,688
Chaffee	300,000	Ouray	700,600
Custer	800,721	Park	400,000
Clear Creek	2,000,000	Pitkin	125,000
Dolores	200,000	Rio Grande	182,000
Eagle	930,000	Routt	75,000
Fremont	20,000	Saguache	100,000
Gilpin	2,208,988	San Miguel	225,000
Grand	10,000	San Juan	418,954
Gunnison	650,000	Summit	350,000
Hinsdale	390,000	Total	$26,306,131
Lake	15,691,200		

Total production last year, $25,750,898, showing an increase this year of $555,233.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Apparatus for Use in Tunneling, Mining, and Excavating Operations.—In the construction of tunnels the usual course has been heretofore to first place in position the drilling mechanism, and prepare holes for the reception of an explosive; next to remove this apparatus so as to leave the tunnel unobstructed; next to charge and fire the blast; then to load the excavated material upon cars that are run in for the purpose, and after loading, by hand run them out and dump, after which the drilling apparatus is taken back into the tunnel and the whole operation repeated. By this method of operation a large portion of the time has been required for the removal of the excavated material, and but a fraction of the time has been available for such work as required skilled labor, and the construction of a tunnel having any considerable length, has from such cause required so much time as to prevent many similar enterprises from being carried out. To obviate these objections is the design of the apparatus now in hand, which consists, principally, in a car having an open front end and adapted to receive the material as dislodged by the blast and provided with a movable top and sides which may be arranged with a chain and bar combination, to practically close the tunnel and cause the flying debris to fall into the said car. There can also be an adjustable drop apron attached to the extreme front end of the car bottom to prevent any of the material from being blown under the car. The platform, or body of the car, is supported upon four or more wheels, that preferably are of much less diameter than those usually employed, bringing the car as near the rails as possihle. Secured to, and extending upward from one end of the body, is an end piece, which has substantially the intended height of the box, while from each side edge of the said body a side piece extends upward to about one half the height of the end piece, and has, hinged to its upper edge a similar piece, that, when placed vertically, carries the height of each side up to that of the end piece. Hinged at one end to or upon the upper edge of the end piece, is a top or cover which has such dimensions as to enable it to close the entire upper side of the car-box when the hinged side pieces are turned inward to a vertical position. This cover is adapted to be raised upward to reach the roof of the tunnel and is thus raised when desired by the following described means, viz: Hinged at one end to or upon the rear end of the cover, is a bar, that at its outer end is provided with a pulley around which passes a rope that has one end connected to a windlass journaled upon the rear end of the car, and the other to the upper side at or near the front end of the cover. The said bar when not in use is turned rearward and downward, where it rests entirely out of the way, but when it is desired to raise the cover the bar is turned upward and forward until it reaches a vertical position, and when its further movement in such direction is arrested and by the turning of the windlass, the rope drawing over the pulley will cause the front end of the cover to be elevated. The upper face of the body, the inner faces of the end pieces, the sides, and the lower face of the cover, are heavily plated with metal, preferably with "T" rails in order that they may be able to withstand the impact of flying rock, and in order that the points between the side pieces may be protected from injury, and at the same time be made sufficiently close to prevent the passage of stones, the continuous edges are bevelled outward and their hinges are placed upon a line with the inner faces of the said parts. The box thus constructed is intended to occupy about one-half the vertical dimensions of a tunnel, and to have such width as to enable it to pass freely through the same.

After the drilling mechanism has prepared holes for the explosives it is moved rearward a short distance, and by suitable means is raised to, and held in position near the roof of the tunnel, after which the car is moved inward upon the rails until its front end is near the rock to be blasted, the cover is now raised until its front end is in contact with the upper side of the tunnel, the hinged portions of the sides are turned outward until they rest against the contiguous sides, after which the charge of explosives, which have been meanwhile placed in position, are fired. The debris dislodged by the explosion will fall directly into the car, or will be thrown against the sides or cover of the same and then fall to the bottom, but little if any will fall below or outside of the car, so that the labor of loading the material will be entirely avoided, and the car with its contents may be speedily, run out of the tunnel and dumped; in the meantime the drilling mechanism has been placed in postion. In order to avoid all possibility of the passage of stone, etc., at the sides of the car, a wing is hinged to the front end of each stationary side piece, and is adapted to swing outward against the sides of the tunnel, and not only operates to close the space between the latter and the side pieces, but also acts as a shield for the front ends of the side pieces.

The mechanism described not only lessens materially the time and labor required for the construction of tunnels, mining operations, etc., thereby rendering more speedily available the capital invested, but it also affords protection to those engaged in the work, preventing in a great degree the loss of life which has heretofore attended the prosecution of such work.

Mr. W. R. Kirk, of this city, has evolved the above described labor-saving apparatus.

BOOK NOTICES.

Lectures on Painting: By Edward Armitage, R. A. Octavo, pp. 337. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson, $1.75.

These lectures are selected from the series delivered by the author to the students of the Royal Academy between the years 1876 and 1882. They cover the following comprehensive and suggestive range: Ancient costumes, Byzantine and Romanesque art, the painters of the eighteenth century, "David" and his school, the modern schools of Europe, drawing, color, decorative painting, finish, the choice of a subject, the composition of decorative and historical pictures and composition of incident pictures: twelve in all, and evidently intended not only for artists and art students, but also for persons who may desire to obtain some idea of a subject which is rarely treated in a simple and practical manner by its professed teachers.

In reading these lectures it becomes more and more apparent to the reader that the author has constantly borne in mind the duties of the teacher of art as stated in the preface to the work, viz: the general pilotage of the schools through the quicksands and mud-banks with which the deep water channel leading to excellence is beset on every side, and secondly the alimentation of that subtle flame without which the architect degenerates into a builder, the sculptor into a statuary, and the painter into a handi-craftsman.

Every lecture is practical, emphatic and pointed, as well as entertaining; full of instruction to the ordinary reader as well as to the art student; bristling with historical allusions, incidents appertaining to art in all lands and among all well known painters, as well as pertinent suggestions as to color, style, choice of subject, manner of handling, etc. Without an atom of art talent in his composisition the reader will become interested in this book, and long to apply the lecturer's common sense, practical rules and directions in person: the real art lover will unquestionably find mines of information and suggestions well worth working.

THE ORGANS OF SPEECH: By Georg Herman Von Meyer. 12mo., pp. 349. D. Appleton & Co., New York, 1883. For sale by M. H. Dickinson. $1.75.

This is the forty-sixth volume of Appleton's International Scientific Series, and is probably as practical and useful as any one of them. It is an attempt to to show that a true knowledge of the laws which govern the transformation of the elements of speech in the formation of dialects or derivative languages can only be obtained from a study of the physiological laws of the formation of articulate sounds. Hence the importance of the philologists becoming thoroughly acquainted with the structure and formation of the organs of speech.

The author is Professor of Anatomy at the University of Zurich, and the book is illustrated with some fifty wood engravings, prepared expressly for the purpose of demonstrating his views and theories. It is divided into three chapters, comprising respectively the formation of the organs of speech, the relation between the organs of speech and the formation of sound, and the formation of articulate sounds.

The object of the work being to discuss the structure and functions of the organs of speech, with special reference to the requirements of the philologist, it will be found that the descriptions of the anatomy and physiology of these organs all have this object plainly in view, and that there are various new and unusual interpretations of both presented.

So thorough a treatment of the subject is not found, so far as we know, in any other work, and musicians and public speakers, as well as philologists, will be especially interested in it from a business standpoint, if from no other.

WHERE DID LIFE BEGIN? By G. Hilton Scribner. 12mo., pp. 64. Chas. Scribner's Sons, New York, 1883. $1.25.

This is an inquiry as to the probable place of beginning and the natural causes of migration therefrom of the flora and fauna of the earth. The author's ordinary business duties are alleged by him to have been sufficient employment without engaging in scientific work, but having followed out certain lines of thought to their logical conclusions in his own judgment and submitted them to his friends, he was persuaded to publish them.

Assuming that the earth was at one time a fiery mass, the first question asked is "what part or parts of its surface first became sufficiently cooled by radiation to be habitable by plants and animals?" Inasmuch as the heat of the Sun upon the earth has always offsetted the heat radiated from the earth, to a certain extent, and this offsetting has been much less in degree at the poles than at the equator, necessarily the region about the poles cooled off and became habitable first. Besides this, the polar regions had less matter to cool, and radiated heat into space more rapidly in proportion to mass than any other portion of the earth's surface; consequently it seems evident that the polar regions necessarily passed through the different temperatures, climates and climatic conditions now characteristic of the various zones, before any other portion of the earth became habitable, and were actually adapted to all the requirements of animal and vegetable life before them. It is next assumed that life did actually commence within one or both of certain zones surrounding the poles and sufficiently removed from them to receive the least amount of sunlight necessary for animal and vegetable existence. Then the lowering temperature and its accompaniments crept slowly downward from the Arctic, through the temperate, to the torrid zone, and the differing forms of life kept pace, abandoning the polar region as its heat was reduced below the living point, and occupying the other zones by turns.

Having thus stated his premises and conclusions, the author proceeds to support them by the topographical condition of the earth's surface, the currents of the ocean, the movements of the winds, the fossil remains of animals and plants found in the polar regions, etc. His points are well made and carry connection with them. The work is logical throughout and attractively written.

ELECTRICITY IN THEORY AND PRACTICE: By Lieutenant Bradley A. Fiske, U. S. N. Octavo, pp. 270. Illustrated. D. VanNostrand, New York, 1883. $2.50.

To any student who desires a work lucidly explaining both the theory and practical applications of electricity, we can offer nothing better than this. As Lieut. Fiske says, many practical men and students have found great difficulty in seeing the relation between the theory of electricity and its practical applications "because they have had to study the theory from books devoted wholly to abstruse theory and the practical applications from books devoted wholly to the practical applications." His object has been to furnish a book showing the principles upon which the practice depends, and explaining the theory of the practical applications. A glance through the table of contents will show how well this has been done, from the grouping and sequence of the topics alone, viz: Magnetism, Frictional Electricity, Work and Potential, Voltaic Batteries, Laws of Currents, Secondary or Storage Batteries, Thermo-Electric Batteries, Electro-Magnetism, Induction Currents, Electrical Measurements, Telegraphy, The Telephone, The Electric Light, Electric Machines, Electro-Motors, Electric Distribution of Power, Meters, Electric Railways.

A thorough examination shows much more than this; that the author not only understands his subject, but unlike many authors, appreciates the difficulties of those not so familiar with it and adapts his explanations and reasoning to their wants.

We find full and careful descriptions of the theory of telegraphy, including accounts of the various systems: of the telephone, with descriptions of its history, its uses and limitations, and the machinery used in receiving and transmitting messages: of the electric light and nearly all of the lamps invented, either arc or incandescence: the electric transmission of power by the series system, the multiple arc system, accumulator system, motor dynamo system, and induction system, with a careful statement of the advantages and disadvantages of each system: arrangement of accumulators, etc. The final chapter is devoted to Electrical Railways, with accounts of experiments therein in mines or street railway lines and elsewhere by Siemens, Field and others, including the accumulator system as tried in London, calculations of horse-power, economic considerations, etc.

In short, the work is just what it purports to be, "Electricity in Theory and practrice, or the Elements of Electrical Engineering," and cannot fail to be of especial service to persons who need, as most readers do, an explanation and clear understanding of the connecting links between theory and practice in this interesting and practical study. Inasmuch as we are emerging from the age of steam and entering upon that of electricity, such a book cannot be too widely distributed, either in the higher schools and colleges or among the mechanical portion of the people.

THIRD ANNUAL REPORT OF THE U. S. GEOLOGICAL SURVEY, 1881–2. J. W. Powell, Director. Octavo, pp. 564; Illustrated. Government Printing Office, Washington, D. C., 1883.

This handsome volume is made up of the report of the Director himself, the administrative reports of each of the assistants, Messrs. Clarence King, Arnold Hague, G. K. Gilbert, T. C. Chamberlin, S. F. Emmons, G. T. Becker, L. F. Ward, J. Howard Gore and Gilbert Thompson, and Accompanying Papers by Prof. O. C. Marsh, Roland D. Irving, Israel C. Russell, Arnold Hague, Thos. C. Chamberlin and C. A. White, M. D.

Major Powell reports the preparations made for a topographic map of the

Colorado Plateau region,—a district embracing portions of Utah, Colorado, New Mexico and Arizona—by Mr. Gilbert Thompson. In Colorado the field-work for a topographic map of the Ten-Mile Mining District has been finished, and the map completed, ready for the use of the geologist. In northern Nevada work has been commenced, which, in connection with previous surveys, will furnish a trusty map of northern and central Nevada.

Mr. Arnold Hague is preparing a memoir on the Geology of the Eureka District, Nevada, and the study of the ore deposits of the same locality by Mr. J. S. Curtis has been finished so far as the field work is concerned. Mr. I. C. Russell, who has been studying the Quaternary lakes of the Great Basin, has completed his examination of Lake Lahontan, and has made a preliminary one of southeastern Oregon. Mr. S. F. Emmons has begun the investigation of the mining and general geology of the Ten-Mile District and of the vicinity of Golden, Colorado, and attention has been given to the soils in the neighborhood of Denver. Mr. Lester F. Ward spent the summer of 1881 in the collection of fossil plants in Colorado and Arizona. Dr. C. A. White began at the same time the collection of a parallel suite of invertebrate fossils, but being called off to investigate the problem of artesian water on the plains, was compelled to postpone it until another season. Prof. T. C. Chamberlin continued his work in examining and tracing the glacial moraines of Dakota and the associated features of the drift. Dr. Carl Barus, under the direction of Prof. Clarence King, has undertaken a series of experiments upon the chemical and physical properties of rocks and rock-forming materials under extreme conditions of temperature and pressure.

The accompanying papers above referred to make up the great bulk of the volume, and are as follows: Birds with Teeth, by Prof. O. C. Marsh; The Copper Bearing Rocks of Lake Superior, by Roland D. Irving; Sketch of the Geological History of the Eureka District, Nevada, by Arnold Hague; Preliminary Paper on the Terminal Moraine of the Second Glacial Epoch, by Thos. C. Chamberlin; A Review of the Non-Marine Fossil Mollusca of North America, by C. A. White, M. D.

There are thirty-five plates and fifty-six engravings, all admirably executed.

POLITICAL RECOLLECTIONS, 1840 TO 1872: Geo. W. Julian. 12mo., pp. 384. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson. Price, $1.50.

Beginning with the "log cabin and hard cider campaign of Tippecanoe and Tyler too" in 1840, the author takes his reader through the exciting political history of the United States, down to 1872, the most important portion of the life of the Nation, since it includes the rise and progress of the slavery question, its settlement in the war of the rebellion and the reconstruction of the seceded States. During all this time, Mr. Julian was more or less actively engaged in politics and, for a number of years, in positions enabling him to command an interior view of important measures and an intimate knowledge of the prominent men of his day. His account of the acts of the old Whig party, the evolution of the Republican party, the progress of Republicanism, the administration of Lincoln and the war, reconstruction and suffrage, impeachment, the Grant and Greeley campaign, and the numerous stirring incidents involved in all these wonderful changes in the affairs of the country, is necessarily interesting, doubly so from the familiar and impressive way in which it is handled. Aside from a somewhat undue airing of personal grievances, the whole account is decidedly attractive and valuable, especially in view of the many notices and anecdotes of the distinguished actors of the time, which doubtless are perfectly reliable.

To all readers whose recollection extends backwards over the period included, Mr. Julian's book will be a valued reminder of an exciting and important portion of their lives.

KNIGHT'S NEW MECHANICAL DICTIONARY. Section IV: Octavo, pp. 240. Illustrated. By Edward H. Knight, A. M., LL.D. Houghton, Mifflin & Co., Boston, 1883. $2.00.

Though Mr. Knight died just one year ago, before he had fully completed this the last volume of this valuable work, it was found after his death that he had left the remainder in such a forward state of preparation that the task of editing was confined chiefly to such arrangement of his material as would put it into the shape intended by him. The volume begins at "printing press" and ends with "zoögyroscope," and includes almost every imaginable machine between them. There are fifty-six full page plates, besides hundreds of smaller engravings and illustrations. Seemingly, no mechanical dictionary can be more complete than this, either in titles, references or descriptions. It is printed on most excellent paper and the engravings are admirable. The publishers certainly have done all in their power towards supplementing the labors of the accomplished and lamented editor.

BALLADS OF HOME: BALLADS OF BEAUTY: BALLADS OF BRAVERY: Edited by Geo. M. Baker. Lee & Shepard, Boston, 1883. For sale by M. H. Dickinson.

These three handsome volumes contain the choicest gems of poetry in the English language in the classes named, and their mechanism is fully worthy of their contents. Each volume comprises about one hundred and seventy-five pages, and is illustrated with forty full page illustrations. Among the authors, from whose works selections are given, we note Leigh Hunt, Tennyson, Browning, Read, Fitz James O'Brien, Rogers, Mrs. Hemans, Sheridan Knowles, Heine, Longfellow, Burns, Mary Howitt, Holmes, Spencer, Kingsley, Moore Saxe, Phoebe Cary, Bryant, Campbell, Aldrich, Willis, Wordsworth, Byron, Bulwer, and scores of other poets less known to fame.

OTHER PUBLICATIONS RECEIVED.

Reports of Observations and Experiments in Practical Work of Division of Entomology, by C. V. Riley, Government Printing Office, No. 3. Report of Entomologist, C. V. Riley, Ph.D., for 1883, Government Printing Office. Reports of Experiments, Chiefly with Kerosene on Insects affecting the Orange Tree and Cotton-Plant, C. V. Riley, 1883. Bulletin No. 1, Reports on Observations of Rocky Mountain Locust and Chinch-Bug, Government Printing Office, Bulletin No. 2, C. V. Riley. Proceedings of the Boston Society of Natural History, Vol. 22, Part 2, Boston, 1883, Edward Burgess, Sec'y. Winter Months in a Summer Clime: Through the Uplands to Florida, 1884. *Agricultural Review and Industrial Monthly.* $3.00 a year, published monthly; American News Company, General Agents. *International Review of Medical and Surgical Technics*, published quarterly, Boston, Mass., U. S. A., Vol. 1, No. 1. Alphabetical Lists of Patentees and Inventions for the half year January to June inclusive. Bulletin de La Société des Sciences Naturalles, De Neuchatel, Tome 13, 1883. Reports from United States Consuls, on the Commerce, Manufactures, etc., of their Districts, No. 34, October and November, 1883, Government Printing Office. Declared Exports of the United States, first and second quarters, 1883, Government Printing Office. *The Electrician and Electrical Engineer*, a monthly review, January, 1884, Vol. 3, No. 25; price 10c. *Journal of Progress*, Vol. 1, No. 3, 1884, $2 a year—10c. a number. Work and Wealth, by R. R. Bowker, N. Y., 25c. The *Indicator*, a magazine devoted to art and music; quarto, 20 pages, weekly, Chicago; $3.00 per annum.

SCIENTIFIC MISCELLANY.

THE OLD MAN OF HOY.[1]

REV. S. J. DOUGLASS.

Beside the Pentland Firth dwells the tallest man on earth,
With his head quite bare to the sky;
No roof can shelter him of towering castle grim,—
St. Peter's is a chapel in his eye.

This Old Man of Hoy was ne'er a little boy,
But always a giant grown;

1. * * * * Whether the sense, or nonsense of "The Old Man of Hoy" is worth a thought, is for you to say. If it is anything, it is a historico-geological sketch, suggested by Sir Walter Scott's and various travelers' descriptions of the rock, and especially by Mr. Geike's recent interesting paper upon it.—S. J. D.

Standing high above the shore, six hundred feet or more,
He is strong as though hewn out of stone.

Not a stripling of a day, but, his locks now iron-gray,
He has long felt the terrors of the North;
But his soul is sunny yet, and his face is ruddy yet,
And he knows what a blithe heart is worth.

How merrily he laughs, as the briny gale he quaffs,
And the sea-eagles scream 'round his ears!
The wildest storm may rave, he defies both wind and wave,
For he never feels a small man's fears.

O he, and he alone, knows who owned the Dwarfie Stone,
And hollowed its chamber strong:
A mighty troll and wife there spent a wondrous life,
His friends through a century long.

He, too, saw the Age of Ice, and he didn't think it nice;
He can tell us of Pict, Norse and Scot:
But for Odin's altar red, and his heroes' mounded bed,
And for Highland carls he cared not a jot:

With the Merry Men of Mey he would dance the livelong day,
Till he danced off a leg in the sea:
Still, the sturdy old chap scarcely ever took a nap,
And his one leg was equal to three.

With ancient Vikings tall, and more modern pirates small,
Full many a battle he has fought:
Yet across the boiling firth bubbled o'er his roaring mirth,
As he joked with Johnny O'Groat.

To the Old Man of Hoy what overflowing joy
Give still the rush and the roar of the waves—
Though the spray oft drives like sleet, and the winds like arrows [beat,
And the rain his gray beard laves!

Long life to the iron soul! While the Atlantic surges roll
May he manfully stand to the fight!
No nobler grave is found than old Ocean's depths profound,
Nor slab than the Carbuncle bright!

Like the Old Man of Hoy, let us heartily enjoy
What the time and the tide may send!
When low the breezes sigh, we will close the watchful eye,—
But with trouble we will battle to the end.

NEW HAVEN, CONN., January 17, 1884.

EDITORIAL NOTES.

THE Kansas City Academy of Science has received contributions to its museum from the following named gentlemen during the past month: From Gen'l John A. Halderman, Minister to Siam, 22 small rubies; from A. M. Stalnaker, of Springfield, Mo., two pieces of mastodon tusks; from Geo. R. Warren, of Kansas City, a copy of Thomas' Massachusetts Spy or Worcester Gazette, dated July 1, 1812; from J. W. Phillips, a large petrified root of a tree; from H. Holbrook, a very handsome specimen of zinc ore and a concretion simulating a vertebral bone.

DR. R. J. BROWN, President of the Kansas Academy of Science, gave us a very pleasant call last month. He is decidedly in earnest about the work of the Academy during his administration, and has appointed the following named committees, every member of which is believed by him to be a zealous worker in his special department of science: Geology—O. H. St. John, Bobert Hay, and Joseph Savage. Mineralogy—G. H. Failyer, Geo. S. Chase, and E. S. H. Bailey. Chemistry—E. S. H. Bailey, H. E. Sadler, and J. D. Willard. Physics—J. T. Lovewell, E. L. Nichols, and H. M. Aller.—Meteorology—F. H. Snow, J. T. Lovewell, and J. D. Parker. Astronomy and Mathematics —E. L. Nichols, D. E. Lautz, and J. A. Lippincott. Botany—W. A. Kellerman, J. H. Carruth, and E. N. Plank. Entomology—E. A. Popenoe, F. H. Snow, and F. W. Cragin, Ornithology—F. H. Snow, N. S. Goss, and L. L. Dyche. Ichthyology—I. D. Graham, F. W. Cragin, and D. B. Long. Herpetology—F. W. Cragin, F. H. Snow, and H. R. Morse. Anthropology—A. H. Thompson, Frank Kiser, J. R. Mead.

CAPT. H. H. C. DUNWOODY, of the U. S. Signal Office, at Washington, D. C., visited this city a few weeks since for the purpose of arranging for the establishing of a system of weather signals by which shippers and others can be warned of the approach of cold waves in time to prepare for them. If this system had been in operation on the first of January great loss of property and human suffering might have been prevented. Through Gen'l Nettleton and the Postmaster it has been arranged to have two signal flags displayed, one in West Kansas City and one up town, as soon as they they can be sent out. Capt. Dunwoody is also endeavoring to have the meteorologists of each State Weather Service coöperate with the Chief Signal Officer and thus secure a more effective general system than ever before.

MARSHALL L. WOLFE, Mining Inspector of Bates County, Mo., states in his Annual Report for 1883, that the number of acres of workable coal lands in the county has been increased by fresh discoveries and newly opened mines, from 95,000 to about double that number; that the number of mines operated in 1883 was about 250 and the amount of capital employed in coal mining $1,000,000.

BARON NORDENKSJOLD, the well known explorer of the Arctic regions, is contemplating another voyage. He intends, however, to leave the beaten track this time and go southward to the Antarctic circle. The attempt will be made in 1885.

THE Secretary of the Navy has instructed Commander Upshur at the New York Navy Yard to make suitable arrangements for the reception of the remains of DeLong and others of the ill-fated Jeannette on their arrival, which will be about the 15th inst. Chief Engineer Melville and Lieut. Danenhauer will take prominent parts in the ceremony. It is expected that these remains will finally be interred at the Annapolis Naval Cemetery.

AT a recent meeting the Directors of Washington University created a new chair of Dynamic Engineering. It will include, with what was formerly known as mechanical engineering, the application of electricity to the arts. The Secretary of the Navy has detailed Assistant-Engineer Wm. H. Alderdice to fill this chair.

GEN'L A. A. HUMPHREYS, late Chief Engineer of the United States Army, died suddenly on the 27th of December of heart-disease. He was not only distinguished in the line of his profession but was also a valued member of several of the most prominent scientific societies of this country and Europe.

PROF. ROMYN HITCHCOCK, the eminent microscopist of Washington City, pleasantly writes: "I am always pleased to get the Kansas City REVIEW, which I esteem very highly. There is always much good and instructive reading in it. I have not seen the January number yet, I hope you will at once send it."

MR. WM. F. E. GURLEY, of Danville, Ill., has published a preliminary notice of certain new fossils in the carboniferous deposits of West. If carried out on the plan proposed it will be a very valuable work. We notice among others, descriptions of new species named *Bellerophon Harrodi*, *Bellerophon textiliformis*, also *Discites Todannus*, all collected at Kansas City by Mr. David H. Todd, of this city. All western palæontologists should encourage Mr. Gurley in this work which will be continued from time to time and published in additional bulletins.

IN addition to Prof. Sternberg's palæontological labors in the West, of which he has so often given proof in the columns of the REVIEW, he has had his eyes open in a utilitarian direction also, the result being the discovery of a bed of very fine silica, which he is now using in the manufacture of a scouring soap for silver, steel, tinware, etc., at Lawrence, Kansas. Samples that we have seen and used give very satisfactory results.

MR. J. O. BROADHEAD, brother of Prof. G C. Broadhead, of Pleasant Hill, Mo., wrote him, upon reading his article in the November REVIEW, that General Cass told him at his residence, in Detroit, in 1864, "That he made the expedition from St. Louis to Detroit *the whole way in boats*, up the Illinois River and across from its head waters, through the lakes and swamps, to Lake Michigan."

THROUGH some oversight on the part of our reporter, credit was erroneously given to Prof. E. S. H. Bailey for the authorship of a paper upon "The Distribution of Saccharine Substance in the Stem of the *Sorghum Vulgare*," read before the Kansas Academy of Science. It should have been given to Prof. G. H. Failyer, of the Agricultural College at Manhattan, Kas., who has devoted much of his time to this subject and who has written a very complete report upon it for the last Quarterly Report of the State Board of Agriculture of that State.

WE acknowledge the receipt of a complimentary admission ticket from H. H. Warner, of Rochester, N. Y., to his observatory, which is in charge of Prof. Lewis Smith.

WE are promised for the next number of the REVIEW an article on archæology from the pen of Dr. Stephen Bowers, who has removed to San Buena Ventura, California, and is publishing the *Ventura Free Press*.

Also an article based on some pendulum experiments in Australia, China, and Japan, by Prof. H. S. Pritchett, of the Washington University, St. Louis.

Also an article on Crinoids by Prof. D. A. Bassett, formerly of Crawfordville, Indiana, now of Colton, California.

PROF. O. C. MARSH, President of the National Academy of Sciences has sent a report to the Commissioner of Internal Revenue, signed by several of the most eminent chemists of the country, to the effect that glucose as at present manufactured is of exceptional purity and uniformity of composition, containing no injurious substance and is in no way inferior to cane sugar in healthfulness.

to Prof. Gustavus Hinrichs, Director of the Iowa Weather Service, for a neat pamphlet comprising a report on the seasons in Iowa and a calendar for 1884. Prof. Hinrichs is a veteran meteorologist, and the Weather Service of Iowa is exceedingly complete.

WE also find in the Quarterly Report of the State Board of Agriculture of Kansas, a very comprehensive report upon the Meteorology of Kansas for 1883, by Prof. J. T. Lovewell, of Washburn College, Topeka, who is State Meteorologist at present. It is exceedingly full and satisfactory.

JOHN E. POTTER & Co., of Philadelphia, have just issued "The Elements of Botany," a new text-book, prepared by Prof. W. A. Kellerman, of the Kansas State Agricultural College. It is designed either for school use or for independent study, and is especially adapted to those students who are unable to give several years to this subject. An important feature, new to text-books of this science, is the department called "Economic Botany," in which the principles of Botany are applied to practical uses.

FROM the 13th Annual Report of the Kansas City Stock Yards by the Secretary, Mr. E. E. Richardson, we learn that the receipts of live stock for 1883 were as follows: Cattle, 460,780; Hogs, 1,379,401; Sheep, 119,665; Horses and Mules, 19,860. For the whole thirteen years they were: Cattle, 3,183,071; Hogs, 6,637,007; Sheep, 577,384; Horses and Mules, 108,474.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Atlantic Monthly* for February, 1884, presents the following table of contents: In War-Time, III., IV., S. Weir Mitchell. A Trio for Twelfth-Night, H. Bernard Carpenter. Voices of Power, O. B. Frothingham. A Roman Singer, XV., XVI., F. Marion Crawford. The Vagabonds and Criminals of India, Elizabeth Robins. Newport, XVIII.-XIX., George Parsons Lathrop. A Memory, A. A. Dayton. En Province, VI., Henry James. To-Day, Helen Gray Cone. In Madeira Place, C. H. White. A Visit to South Carolina in 1860, Edward G. Mason. Reminiscences of Christ's Hospital, J. M. Hillyar. Foreshadowings, Julia C. R. Dorr, The Confederate Cruisers. Mr. Trollope's Latest Character. Greater Britain and the United States. Mr. Crawford's To Leeward. The History of Sculpture. The Contributors' Club. Books of the Month.

THE *Adrian* (Mich.) *Times* is the first newspaper ever printed by power generated through the sncessful combustion of petroleum or any of its products. In the burner used the patentees seem to have solved the long sought for desideratum, the perfect and economical combustion of petroleum and its products, for the generation of heat.

PROF. EMIL SEIFERT, who is well known to our citizens as a musician of eminent attainments, has commenced the publication of a weekly quarto periodical entitled, "*The Western Art of America.*" The four numbers which have appeared give assurance of his talent and fitness for the work, and it is to be hoped that the citizens of this place and vicinity will give it a hearty and liberal support. $3.00 per annum.

THE Ft. Scott *Monitor* announces that a deposit of paraffine and crude oil has been discovered near Fontana, Kansas, at a depth of thirty-five feet below the surface.

THE fifty-second number of the *Humboldt Library of Science* comprises M. Th. Ribot's essay on "The Diseases of the Will," in which the various phenomena of impaired will power are carefully discussed and explained, with abundant illustrations from the history of many celebrated cases. Published by J. Fitzgerald & Co., New York; 15c.

THE *North American Review* for February contains an article by Mr. Carl Schurtz entitled "Corporations: Their Employees and the Public," in which he discusses the conflict between telegraph and railroad men and their employers; a sketch of the life and works of "Henry Vaughan, Silurist," a remarkable poet of the 17th century; the long expected article on "John Brown's Place in History," in answer to that recently published by Rev. David Utter; a very able and effective argument in favor of Greek and Latin in the Schools, by Prof. West of Princeton, etc. To builders the discussion of the "Rival Systems of Heating," by Professors Bell and Trowbridge will be found decidedly valuable and instructive.

THE *Magazine of American History* for January, 1884, appeared a week earlier than usual, and is replete with instruction and entertainment. This valuable periodical is without a rival in its special domain, and is rapidly becoming indispensable to all intelligent readers throughout the land.

THE Kansas City *Medical Record* is the title of a new journal just started in this city by Drs. Halley and Fulton. It is a very handsome monthly, filled with able original and selected articles pertaining to all branches of medicine. The reputation of its editors is a guarantee of its success, professionally and financially. $3.00 per annum.

PROF. C. A. YOUNG, of Princeton Observatory, in an article in the *Popular Science News*, upon the red glow at sunrise and sunset, says that it seems that the volcanic (dust) theory is more likely to be the true one than any that has been advanced. A chemist in New York claims to have collected from a bank of snow, remote from any settlement, enough of this dust to prove, by analyzing it, that it is composed of volcanic mineral. Mr. Whymper, the great mountain peak explorer, states in *Science* that he has seen this phenomenon distinctly produced by volcanic ashes and dust, in the air.

WE have received the January number of the second volume of the *Platonist*, edited by Thomas M. Johnson, of Osceola, in this State. It is to be an exponent of philosophic truth, and devoted mainly to the dissemination of Platonic philosophy, and as such should be patronized by all students of philosophy. 16 pages, large quarto, monthly, $2.00 per annum.

THE *Science Observer*, of Boston, states that a cable message was received at Harvard College Observatory, January 15, from Dr. Krueger, of Kiel, announcing the discovery of a comet at Melbourne, Australia, the position of which, on January 12, at Greenwich noon, was: R. A. 22h. 40m., Decl. —40° 8′. The comet is small, with a rapid motion towards the southeast.

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ARCHÆOLOGY.

PRE-HISTORIC YANKEES.[1]

WARREN WATSON, KANSAS CITY, MO.

When the white man first set foot on the American shores, he found evidences that civilization had not been confined to the old world. Not only was he confronted by existing phases of native culture which justly aroused surprise, curiosity and admiration, but he was also shown the hoary monuments of races, who in a remote and forgotten antiquity, had flourished for a period, rose to an elevated pitch of power, culture and prosperity, then disappeared so completely that nothing remained to testify of their existence, or their history, save the dumb relics of their art and industry and the unintelligible voice of tradition. Among these ancient races, none have excited more attention, or more controversy, than the people we have been accustomed to call the Mound-builders.

Upon examining a map of North America, it will be observed that the great central basin, known as the Mississippi Valley, is penetrated from the northwest by innumerable streams, which, gradually mingling their currents, form at length the mighty flood which bends its course beside this prosperous city. Near the sources of the most northern of these confluents of the Missouri are the fountains of three other fluvial systems which pour their various streams into the Arctic, the Pacific and the Atlantic Oceans. Of these the least important to our theme are the streams which flow northward to Great Slave Lake and empty, through

1. Read before the Kansas City Academy of Science, February 29, 1884.

the Mackenzie, into the Arctic Ocean. Between the headwaters of these tributaries of the Mackenzie and the sources of the Missouri, is interposed a network of streams that flow eastward into Lake Winnipeg and the Red River of the North, and, distributed from thence into the great lakes and Hudson's Bay, find their way into the Atlantic. Of these streams the most considerable is the Saskatchewan, the northern branch of which rises a little to the north of Athabasca Pass, at about the 53d parallel, and, uniting with the southern fork, flows into Lake Winnipeg. On the western side of the mountains the rivers which seem pertinent to the subject are the Columbia and Frazer's Rivers; the former of which draws tribute through its northern and southern branches throughout a region extending from the 40th to the 52d parallel—from Athabasca Pass on the the north to Fremont's Peak on the south. Gathering from this immense scope of mountain and plain a mighty flood, this river rolls its united waters westward and enters the Pacific about 120 miles south of Vancouver's Island. Frazer's River rises within Athabasca Pass and, flowing first northeast then southwest, empties in the gulf that separates Vancouver's Island from the mainland. Between the Columbia and Frazer's River, formed by them into a peninsula of wonderful beauty and fertility, guarded on the west by the sea and on the east by the escarpments of the Rocky Mountains, lies a region which was probably one of the earliest homes if not the cradle land of the Mound-builders. The mountain barrier which forms the eastern limit of this mesopotamian country is traversed by several passes, among which are those of Athabasca and Kananaski. Of these, the former is accessible by way of both the rivers named—one even rising within its gorge—and the latter is contiguous to the northern sources of the Columbia. Thus it would naturally result from traversing these rivers to their fountain-heads, that the passes referred to would be discovered; and they certainly would be utilized if the wandering instinct should tempt the discoverers to a passage of the mountains. Between the northern and southern branches of the Columbia, the country is, for the most part, rugged and uninviting; full of difficulties for the traveller, yet presenting, now and then, spots of singular loveliness and fertility. In the region thus described portions of British Columbia, Oregon and Idaho and all of Washington Territory are comprised—a theatre more extensive and more varied in character than ancient Egypt, Chaldæa, Greece or India.

In the northern part of this region, on Vancouver's Island and the neighboring mainland, remains exist in considerable profusion, which have been declared identical with mounds and earthworks found in the Mississippi basin. Indeed, if the newspapers can be trusted, it is in this vicinity that the mound-builders left their most stupenduous work—a mound 300 feet high and 900 feet square at the base. I know that the exploration of this region has not been either thorough or very intelligent, yet no candid student can reject the evidence at hand, which needs only be credited to establish the presence at this point on the Pacific coast of characteristic remains of the Mound-builders. Northward, however, of this locality, passing travellers have noticed analogous remains extending even to the boreal latitudes drained by the Yukon and the littoral parts of western Alaska.

From Vancouver's Island, spreading eastward to the mountains and converging along the rivers toward the most accessible passes, the Mound-builders debouched from the mountains into the great central basin at various points, designated by their relics, from the 50th to the 53d parallel. Of this horde there seems to have been two streams; one pursuing to its mouth the Saskatchewan River, passing southward along Lake Winnipeg to the Red River of the North and ascending that stream into the present Minnesota and Dakota; the other descending the sources of the Missouri and converging its scattered detachments npon that mighty flood. It is quite possible that this stream of migration divided at the foot of the mountains and that a portion followed south the chains and spurs of the Rocky Mountains as the others followed the streams. The monuments of this mountain people, changing with their changed habitat, have been traced through Montana, Colorado, Idaho, Utah, Arizona, the Mexican State of Chihuahua and onward to the great table-land, the tierra templada, of Mexico.

Following the course of the Missouri and leaving remains in every fertile and well-watered region contiguous to its course, the Mound-builders paused at nearly every point where modern commerce has established its depots, and left profuse monuments to testify of their sagacity. From Omaha to St. Louis an almost unbroken line of mounds follows the river and, where the Mound City is now seated and stretches forth the arms of commerce into all parts of the continent, the Mound-builder established one of the centres of his empire.

In the meanwhile, the detachments which had crossed to the Red River pursued their eastward course no farther. In Canada no traces of the Mound-builders exist. Turning their faces southward they passed the boundaries of the present United States, advanced around the great lakes as far as New York and descended the Mississippi until they met, as foemen or as friends, the ancient citizens of St. Louis. From thence they occupied every tributary of the Father of waters. On the Illinois, the Ohio, the Tennessee, the Arkansas, their monuments challenge wonder and admiration; nor did their wanderings cease till they had penetrated east and south as far as the Alleghany Mountains and the Mexican Gulf, crossed the Rio Grande into Mexico and even reached through the inviting savannahs of Georgia and Florida, the shores of the Atlantic Ocean.

It is now proper to describe in a rapid way the antiquities from whose testimony the foregoing itinerary has been deduced. But it should be premised that mounds and earthworks are not peculiar to this continent. All over the world, among the relics of pre-historic times, fortifications, dykes, tumuli and cairns form conspicuous elements. In the British Isles the smaller mounds are common features of the landscape. From the shores of the Atlantic to the Ural Mountains they have been found in great abundance, and in Asia they are scattered over the great steppes from the Russian frontier to the Pacific Ocean as far North as Behring's Strait and from Siberia to India. Even in Africa they are not wanting. Most of these are small in size, but among many similar works may be mentioned Silbury Hill in England, an artificial mound 175 feet high. While the great majority of these old world relics are of unquestionable pre-historic origin, there are many which have been reared within the historic period. Of these the most conspicuous examples are the tumuli of Queen Thyra and King Gorm, in Denmark; the Kouloba tumulus in the Crimea and the cairn raised to the memory of the Prince-consort, Albert, to which each member of the English royal family contributed a stone. If we turn to reminiscences of the past, contained in ancient literature, we find that Semiramis buried her husband King Ninus under a great mound of earth; that over the grave of his friend Patroclus, Achilles heaped a mound upwards of a hundred feet in diameter; that the tomb of Alyattes, King of Lydia, was a tumulus of stone and earth nearly a mile in circuit; that Alexander the Great caused a mound to be heaped over the grave of his friend Hephæstian at a cost of nearly one million dollars; and that according to the earliest historians mound-burial was practiced by the Scythians, Etruscans, Greeks, Germans, and many other nations. Nor are fortifications, or embankments, less abundant. Sometimes these are long ramparts like that which stretches from Bristol Channel to the Dee; sometimes they are isolated fortresses like those in the Scottish highlands and elsewhere. These are almost identical with American works of the same character.

Throughout the broad extent of territory over which the Mound-builders wandered, but chiefly on the river courses that form the Mississippi system, their remains are found in great profusion, and may be placed in the following categories:

I. Mounds. These are various in character and have been classed as temple, altar, burial, observatory and residence mounds. But besides those which can be identified as belonging to either of these classes there are many whose status is not at all obvious. Some of these are conjectured to have served as garden beds; but these, as well as the so-called residence tumuli, are more properly described as terraces than as mounds. The temple mounds are of various forms, rectangular, octagonal, oval, conical, etc., and their truncated tops, usually spacious and at a commanding elevation, suggest the teocallis and huacas of Mexico, Central America and Peru, and have given them their supposed religious character. Like these southern structures they are ascended by graded ways or terraced steps or spiral paths. Mounds of this class are rare in the northern habitat of their builders; but at Cahokia in Illinois, in various parts of Missouri, Ohio, and Indiana, and in almost every southern State west of the Alleghanies, from Virginia to Texas, these relics of antique devotion are abundant and worthy of attention. The great mound at Cahokia covers a space of eight acres, is ninety feet in height and the platform on the summit is nearly two acres in extent. Around this mound an immense number of smaller tumuli are scattered, presenting a scene similar to that viewed by Cortez from the summit of the pyramid of Cholula. While this class of mounds occur but rarely in higher latitudes of the Mound-builder's territory, they grow more numerous and remarkable toward the south; seeming to insist in unmistakable language that progress in religion and industrial art accompanied by a well organized but despotic government was leading the race to a high stage of civilization. The most lofty of these mounds, the pyramid of Kolee Mokee is an antiquity of Georgia; it is ninety-five feet in height and 1128 feet in circuit. It is a parallelogram 350 by 214 feet, and the plane on the summit measures 181 by eighty-two and a half feet. On the Lower Mississippi these tumuli assume a more finished form and structure. Here we meet with the use of adobes, or sun-dried bricks, in their construction, and, in one or two instances, stone is reported to have been used as a material. There is little doubt that on the lofty summits of these mounds, either in a wooden oratory or under the over-arching sky, the priests performed the imposing ceremonials of a highly developed religion while the whole community watched the mysterious rites with unquestioning devotion. Taking a general view of the entire region traversed by the mound-builders, and ignoring the mound reported from Washington Territory, the temple mounds have not been found further north than the great lakes, further east than Virginia or westward of the Arkansas Valley; while they are distributed profusely throughout the Gulf States near navigable streams and especially along the Mississippi River.

The barrows which have received the name of altar or sacrificial mounds are usually symmetrical cones with rounded summits. In the construction of these mounds their builders followed a method which has attracted much curiosity as to its signification. Beneath the apex, either on a level with the surrounding surface or raised a little above it, altars or hearths of baked clay are invariably found, and over this the mound is heaped in concentric layers of material, usually of soil, gravel, clay and sand. This hearth evidently possessed a sacred importance, and to protect it from desecration, the superimposed tumulus was formed in successive strata and of substances of such a nature that the least disturbance of its surface would become apparent at once. It is my opinion that to these altars the sacred fire had imparted a character which excited superstitious veneration. When they had served their purpose, perhaps at the command of the priests, the protecting mound was heaped above them in as many layers as the caprice, or the wealth, of the owner dictated. In some cases, particularly in Iowa and in Clay County, Missouri, these mounds have been found with stone structures in the interior, whose use is entirely problematical. Human remains are not found in mounds of this character except in cases where the modern red Indian has interred his dead in them and left the broken strata to tell the story of the desecration.

The burial mounds, as the name indicates, were places of sepulture; these were probably used as burial places for the rich and the eminent and occasionally reach very imposing dimensions. Mounds of this class are of all sizes and are generally conical in form. Sometimes even the temple mounds were used to bury individuals of more than ordinary influence or sanctity. The mode of burial was extremely variant; sometimes the body was placed in a sitting posture, sometimes prone upon the face, and again on the back or side. Near by were spread the burial offerings, the amulets and the food which primitive and savage man all over the world left at the grave of his dead. This custom is not a mark of savagery however; Sophocles introduced in the tragedy of Electra the ceremony of placing food upon the grave of the murdered Agamemnon, and the Chinese, Egyptians and Assyrians invariably supplied their dead with abundant food and drink for their journey to the spirit land. It is noticeable that while certain customs of the Mound-builders were never departed from in their long journey, the mode of observance was varied in many ways. For instance in British Columbia a piece of quartz is frequently found among the funereal relics; in some instances this is replaced by a piece of coal, and this again, during their later pilgrimage, by a piece of mica quarried in the Alleghany Mountains. It was also usual to deposit with the dead manufactured articles; and it is likely that this custom arose from the world-wide superstition against the use of property which belonged to a dead person—the natural result of which would be to place them in his grave that he might use them in the spirit world. While the burial mounds contain by far the most of the surviving relics of their builders, yet all the tumuli, except those designated as altar or sacrificial, have yielded along with archæological treasures, the mouldering bones of this ancient race. It may as well be stated here that mound burial was more common in northern latitudes than under the southern cross. In the course of the centuries that must have passed between the time of their exodus from British Columbia, and the time the lower Mississippi was reached, there was sufficient space for the rise of new forms of burial. Among these may be noted cave-burial, urn-burial, burial in stone graves and in sepulchres formed partly by nature, partly by artificial means, in the face of cliffs and exposed rocky strata. Sometimes there are found trenches and pits filled with human bones; these are perhaps the depositories where the common herd of what must have been a dense population received scant honors of sepulture. Occasionally masses of bones are found under terraces of earth, or stone, which probably are of similar origin. On Vancouver's Island the dead were usually buried in a basin-shaped hole and covered with a slab before the mound was heaped above them; and mounds in Wisconsin have been found where the body was deposited in similar excavations. It is probable that an examination of the vast unexplored regions extending from the Red River to the mountains will show this mode of burial to have been commonly practiced.

The observatory mounds were simply signal stations; and systems of them have been traced, so sagaciously arranged that communications between communities, hundreds of miles apart, could be passed along as rapidly as a modern telegram.

The mounds which are supposed to have been used to erect dwellings upon, differ somewhat in form from the others. Usually they are small platforms of earth elevated from two to fifty feet above the surface and of varying dimensions; one of these constitutes a terrace of the great Cahokia mound and communicates with it by a graded way. Among other indeterminate forms are the animal mounds of Wisconsin, Ohio, Missouri and the Arkansas Valley. Some of these are noteworthy for their size, some for the shapes which they assume. Among these the most remarkable are the serpent and turtle mounds of Ohio, and the elephant mound of Wisconsin. The serpent mound is more properly an embankment, over seven hundred feet long, extending in sinuous curves along the summit of a ridge; ending at one extremity in a triple coil, and at the other in the head and open jaws of a snake. Within the jaws is an oval mound of no insignificant proportions itself; and it has been thought by some archæologists that the oriental symbol of a serpent swallowing an egg was intended by its builders. Its head, however, with the accompanying mound, is suggestive of the Egyptian tau, or cross, with its oval loop, as the neck of the snake is intersected just behind the head by a bar, which is certainly no natural complement of the animal. The mound referred to as representing the form of an elephant leaves a strong suggestion in the mind, that this mysterious people either knew familiarly the now extinct mastodon or else brought from some other land a memory of the elephant; especially as its testimony is supplemented by a pipe in the same shape from an Iowa mound. These so-called animal mounds are in fact immense bas-reliefs of men, beasts, birds and reptiles. Cruciform mounds are also found, some pointing with great exactness to the cardinal points.

II. Embankments or ramparts. These may be distinguished as either defensive or religious, though many possess no obvious significance. Those of a military character manifest a respectable progress in the art of war. In some instances the intrenchments surround extensive areas and, occasionally, they are carried—like the Chinese wall and Offa's Dyke in Great Britain—over long stretches of country and connect the monuments of widely separated communities. Usually, however, these works seem to have formed citadels of refuge, easy of access and secure from assault when the wild people of the woods took the war-path. Sometimes a precipitous hill was chosen as the nucleus of the fortress; sometimes an ocean headland, or a peninsula whose steep and rocky sides projected into a stream, was selected as a position to be easily fortified and defended; sometimes contiguous streams were connected by canals and the strong position thus created further strengthened by embankments and stone walls. The approaches to many of these fortifications are protected by defenses that show no mean ability in the practice of the military art. In one case the approach to an aboriginal fort is along a covered road with embankments on each side thirty feet in height. Very frequently these defensive works are connected with remains of some or all of the other classes described; and they are the most widely distributed and the most homogeneous in character of all these remains. Indeed, plans drawn from earthworks in the Mississippi basin bear so strong a resemblance to those in British Columbia and even to those left by the Pueblo or Cliff Indians of the Rocky Mountains that they have served to delineate the features of these works with very slight alterations.

The enclosures presumed to be of a religious nature, are well calculated to arouse curiosity. They are usually combinations of geometrical figures, in which perfect squares and circles predominate. It is obvious from this fact that the

Mound-builders had advanced at least as far as the ancient Egyptians in mathematical skill; any modern surveyor can appreciate what difficulty there would be in drawing a perfect circle which should enclose an area of ten or twenty acres. In some instances circles and squares enter into various combinations and these are repeated in separate localities with such exactness that there remains no doubt of their possessing a well-defined meaning if we could but discover it. Some of the most remarkable of these earthworks are in the vicinity of Cincinnati.

III. Mines and excavations. Numerous traces have been left by the Mound-builders in the mining regions of Lake Superior. As an instance of their temerity in mining operations, it may be mentioned that, at one place, a piece of pure copper, weighing over five tons, was found fifteen feet below the surface beneath trees at least four hundred years old. After having been elevated a distance of several feet from its original bed, by means of skids, the attempt to raise it seems to have been abandoned. The mass of mineral bore marks of fire, and stone tools were scattered about. So sagacious were these ancient miners in locating their mines that modern prospectors feel certain of a rich find whenever the traces of their work are discovered. In working these mines, sledge-hammers of stone were used weighing from thirty to forty pounds and wielded by means of a handle of twisted withes. Wooden shovels were also used; specimens having been preserved by the antiseptic action of copper-salts. While the Mound-builders seem to have been unacquainted with the value of the immense deposits of iron-ore within their reach, they were perhaps the only people who made use of iron, in any form, at the stage of progress reached by them. Iron pyrites was mined by them and worked up into mirrors and other ornaments. They also quarried extensively to procure various kinds of rock as materials from which to fashion their pipes, weapons and utensils. At Golden Grove, in Barton County, Missouri, there are remains of ancient excavations, which have always been a riddle to the inhabitants. It is thought by some that they are remains of De Soto's gold-hunting expeditions; and in that belief no insignificant sum has been sunk in attempting to find treasure. All of the shafts opened were stopped by a strata of hard porphyritic rock, which, in my opinion, was the real object sought by those who made the excavations—the Mound-builders. This view is strengthened by the fact that porphyry has been found in mounds removed hundreds of miles from localities where this rock is found. The mound-builders also mined galena, though not to any considerable extent. It is but seldom found in the mounds. In North Carolina are ancient quarries from whence they drew the mica which formed so important an element in their funeral offerings throughout the Mississippi Valley.

IV. Arts and manufactures. It is hardly necessary to enter into a minute description of the specimens of arms, utensils and ornaments exhumed from the mounds. They have been familiar to all residents of the Mississippi Valley since childhood. At any rate, I shall pass over all such common and well-known relics as arrow-heads, stone knives, hatchets and hammers, and in fact, all objects which are not peculiar, alone, to the Mound builders. For it must be known that the ingenuity of man, in arriving at the earliest inventions, pursued the same course, and reached the same goal amongst every race on the face of the earth. Just as art, up to a certain stage, passes through identical forms and is expressed through similar artifices wherever the artistic impulse is generated, so invention, in its primitive stages, was forced to proceed in the same way to reach the same conclusion—the manufacture of the most necessary implements and utensils from the commonest or most easily managed materials.

The relics of mound-builder art and industry include articles of metal, stone, earthen-ware, horn, bone and shell. Besides articles which are known to have been useful, or ornamental, there are many objects whose use is not at all obvious. It was thought for a long time that the Mound-builders were ignorant of the arts of casting, welding and alloying metal; but a careful and intelligent scrutiny of their metallic relics has shown that they were at least acquainted with a method of casting. While large numbers of implements and weapons have been found fashioned from copper, the most common use to which this metal and others was put, was in the manufacture of ornaments, such as rings, gorgets, medals, bracelets, beads and many other problematical articles—some of which it is conjectured were used as money. As gentlemen nowadays wear on their watch-guards, or fobs, miniature utensils, weapons, etc., so the Mound-builder bore on his person small models of objects of utility, or defense, either as ornaments, or as badges of his avocation. Several mounds have been opened which produced amulets so cunningly wrapped in silver that the work could scarcely be distinguished from plating. In southern localities, the mounds have produced gold beads and other curious articles in the same metal, which by some are thought to be coins.

The pottery of the Mound-builders was a production of superior mechanical and artistic type. Specimens can be collected which may not be distinguished from the work of primitive Egyptian, Mesopotamian or even Greek artists. The material is usually a pure clay, containing in some instances a slight admixture of pulverized quartz, or colored flakes of mica, though a black earth was occasionally used, evidently of artificial composition. Notwithstanding the great regularity of form and the beauty of finish of their pottery, there are no traces of the use of the potter's-wheel; and glazing, or vitrification, was rarely attempted. The decorations on pottery include animal forms, arabesques, geometrical figures, and in a few cases, the human form and features. These decorations were usually incised with sharp instruments. Besides weapons and knives, pipes are the most abundant of the articles exhumed from the mounds; and it is upon these objects that the Mound-builder expended his highest art. Instead of the rude monstrosities which delight the savage artist, the delineations upon these pipes represent, with accuracy and taste, objects in the various kingdoms of nature. Among forms truthfully drawn may be mentioned the elephant pipe of Iowa, and others which represent animals and birds unknown to the temperate zone. The material of these pipes is usually a hard red porphyry.

Specimens of mound-builder cloth have been found in several instances, strangely preserved from the most remote antiquity, through the effect of antiseptic substances, or, from being charred by fire. This cloth was woven of both animal and vegetable fibre; was coarse in texture, but composed of threads uniform in size, and regularly spun. While the process of weaving seems to have been usually of the simplest description, there are instances of the manufacture of a kind of cloth so knotted at the intersection of warp and woof as to prevent either from being drawn.

Besides the relics enumerated, a few statuettes and figures of animals have been found, which may have served as idols; though there is nothing to show but what they were simply outgrowths of an esthetic feeling common to humanity. A few sculptured and incised tablets have been exhumed, which represent scenes of mound-builder life, and give us a dim perception of their characteristic habits. One of these, known as the Davenport tablet, depicts a circle of persons dancing, or standing, around a mound upon which a fire is burning; while on the ground near by several human forms recline to await either sacrifice or burial. This sketch is rudely scratched upon a piece of slate on the other side of which are a number of characters, which, by some, are thought to form a calendar. Above the scene described, the arch of the sky is represented with sun, moon and stars, and above this again, are numerous characters which bear evdence of being an inscription,—indeed there is no doubt but that they convey a meaning in connectioo with the scene depicted below, which would unravel some antiquarian mysteries if we could but decipher them. Another object of the same sort is figured by Mr. Conant, in the "Commonwealth of Missouri." This is an incised shell which was found in a mound near New Madrid, and depicts the war-like adventures of some prehistoric hero. It is a valuable relic for the information it conveys as to mound-builder costume and arms, as well as some notion of the stage of advancment reached by this race in representing not alone the human figure in a state of rest, but also, when moved by passion or emotion. There is a most remarkable resemblance between this relic and similar specimens of native art discovered in Mexico, Central America and Peru.

Having thus rapidly surveyed the archæological aspect of the subject, it remains to present what we have learned of this people by an examination of their monuments. One fact is impressed upon us at once; and that is that they were a numerous and strongly governed people.

If their communities had not been extremely populous, it would have been impossible to furnish the labor for constructing the immense works which have excited so mnch attention from antiquarians; and unless they were controlled by despotic power it would have been impossible to utilize the labor for this purpose. That they were one race from Vancouver's Island to Texas and Florida is proved by their relics, and by the mouldering remains of the people themselves. They possessed physiological characteristics which not only distinguish them from the modern red man, but also from nearly every modern people. One of the most striking of these characteristics is the low retreating forehead, and the

the flattened tibia. Their institutions, while they may have received many modifications and developments, during the transit from north to south, were practically homogeneous in all parts of their habitat. They were agriculturists, miners, artisans. They cultivated maize and tobacco; and it is a curious fact that both of these plants are by some savants thought to have originated in Asia. There is no doubt but that the cultivation of the former passed at a very ancient period from the southern Asiatic islands, into China, where it has since been found, in remote districts, in a wild state. Tobacco has also been found growing wild in China. The mound-builders cultivated other products of the soil; among them a fibrous plant allied to hemp or flax, from which their cloth was woven. They manifested a considerable advance in the art of war, especially in the defense of fortified places. Their skill in the manufacture of pottery and in stone- and bone-carving was not at all contemptible, and the mathematical knowledge displayed in the construction of earth works, geometrically perfect in form, shows that they had advanced far above the condition reached by any Indian race known to the white man within the boundaries of the United States. Of the extent of their commerce it may be said that side by side, in the same mound have been found objects in copper and silver from Michigan, mica from the Alleghanies, obsidian from Mexico, and shells from the Gulf of Mexico.

Of their architecture we can have no exact knowledge. There is little doubt, however, that the temple-mounds were surmounted by sacred edifices, constructed of perishable materials, which, in order to conform to the magnitude of their sites, must have made some pretensions to architectural beauty and grandeur. The richly ornamented edifices of southern Mexico and Central America, especially those at Uxmal, are considered by competent authorities to have originated from wooden models. It is obvious that even a wooden structure, decorated and finished with the care and skill bestowed upon Central American temples and palaces would present no mean appearance. A powerful priesthood and a wide-spread religious system are implied by the monuments. We are ignorant of their religious rites, though it is indubitable that the cult was a worship of the Sun, and that human sacrifices was an accompaniment of their ceremonies. It is quite probable that their government was a theocracy or a partial theocracy—the priesthood being the governing caste. The construction of the stupendous works described could best be explained by a supposition that a large portion of the people lived in a servile condition. The mining exploits of the Mound-builders have been sufficiently referred to and the mounds are eloquent with mechanical skill and industry.

When the passage of the Mound-builders was stopped by the southern seaboard, what then? Were they slaughtered by pursuing enemies, or driven into the waves, or exterminated by pestilence, or overwhelmed by some tremendous cataclysm? They were a race of navigators. Their journeys were almost invariably pursued along the courses of navigable streams; and it is only natural to suppose that these journeys were really voyages by water. Why then should the waves of the Gulf affright them? With canoes no larger than many used by the modern red men it is possible to coast the shores of the Mexican Gulf and the Carribean Sea. Such a canoe was seen by Columbus off the coast of Yucatan, bound on a trading voyage, and having on board a cargo of aboriginal merchandise. Whether or not the Mound-builders now became navigators and sent colonies around from the mouth of the Mississippi to the sea-board of South America, and peopled regions where the spaniards found so much to admire and destroy, it is certain that Mexico could have been, and was, entered through Texas. For here and there amongst palaces and temples once the abode of Aztec culture and devotion, now ruined and desolate, a constant feature intrudes itself; here are the unmistakable shrines of the Mound-builders' religion and the characteristic graves of their dead.

The most remarkable monument of pre-Aztec culture in Mexico, the great pyramid of Cholula, reminds us of the temple-mounds of the north. In fact one of the most prominent features of American ruins, is the ever present pyramid. In Mexico and Central America they are common objects of the landscape, and the bewildering ruins of Gran Chimu in northern Peru, are remarkable for the number of pyramidal structures scattered about. It may not be out of place to introduce here a few remarks as to the significance of these structures and their place in the discussion of anthropological questions. It is a trite saying that art is, up to a certain point of development almost identical in expression the world over. Upon this fact, which is not at all wonderful, the most extraordinary theories have been based as to the origin and development of American civilization. Thus it is said that the presence of pyramids in America attests an old-world origin for their builders; because there are pyramids in Egypt. But this architectural feature of primitive culture has been of universal use as an expression of devotion or as a memorial of some person or event. Pyramids have been found in Chaldea, India, China, Mexico, Central America, South America as well as Egypt. Genghis Khan is said to have reared a pyramid of human skulls to commemorate his victories; the pile heaped above Porsenna, "o'ertopped old Pelion" and "made Ossa like a wart"; Jacob and Laban heaped stones together to keep their treaty in remembrance. All over the world cairns, or heaps of stones, and artificial mounds of earth, show, in its most primitive condition, a structural form which might easily develope into such marvelous monuments of power and industry as the pyramids of Cheops and Cholula—the most stupendous creations of human skill and industry extant. Indeed we have found the simple tumuli, like that of Cahokia, gradually assuming the pyramidal structure, in the southward progress of the Mound-builders, until it culminated at length in the edifices of Mississippi, Arkansas and Texas, in which adobe blocks, or even stone, were used as materials.

As the pyramid of Cholula is so nearly related to the northern temple-mounds, and is so evidently a development from them, I will close this paper by briefly describing it. It derives its name from the pueblo near which it is situated; the ancient Aztec and pre-Aztec city so celebrated for its culture and devotion. The pyramid is now covered with trees and shrubs and its terraces are in ruins, but when the bloody wave of Spanish conquest swept up its spacious stairway, it was in perfect repair and bore on its summit a magnificent temple. The worthy descendants of the Goths and Vandals who followed the adventurous Cortez did not hesitate to apply the lever and torch to this shrine of native piety with destructive effect; yet the eminent Humboldt was enabled in 1803 to still discover the original form and dimensions of the great pyramid. Rising from a base about 1440 feet square, carefully oriented, the structure was carried in four equal terraces to a height of nearly two hundred feet, and a platform nearly two hundred feet square occupied its summit. The ground covered by its base was nearly forty-eight acres in extent, while the pyramid of Cheops covers but little over thirteen acres; the latter, however, is more than twice the height of its American rival. Unlike the pyramids of Egypt, but like the one at Ninevah called the temple of Belus, the Cholulan edifice was constructed of adobes or sun-dried bricks. These are about fifteen inches long and are laid in regular courses with layers of clay between and the pyramid was faced with a cement composed of sand and lime which is now, wherever perceptible, as hard as stone.

Like the temple mounds of the north, this structure was used for sepulchral as well as devotional purposes; the persons interred therein having been, in all probability, priests or grandees.

The chroniclers of the Spanish conquest are full of ejaculatory expressions of admiration at the beauty and grandeur of the temple which surmounted the mound of Cholula. Strangely enough, however, they failed to describe a single feature of the edifice, and we can only take our enthusiasm over it at second-hand. On the spot where this temple once stood, and where the holy fire sent up its wreaths of smoke by day, and gleamed undying through the night, a chapel has been erected in honor of the Virgin Mary. And its bell now summons to worship at the shrine of the Fair God and his immaculate mother, the descendants of those who of old invoked with prayers and chants, and propitiated with sacrifices of sweet flowers, the wise, the beneficient, the adorable Saviour of men, Quetzalcohuatl.

NOTES FROM THE CRADLE OF OUR CIVILIZATION.

PROF. O. T. MASON, WASHINGTON, D. C.

How different has the study of history become since we were children. Nothing was more irksome to us than the memorizing of names and dates, and the records of events that seemed to have no connection. The bookmakers, even then, had the good sense to gratify our love of the marvelous by saving the myths and dreadful stories which had come to them. Of course, it was the Germans who began first to study history critically, and to take away our dear old myths until the narrative was reduced to bare bones, sure enough. We were worse off than before,—this was the age of demolition. A new era has dawned upon us, all things are caused, "nothing walks with aimless feet." The dear old myths have come back, and with them troops of things, not as sober fact, however, but as the ruins of fact. What stone implements and old ruins are to the archæologist, so are old wives' fables and folk customs to history. How delightful, in this age of love for

> "Old wine to drink, old books to read,
> Old wood to burn, old friends to heed,"

to find that in the earnest desire for old things the search for the origin and relationship of old ideas and customs is not neglected.

In no part of the world are there so many interesting relics of antique thoughts and customs as in Hindostan, and the British have not been backward in noticing the fact. From the days of Sir William Jones to the present moment, there has been an unabated interest in the light which the every day speech and fashion of India could throw upon much that is obscure in our own civilization. There are now published in Madras, Bombay, and Calcutta journals of great value, and another has just been started in Allabahad, in the Panjab, which will be devoted to the systematic collection of authentic notes and scraps of information regarding the country and people.

Now, the proper spirit in which to approach such a study is not that which most people indulge in matters of this kind. No doubt, a Thibetan working his *mani*, or praying machine all day long, keeping it going with one hand while he does his work with the other, is an object of derision to all thoughtless people. To the student who knows that the web of human history is continuous, such things become of absorbing interest.

The Rámáyana is the ancient Sanscrit epic in which are recorded the lives of Rama and his wife Sita. Bal Mik Rishi, better known as Válmíki, who wrote the Rámáyana, was a great hunter before he turned his thoughts to religious matters. Holy men preached to him and then he felt himself to be a great sinner. The holy men studied hard to invent a penance in proportion to his former sins. Said they: The most appropriate penance would be to make him repeat the words *Ram*, *Ram*, but that would never do, so holy a name as that would not come out of the mouth of such a sinful man. We have it: he shall say *Mra*, *Mra*, which really comes to be *Ram*, *Ram*, if you say it fast enough. So the holy men told Válmíki to keep on saying *Mra*, *Mra*, until his sins were all gone. They went on their way, and did not think of Válmíki for several years. After this long period the holy men passed that way again, and being tired with the journey they sat down on a huge ant-hill to rest. When they were very quiet, they noticed a strange buzzing inside the ant-hill. They all laid their ears to the ground at once, and heard faintly issuing from the centre of the hill, *Mra*, *Mra*; *Mra*, *Mra*. The holy men simultaneously straightened themselves up, and coming to their senses, exclaimed in a breath "it is the sinful hunter to whom, years ago, we gave these words as a penance." They lost no time in digging Válmíki out of the ant-hill, and taking him into their company, saw him become a very holy man. There may be no truth in this story, but it is a matter of extreme pleasure to know that all round the world great spiritual blessings are believed to be the outcome of an indefatigable spirit.

The folk-lore and questions of the Panjab cast much light on our own manners. When a Hindú Panjábí brings home his bride, his sister must stand in the doorway and endeavor to prevent the entrance of the couple, until they pay her something. The sister does not own the house, has no claim to it, indeed. According to Hindú custom she has probably been for years betrothed to some one else. It is doubtless a survival of those good old days when a man could not carry off a wife without paying a good round sum.

In the Delhi district they have a punishment for a man who is lewd, that consists in putting him on a donkey and riding him round the village. Now the ancient punishment for the same offence was to blacken the culprit's face, put a string of old shoes around his neck, set him on the donkey with his face toward the tail, and thus to ride him round the village.

In the Munee hills there is a *larva* of a beetle which comes out after a rain and emits light, in fact, is a glow-worm. The natives say that, in a former life, a fakir refused to give fire to Behmáta, the goddess who is present at the birth of children, when she demanded it of him. For this act of disobedience he is condemned to carry a light about with him forever.

Some of the lucky and unlucky signs are very interesting: Friday is an unlucky day in the Panjab. If a hunter kills the first game he sees on Friday, he will have good sport. If you are unlucky at any time change your shoes on your feet right and left. A house with the front narrower than the back is lucky, one with the front wider is unlucky. While a house is building, a lamp should be kept alight at night to drive away evil spirits, and an iron-vessel (*nazar watú*) hung up to avert evil eye. The number of steps in a staircase should be uneven, and you should always begin to go upstairs with the left foot on the bottom step.

As a protection against evil eye it is necessary to use something of iron, or, at least, something black. This may account for the following conversation reported by Ibbetson:

Sáhib.—"Why don't you keep that pretty child's face clean?"

Father.—Oh, Sáhib! a little black keeps off the evil eye."

The unusual derivation of the word *Ogre* from Orcus or Horkos, or Hades, is not quite satisfactory to some lexicographers, so Mr. Ibbetson offers another. In Rohtak a fakir was seen to eat of the body of a recently buried child which he had dug up. He said he learned to do this in the Jínd State, where it is a custom. Now these cannibal fakirs are called by the people *Oghars*, from Aghon, which means without fear, and is a title of Siva. These Oghars are the most depraved of mortals, for, instead of washing their bodies, they smear them with the worst of filth. They also drink out of human skulls, and outrage all laws of good behavior. The question arises whether this sect are at all chargeable with our word *ogre*.

On the northern border of the Panjab is Thibet, and the people of this vast region are of great interest not only in their racial characteristics, but also in their religion. Mr. Hutton gives the following account of the election of a Grand Lama: "When a Grand Lama dies an inventory is made of all his effects, which are carefully sealed up until his reappearnce in life to claim them. Suppose a Grand Lama were to die in Chinese Tartary and to appear at Nako in Hangrang in the form of some Lama's child. This child would be known to be the new Grand Lama from his laying claim to the sealed-up effects of the deceased Grand Lama. He is then called on to state what these effects consist of, and where they are. He accordingly describes them one after another. If doubt still remain, the effect of the deceased are brought and mixed with other things, and the young aspirant is directed to show which are his. If further proof be still necessary the child is desired to give some token of the Grand Lama, which he does by commanding them to carry him to some spot which he points out, and then he places his hand or foot on a large stone, when, if the spirit of the Lama really be in him, the impression remains indented in the rock."

The same author describes the *mani*, or praying machines. The word *mani* is applied to a small barrel-shaped instrument, about two or three inches long, which is made to revolve round an axis, one end of which is held in the hand. The oftener this is made to revolve in a day, the greater the chance of the operator going to heaven. It is laid aside when the possessor is employed in laborious work or in any occupation requiring the assistance of both hands, but the instant that task is accomplished the whirling of the *mani* is resumed. In it are enclosed a few scraps of paper inscribed by the Lamas with some sacred sentences.

ANIMAL MOUNDS FOUND IN WISCONSIN.

PROF. WRIGHT, OBERLIN.

The ancient earthworks of Wisconsin are not remarkable for their size, but for the number among them representing animal forms. It will be remembered that in Ohio three of the mounds enumerated were of this character, viz: the Alligator in Granville, the Eagle in Newark, and the Serpent in Adams County. Those three are exceptional in that region, but in Wisconsin mounds in the shape of animal figures are the rule, and over the southern part of the State are very numerous. They are specially abundant in the vicinity of Milwaukee, near Lake Horicon, around Lake Winnebago, at Madison, and to the southeast, in the upper valley of the Fox River, and the lower portion of the Valley of the Wisconsin, and for some distance along the Mississippi River, above Prairie du Chien. Small mounds occur all over this region, but most of them are simply piles of dirt beneath which the dead were buried.

In that portion of Milwaukee known as Sherman's Addition there was formerly a rude representation of a wolf or a fox guarding a large though low mound immediately before it. The elevation was slight, but the outlines were clearly traceable. The body of the animal was forty-four feet long, and the tail sixty-three feet. Near by was the more graceful figure of an otter, whose head and neck were twenty-six feet long, body fifty feet, and tail seventy feet.

In the same vicinity was another, shaped like a bird, whose body was thirty-four feet long, and half-folded wings, sixty feet. But it will not do to dwell too long upon this region, where so many of the works have been destroyed by the growth of the city. In a distance of twenty miles up and down the Milwaukee River these strange forms occur by the score, if not by the hundred.

Passing to the valley of the Pishtaka, there are, if not destroyed, two turtle mounds and several of conical form on the northeast shore of Lake Geneva. At Big Bend, about twenty miles south of Waukesha, a large space is covered with mounds resembling lizards, alligators, and flying dragons. Their heads point up hill and toward the southwest. The largest of the three dragons leading the host measures 200 feet from tip to tip of his wings. Simple oblong figures follow for nearly half a mile. The largest of the train, shaped somewhat like a lizard, is 286 feet in length.

Waukesha is another interesting center of animal mounds. Here stood what was called the turtle mound, the body of which was fifty-six feet in length, and the tail 250 feet, and the height six feet. This, however, was obliterated many years ago by the advance of civilization. But other forms no less remarkable on the grounds of Carroll College and on Bird Hill still remain.

A mile and a half southeast of Pewaukee, in this same lake region, occurs a remarkable collection of seven lizards, two turtles and four oblong mounds. One of the turtle mounds whose head has been injured by the road, is 450 feet long. Three of them have curled tails, and the tail of one of them is turned clear back. It will be observed that here, as in Ohio, the mound-builders chose for the scene of their operations the places that are still most frequented by civilized man. This whole region is now one vast summer resort.

Passing westward to the valley of Rock River, the mounds on the shores of Lake Koshkonong are worthy of note. At one place a series of mounds extends along the high lands for two miles. The most prominent figures are turtles with short tails. One of the turtles is fifty feet wide at the point of greatest expansion and seventy feet long and from five to six feet high.

At Aztalan, twenty miles above Lake Koshkonong, occurs the only ancient inclosure found in the State, and one which resembles in many respects several of the inclosures described in Ohio. This at Aztalan is rectangular, and contains about eighteen acres. The embankment is about five feet high, with twenty-five feet base. The total length is 2,750 feet, making about 10,000 cubic yards. Within are several truncated mounds of moderate size. The earth within the inclosure is found to have been burned, making it somewhat resemble brick; but there is no evidence of brick having been shaped by molding. The bricks of Aztalan are simply shapeless clods of clay hardened by fire built on the surface. Dr. Schliemann describes such in ancient Troy.

We advise the citizens of Wisconsin to visit Aztalan before going to Europe. lest they share in the chagrin which one of the most learned antiquarians of our country (Prof. James Davie Butler, LL.D.) so frankly confesses to have overtaken him not long ago. European savans make long journeys to see these ancient works, though in themselves the ruins are much less important than any one of several in Ohio. Dr. Butler writes:

It has often been a matter of shame to me that, while living a quarter of a century in Wisconsin, my feet had never stood within the gates of Aztalan. My having passed it by on the other side was a special mortification to me when questioned about it—as if it were the only object of interest in our State—by savans in France, Germany and Italy.

Passing up to Madison, we find a number of animal mounds overlooking the beautiful lakes in the midst of which the capital is built; and for many miles westward, along the great Indian trail, or war-path, from Lake Michigan to the Mississippi, mounds are specially abundant. About eighteen miles west of Madison on this trail, "six quadrupeds, six mounds in the form of a parallelogram, one circular tumulus, one effigy of the human figure, and a small circle, extend in line for about a half a mile." The animals somewhat resemble bears, and are from ninety to 120 feet long. The human figure is 125 feet long, and 140 feet from the extremity of one arm to the other, the body thirty feet wide, the head twenty-five feet in diameter. The elevation of this mound is about six feet. These forms are situated upon an open prairie, on the dividing ridge between the Rock and Wisconsin Rivers.

Passing west and north, into the valley of the Wisconsin River, we find ourselves in what has been called the great central seat of the population which erected animal-shaped earthworks. From the Lemonwier River above the Dells, to Prairie du Chien, these singular works of art are found by the hundred. The fantastic forms of birds, lizards, buffaloes and human beings dot the sandy plains about Baraboo, adorn the single grassy slope which interrupts the wild and rugged shore of Devil's Lake and line the fertile interval which marks the course of the Wisconsin River to its junction with the Mississippi. "The valley of the Wisconsin River above Prairie du Sac for three or four miles is completely filled with these [emblematic] mounds." Here in one place are a number of bird-shaped mounds, with bodies eighty feet long, and outspreading wings 120 feet from tip to tip. In another place, near Honey Creek, is a pair of buffalo mounds, one of which represents the animal as 100 feet long and forty feet high. In another place is the representation of a bear, ninety feet long and twenty feet broad. In another place still is a gigantic bird with a forked tail and stretched wings 150 feet from tip to tip.

Time and space are too limited to go into further particulars. On ascending the Mississippi, a few miles above the mouth of the Wisconsin, and going eastward to the dividing ridge between the Mississippi and the Kickapoo, the road is for some distance lined with mounds, made to represent birds and buffaloes. Few animal-mounds are found south of the State line, but eight miles below the mouth of the Wisconsin River, on the sandy bottom-lands of the Mississippi, where they are sufficiently high to secure from all floods, there is a figure known as the Big Elephant Mound, which, according to the measurements given, is 135 feet long, sixty feet broad (from the bottom of his feet to his back), with a trunk, or proboscis thirty-one feet long. The head is large and the proportions of the whole are symmetrical. Rev. S. D. Peet calls attention to the resemblance between the various buffalo mounds and this elephant mound, and intimates that we need to be cautious about indulging in confident speculations based upon the reality of this being designed to represent the figure of an elephant. Still, Moses Strong, of the State Geological Survey, says it resembles an elephant much more closely than any other animal, and the resemblance is much more perfect in this than in other effigies.

It should be remarked, with reference to these animal mounds in general, that some one feature of the figure is usually greatly distorted. In the figures of the human body, for instance, the arms are nearly always of inordinate length. A squirrel, on the Wisconsin River, has a body forty-six feet long and a tail nearly 100. The wings of the birds are likewise usually of an enormous length, as well as the tails of the lizards. I should rather maintain, even in the face of the general opinion of the neighborhood, that the so-called Elephant Mound was a buffalo with his nose unnaturally prolonged, than to be compelled to maintain that the mound-builders of Wisconsin were familiar with the form of the elephant. —*Chicago Advance.*

NEWLY DISCOVERED RUINS OF CLIFF CITIES IN ARIZONA.

Mr. James Stevenson, of the Geological Survey, has reported to Maj. Powell as one of the results of his last season's field operations the discovery of several more ruined cave and cliff cities, differing in some respects from any he had before examined. The most remarkable was a village of sixty-five underground dwellings, situated near the summit of one of the volcanic foot hills of the San Francisco Mountains in the San Juan region of Arizona. The surface stratum of the hill had by exposure become hardened and formed the common roof for the entire community. The dwellings were excavated after a common pattern, and a description of one gives one an idea of the whole. They had no intercommunication beneath the surface, and were only accessible by means of square holes leading from the surface by a vertical shaft to the floor of the main room of the dwelling. Foot rests—holes at convenient distances—along the sides of the shaft served the purposes of a stairway.

Descending the shaft, the explorers found themselves at the side of an oval-shaped, arched roof, room, about twenty feet in its smallest diameter. At the ends and in the opposite entrance low doorways connected the main room with smaller rooms, the whole suite or dwelling consisting of four apartments. One of the smaller rooms had its floor excavated to a depth of two or three feet below those of the other rooms, and is supposed to have served the purpose of a store room or cellar for the ancient occupants. The other small rooms may have been bed-rooms. A groove eighteen inches deep by fifteen in width extending from the floor of the main room up one side of the shaft to the surface of the hill. its bottom filled with ashes, and its sides blackened by smoke, formed the fire-place and chimney of the establishment. Around the mouth of the shaft a stone wall was found, forming by its enclosure a kind of door-yard to the dwelling below. The wall, doubtless, served the double purpose of guarding against snow-slides, which might otherwise fill up the rooms and bury the occupants, and against the accidental fall of an inhabitant into his own or his neighbor's dwelling, upsetting the dinner-pot and possibly breaking his neck in the operation. Considerable debris was found in these ancient dwellings, an examination of which led to the discovery of many *curios*, illustrating some of the social and domestic customs of the extinct race. Stone mauls and axes, the implements used in excavating the dwellings; pottery bearing a great variety of ornamentation, bone awls and needles of delicate workmanship, the metate or family grinding stone for grain, its well worn surface indicating long use; shell and obsidian ornaments, and implements of wood—the uses of which were undiscoverable—were among the trophies of the exploration. Search was made for a water course or spring, but no appearance of the existence of water in the neighborhood during recent centuries was discovered. There were signs of intercommunication between this village and a cliff city some fifteen miles distant; also a new discovery which indicated the contemporaneous inhabitancy of the two. This city, or, rather, cluster of villages, occupied the sides of a cañon which has recently been christened Walnut Cañon. It is an immense fissure in the earth, with nothing above the general level of the country to indicate its existence to the traveler until he stands upon the sides of its almost precipitous brink. The sides have been gullied by storms and torrents, leaving shallow, cave-like places of great length at different heights, along the bottoms of which, whenever the ledge furnishes a sufficient area, dwellings in groups or singly were built. The season was well advanced when the place was reached, and only little time was spent in its exploration. All the ancient methods of approach had been long before worn away, and access to the nearest of the groups of houses was a work of difficulty.

The group or village which was most narrowly examined, was about three-quarters of a mile in length, and consisted of a single row of houses, the common rear wall being the lining rock, while the sides and fronts were made of large squared stones laid in clay. A narrow street or pathway extended along the entire front. Other and similar villages could be seen along the cañon for a distance of five miles.

Among the relics found here was a wooden spindle whirl similar to those in use by the Pueblos of the present time, but unlike them in the apparent manner of its manufacture. Nothing indicating the use of metallic tools of any description was discovered. The surface of the wood of which the whirl was formed had apparently been charred and then ground down to the required size and shape by rubbing it upon sandstone. A shaft of reed, similar to bamboo, a species entirely unknown in that region at this time, still remained in the whirl. It had been broken by the ancient workman, and neatly mended by winding about it a piece of fine twine. The ends of this twine being examined under the microscope, disclosed the fact that its fiber was of very fine human hair. Articles of wood, corn-cobs and even the perfect grains of corn, walnuts, bones of elk, antelope, and wolf, portions of wearing apparel of a fabric resembling the mummy cloth of Egypt, but made from material unfamiliar to the explorers, and other perishable articles were found in abundance buried in the piles of debris which partially filled these deserted homes, and would at first thought, seem to indicate somewhat recent inhabitancy. On the other hand, however, the preservative qualities of the atmosphere of this region are remarkable, and it is the belief of the explorers that centuries have elapsed since the last of the departed race or races occupied these old cities and villages as houses.

The absence of the weapons of war, of works of defense other than such as are constituted by the selection of almost inaccessible localities, of temples or idols, of hieroglyphics or pictures, together with the durability and solidity of the dwellings, so different from anything to be found of the handiwork of existing uncivilized races of that region, and the wide extent of these ruins, indicating the existence of allied races covering large portions of the present territories of Arizona, New Mexico, and Utah, as well as northern Mexico, are the elements of the problems involved in the origin, history, and disappearance of these races; problems which seem no nearer solution than when Coronado, nearly 400 years ago, made a raid for the purposes of conquest, among these places, and through his priests gave to the world the first meagre accounts of them—then as now, vacant and ruined.—*National Republican.*

AN AZTEC CALENDAR.

At a recent meeting of the California Academy of Sciences, held at San Francisco, Eusebio Molera, a graduate of the University of Madrid, who has distinguished himself by his antiquarian researches, read a paper on the Aztec Calendar, or Mexican calendar stone, from which an insight has been obtained to the extent of the astronomical knowledge of the Aztecs.

The stone was unearthed in the City of Mexico on the 17th of September, 1790, and was placed in the base of one of the towers of the cathedral, where it remains to this day. The stone is eleven feet nine inches in diameter, and originally weighed twenty-four tons. The conjectures of a number of antiquarians in relation to this object were revived by Molera, who described its prominent characteristics by means of a painting of the same size as the original, which was prepared by himself. The central figure was a picture of the Sun's face, a distorted human countenance, and about it were geometrical signs, and figures of animals, reptiles, birds, and specimens of vegetation.

There were characters the interpretation of which presented a history of the creation of the earth. There was a period when there was no sun and the tigers came out of the woods and devoured everything. After a time the sun "died again," and there were great hurricanes of wind, causing them to perish. Another age was that of the flood, when everything was submerged, and the last epoch was that of fire, and men became birds. Around and about these central figures were cycles containing representations of the days of the month, the days of the year and other peculiarities.

Some antiquarians thought that it was a calendar stone, but Mr. Molera had an idea that it was designed for one of the sacrificial stones on which captives were slain, their hearts being offered to the sun. He believed it was constructed under the second Montezuma, who, having done nothing to perpetuate his name, determined to construct a sacrificial stone, the same as his predecessors had done. He wanted to make it larger than any of the others, and gave orders that it be two elbows larger than they were.

The Indians began hauling the stone, which finally said it would not go any further. There were 10,000 Indians pulling the stone, and the ropes broke and the stone would not move. This the historians cite to show that supernatural phenomena were connected with the event. However, it appears that the stone was really brought to town, and it was so heavy that it broke the canal and fell down.

GEOLOGY.

A GEOLOGICAL LESSON.

PROF. S. H. TROWBRIDGE, GLASGOW, MO.

As a simple illustration of the way in which nature should be taught, and of the ease with which young persons can be interested in nature studies, I will give a true and consecutive account of an hour's ramble of Mr. Inquisitive and his three little boys, aged nine, seven, and five years, and, for convenience, named by the numbers indicating their respective ages.

After leaving the street on which they live, and perhaps three minutes from home, they come to the top of a hill from which could be seen several other hills with valleys or ravines between them. Here the father gave the boys the first scientific problem to solve for themselves, in this form: "How came the valleys between all these hills?" The first solution, given almost immediately by Five, was, "water washed the valleys out." Their attention having previously been called to the miniature mountains and volcanoes formed in the process of cooking mush, the second answer, from Seven, was that "volcanoes had thrown up the hills leaving valleys between." Here were two possible solutions to the problem, which are now to be tested. [Nine, in these inquiries, was expected to withhold his opinion and act only as a reserve to be called on when more wisdom was needed.] An objection raised against Seven's theory was, "if of volcanic origin, the hills ought to show rocks upon their sides or top." But these were nowhere to be seen. Seven urged the objection against Five's theory, that the valleys were covered with grass and water, and gullies were not. On descending the slope of this first hill, Seven saw a gully, which he acknowledged had been washed out by water, in parts of which grass was growing. On reaching the valley below, he found a larger gully in which more grass was growing, and a little further on could see a broad ravine, or valley, in which a small stream was still running, and this all had previously seen swollen to a river of considerable size. By this time Seven was ready to admit that Five had given the correct solution.

In the first valley they entered, the second problem which presented itself was this: "How high *was* the ground, where the valleys now are, before any was washed away?" After some wild guessing by Five and Seven, Nine, after noticing that the several hills about them were nearly of the same height, answered that it must have been as high as the hills are now. By looking to the head of this same valley, they could see that the high ground is still being washed away, and the valley even now extending, with each washing rain, farther and farther in that direction.

A few steps beyond, they come to a ravine on whose edge, twenty-six inches below the surface, which was covered with a thick turf, a long streak of brick red earth appears with occasionally a few bricks, and, in one place, a pile of unplastered bricks. This suggested for problem three the question how the red earth and these bricks came there, lying as all did upon a rich, black soil. Nine answered promptly, "There must have been once a brick-kiln here." From the resemblance to the surface of other brick-kilns they had before visited, all were satisfied with this solution, though a kiln in this place was never seen or heard of by any one of the party. Problem four was at hand in the question how the brick-yard became covered over two feet deep with earth. The answer was equally at hand in the obvious fact that this was at the foot of a long valley from whose head the earth was still being washed down by every rain and deposited as the water spread out over the flat surface below. Next came problem five in the query whether the washing in of the earth to cover the brick-yard was before or after the washing out of the gully which now reveals its former existence. The answer to this was too plain for dispute, though, strange to say, rather slow in coming. Bricks exposed on the edge and tumbled into this gulch prove it of later origin. Land-slides and faults on the opposite side of this ravine had before received attention and were no longer problems but *facts*, worthy of no special attention except to test the permanancy of previous study and conclusions. This they did satisfactorily.

Passing on a few hundred yards, they came to a railroad cut, showing at the bottom a red deposit with rounded pebbles of all kinds scattered through it, and above, with a distinct line of division between the two, a yellowish colored bed made up of fine sand and no pebbles. This dividing line varies in height, often with wavy outline as the slope of the cut was washed into in places, sometimes running out of sight at the level of the track and again disappearing at the top of the slope. An explanation of this varying line between dissimilar deposits is the sixth problem. Nine, after following the undulations of the line for some distance, concludes that there were hills and valleys in the lower red layer when the buff layer began to be deposited, and that the curved line marks the outline of the old surface. Problem seven inquires what were the conditions under which the top and bottom layers were deposited, running or standing water? Its absence of pebbles and entire composition of minute particles led Nine to conclude, after a suggestive question or two, that the top stratum must have settled to the bottom of quiet water like a vast lake, and that the small rounded pebbles in the bottom layer must have been pushed and tumbled to their places by gently running water. Shells of various kinds in the upper layer suggested for problem eight the inquiry as to how they came there. The bottom of ponds, from which specimens had previously been collected, with living and dead shells in the soft fine mud, soon to be covered out of sight by a later deposit of mud from soil washed in by the next rain, furnished to all a ready and satisfactory answer.

A little further on, a bone sticking out from a bank twenty inches below the turf-grown surface, furnishes for problem nine the question whether it is of ancient or recent origin. By digging the earth away from around it, a strip of tin from a cast-off cooking vessel soon came to light, and on the same level with the bone several fragments of brick, which proved to even the youngest that the bone had lain there no longer than the tin and brick, and, consequently, was recent. Its toughness when pounded, showing the presence still of animal matter, and its equine characteristics, make the conclusion still more satisfactory.

Nearer the river they find large boulders of limestone, granite, etc., with no sharp corners or edges but all with a more or less rounded form. Problem ten inquires how they came thus rounded. Seven answers at once, "by being rolled and bumped against other stones by running water." At a sudden bend in the river, on a slope of the bluff which deflects the river's course, was found a large pile of rocks of all kinds and sizes, some entirely unlike any in beds within hundreds of miles. And problem eleven asks how they came there and where they came from. Nine explains that they were frozen in cakes of ice, floated down the river in the spring, perhaps from a great distance, lodged on the slope in a "block" of the ice, and left there when the river fell and the ice melted. Nine also notices, near the water's edge on the gradual slope of the river bank, the benches or stair-like surfaces one above another, and recognizes them as miniature illustrations of the terraces along the Connecticut River, left at different heights as the high water gradually receded, which he saw when on a visit to his grandfather in Vermont.

Now such familiar facts as these, which are fair *representatives* of what may be found in an hour's walk in almost any country place, may easily be made the basis of a large amount of geological knowledge which will be a real acquisition, and not the utterly hypothetical and intangible stuff as a substitute for knowledge, which one *gets* from mere text-book perusal. When the student, whether young or old, has once grasped the idea, from *actual observation*, that the hills and valleys in our surface soil are caused by the erosive power of water, he is, for the first time, ready to comprehend the broader facts of mountain sculpture, cañon erosion, and denudation, which have wrought such stupendous changes upon the surface of our globe.

From the simple discovery of a bone or shells in the soil, or a buried brick-yard, the thoughts natually expand to the closely related facts of the origin of fossiliferous beds; the mode of deposition of stratified and sedimentary rocks, varying in aggregate thickness over the earth's surface from a few inches to fifteen or twenty miles; and the order of succession of geologic events. And these embrace the whole of historical geology, and part of dynamical and lithological geology.

Again, the observation of rounded boulders in every creek-bed and often in higher positions; of the foreign or "lost rocks" often seen even in elevated fields; and of the thick and wide-spread deposits of the sandy loess in northern latitudes, which are just like the silty mud left high and deep nowadays after the flood waters of the muddy Missouri have subsided, forces unbidden upon the *thinking* mind a consideration of the unmeasured caps of moving ice progressing southward like an immense plow; the subsequent floods, perhaps more universal than Noah's, transporting and assorting unnumbered tons of material with overwhelming power; and the vast lakes of muddy water which succeeded.

Till the method of studying the earth's history,—not only by geologists, but by teachers and pupils in school,—proceeds from the known to the unknown, and the facts under our daily observation are made the starting point in explaining those of like character which occurred in ages past, we need not be surprised that students graduate with no practical knowledge of geology, for the lack of which their future fortunes are often destroyed; that good but simple men fear a knowledge of the works of God will weaken faith in his word and himself; or even at the inglorious boast of a "thorough" educator that he has "yet to learn any practical use for geology," and frequent ridiculous guesses in attempted explanation of scientific allusions in the Bible record.

EXPLORATIONS IN NORTHEASTERN OREGON.

CHAS. H. STERNBERG.

In the winter of 1878, while in San Francisco, I received orders from Prof. Cope to go to Oregon, or some other locality for fossil vertebrates. After a pleasant sea voyage of 700 miles, I arrived at Portland, Oregon, to find that the Columbia River was frozen above the upper cascades. In company with some twelve or fifteen men, I resolved to go up the river as far as I could, and trust to luck to get to the Dalles, and there take the stage for Walla Walla.

The river was open as far as the lower cascades. Here the party crossed the river and proceeded on foot for the Dalles, sixty miles above. The ground was covered with slush, and we found it hard work traveling. We had streams to cross, and were soon wet to the skin, but we trudged bravely on. I had a roll of blankets, a shot-gun and fishing rod. One man who had none, carried the blankets in consideration of which I agreed to share them with him at night, another carried the gun, in hopes of killing some game, and I disjointed the rod for walking sticks. Wben night overtook us, we found an old deserted house, which had been used for a hotel when the railroad was on this side. The question now arose what could we eat, we had been so anxious to reach the Dalles that we had not thought we might get hungry on the road. One man, however, had been wise enough to buy a box of herrings, and another a sack of crackers. We found some tin cans. In a large fire-place we built a comfortable fire, and put on snow to melt and I broiled our herrings on sticks before the fire, and these with the crackers made us a hearty meal. The herrings made us so thirsty that we had to take turns all night melting snow. The next day we again started and after travelling a short distance found a house that was inhabited, and got something to eat. We resolved to wait here in hopes that the boat would make its way down from the Dalles. After two or three days waiting we again started on our journey. I purchased a pony for $10 and got along very comfortably. After going a couple of miles, we saw the steamer coming down the river. We all returned to the landing, and I sold my pony to the one I purchased it from for $7, a pretty expensive trade, as I had paid $10 for it a couple of hours before. We met with no more adventures, and reached Walla Walla safely.

I spent the winter in Washington Territory, and in April procured an outfit and two assistants in Walla Walla and started for the John Day fossil beds. We passed through a magnificent farming country, where great wheat fields stretched out on either side, crossed the Blue Mountains into the Grand Rounde Valley, which is about forty miles long, and twenty miles wide and thickly settled. By examination I became convinced that this valley was the bed of an ancient lake, and from this place we passed through the jagged peaks of Powder River Mountains and into the John Day River valley. About twenty miles below Cañon City, I discovered a bed of shaly clay, filled with the impressions of ercotyledonous plants and fish bones; near by was a large clay bank in which I saw an example of insects taking advantage of their environments. They were common mud wasps, and instead of making the ordinary mud nest, in which to deposit their eggs, they had dug circular holes into the clay bank, deposited their eggs, and the food for the larva, and closed the mouth with mud; the whole face of the bank was honey-combed in this way. A short distance below this place I found a ledge of soft clay stone that was so light that it floated in the water when thrown into the river. It will become valuable I think for making dynamite, as it must be a great absorber. Doubtless the ancients used such clay to make their floating bricks with.

Near the gorge in the John Day River we went into camp and prepared to pack our horses and go into the basin, as the fossil beds were called. Nearly all our work after that had to be done by means of pack animals, as there were only narrow bridle trails leading across the country. A good pack-horse will carry from 300 to 400 pounds on its back all day. At this place the John Day River, which had been flowing due west skirting the base of the mountains, made a right angle and going directly north cut a gorge about 500 feet deep right through the heart of the mountains, which were largely composed of basalt and other volcanic rocks. On the south side of the gorge lie the beds of the old Pliocene lakes. They are drab colored and wash easily, making picturesque hills, ridges, mounds, etc. They are topped by a thick bed of compact volcanic sand and ashes, which resemble, I am told, the material that covers the buried cities of Herculaneum and Pompeii. This great Pliocene lake had an outlet through the mountains by a great water-fall which had worked its way back until it cut out the gorge that emptied the lake. When we got in sight of the basin a beautiful view presented itself to us. The basin or cove is a semi-circular valley cut out of the mountains. From the water's edge to a height of about 500 feet were the brilliantly colored beds of the old miocene lake deposit, deep red, yellow, orange and green. They were principally of clay and are cut in the ordinary Bad Land scenery. Above is one escarpment above another of basaltic columns; these are often perfect prisms of from six to eight sides. On the very summit are forests of pines, their green blending with the rocks below, making very pretty scenery. We went into camp near a large fossil field and went enthusiastically to work. Very dangerous we found it clinging to the almost perpendicular bluffs or cutting niches for our feet as we made our way up some steep ascent, where one misstep would hurl us into a deep gorge below. From the valley we appeared very small clinging to perpendicular walls. Our toils were well rewarded, as nature always does reward persistent effort in searching for her buried treasures.

One unaccustomed to this kind of work would soon be convinced that no specimens could be found. We often searched a week, or more, with no success, and then perhaps found perfect specimens in the ground we had looked over again and again. Perhaps only the point of a tooth would be exposed, which further work would prove to belong to a perfect skull and a perfect skeleton below. The remains were often preserved in hard concretions. When we found a skull preserved in this way we were always sure of a perfect specimen, the concretion, in its friendly embrace, retaining every process, tooth, or other delicate part, intact.

The most common species was what palæontologists call the *Oreodon*, a hog-like creature that lived in herds and was omnivorous in habit: they varied in size from a peccary to a large hog. We found a good many of the horse species, *Anchitherium*, etc.; these all had from three to five toes on their hind feet, and three on their front ones. I dicovered a large animal of the rhinoceros kind with two horns on the nasal bones, one on each side. We found great numbers of herbivorous beasts, and a corresponding number of carnivores. One species of the cat family had serrated teeth and was as large as a tiger. It resembled the saber-tooth tiger of this formation.

One very large animal I discovered was as large as the rhinoceros. It was new to science, and was provided with a large process on the humerus, and was called *Böocherus humerosus*, by Cope. We found about ten species of the cat family. Rodents were very common and we added a number of new species to science.

Fresh-water turtles were found, some were three or four feet long, their shells beautifully sculptured. Prof. E. D. Cope, the noted American palæontologist, has described all the species discovered by my expedition, and the work published by the Government is a large quarto volume with a great many beautiful lithographic plates. When I receive a copy I will try and give a more detailed description of my collections.

Whenever we got a load of fossils, or were out of provisions, we went into a small settlement on John Day River. One day in July, I think, I led in a horse packed with two boxes of fossils, and when I got to the house where I left my specimens, I found no one at home but the old gentleman. He told me that Gen. Howard had sent a courier through the settlement, advising all to gather together and build a stockade for protection, as a body of 300 Snake Indians were on the war-path, and would come down the South Fork of the John Day River and cross over to the Columbia. They had 3,000 stolen horses with them and killed all the settlers they met with, but would not be likely to attack a body of armed men. All the people but this old man had gone to Camp Watson, or Spanish Gulch, as they called it, and built a stockade. I loaded up my cartridges, got my Sharp's rifle in shape and stayed with the old man over night. One of my assistants came in that night, the other was still in the fossil fields, ignorant of any danger from Indians. Next day I went into the beds for him, we cached our tent, etc., and returned to the settlement, then all three of us, after we had cached our fossils, went to the stockade, where we found all the settlers in the neighborhood gathered together. The next day the Indians passed down the South Fork and across to Fox Prairie, about six miles from our ossil beds. On the route they killed three sheep-herders and burned one ranch, and killed horses and sheep. I followed up their trail next day and found where they went into one house and poured out a barrel of molasses, covered it with flour and stuck a little dog in it, which was dead when I saw it. In another place they took out a lot of cheeses and rolled them along with sticks as a boy would a hoop. As they were not injured I put one in my pack. At Fox Prairie they caught a good many sheep and cut off their legs and threw the bodies in piles to die. Here they joined the Umatillas, and went to the Columbia where they killed a number of citizens, burnt Cayuse Station, etc. The day I followed their trail I saw a few horsemen and an ambulance coming down South Fork, they proved to be General Howard and staff. The General told me they, with the troops behind, were in pursuit of the hostiles and had had nothing to eat but fresh beef, without salt, for three days. I directed him to a smoke-house where there was plenty of bacon, and to a house where he found plenty to eat. The table was set, and the people had just sat down to dinner, when the alarm of Indians coming was given, and they fled, leaving everything.

The General and troops stayed here a short time waiting for their pack-train of rations to catch up with them, and recruit a little. He accomplished a great feat in bringing a wagon-train down a large hill called Jackass Hill, at the head of the South Fork. A great many wagons had been broken to pieces before in attempting to make the descent. None had ever been brought down before.

Luckily, Gen. Howard knew the plans of the Snakes, as he had with him as guide the Princess of Winnimucca, who knew all their plans and revealed them to Howard. They intended after leaving their reservation to strike directly north, steal all the horses they could and get the Columbia River Indians to join them and then to cross the Columbia, ravage Washington Territory and retreat into British Columbia, where they meant to sell their horses and be safe from our troops. Copying Sitting Bull's tactics Gen. Howard got men to the Columbia first, turned all the steamers into gun-boats, and patroled the river, preventing any one from crossing.

Chief Homily, of the Umatilla Indians, with a number of other chiefs, were captured on the charge of helping Egom, the chief of the Snakes, and were offered their liberty on condition that they capture or kill Egom; a reward of $2,000 being offered for his head. Homily with two of his braves went to meet Egom at a place that the two had agreed upon, where they were to consummate an agreement by which Homily was to join him in his raid. As they were riding along side by side, Homily gave a signal, and he and his men drew up their rifles and killed Egom and his followers; they cut off Egom's head and brought it to the U. S. officers, and claimed their reward of $2,000. It was the worst piece of treachery I ever heard of. This put an end to the war, the Indians, without a leader, left their horses and pack-animals, separated in small bands and fled; eventually returning to their reservation, where they were all captured.

After this my party and myself returned to our fossil fields. We had good success and added some thirteen new species of vertebrates to science. I spent two seasons in these rich fields, and obtained a great many fine specimens of mammals and turtles which have been figured and described by Prof. E. D. Cope, the U. S. palæontologist, in the Oregon Fauna.

I was very much disappointed in Oregon. From what I had read in my boyhood, I supposed it was a rich farming country, with mild winters. I found it to consist of two distinct countries, as different from each other as Virginia is from Maine. Western Oregon, or the Willamette Valley ("a" pronounced like "a" in am), is a rich fertile country, with warm winters. It is the farmer's paradise: they raise from fifty to sixty bushels of wheat to the acre and let their land lie idle a year and reap forty bushels per acre as a volunteer crop. When I was there it was worth $1.00 per bushel in gold.

They have a rainy season for their winter, and it rains nearly every day for four or five months. Fruit grows very luxuriantly, they raise peaches, pears, grapes, apples, prunes, etc. The people are hospitable, good-natured and lazy. I have seen the ferns growing in the open fields. The north sides of their houses are covered with moss,—the people are called "moss-backs," or "web-footers."

Sixty miles east, or east of the Cascade Range, we find an entirely different country. It is rough and mountainous with but little farming land, and this is only on the water-courses where it can be irrigated. It seldom rains, and the climate resembles the plains of western Kansas. It is used chiefly as a range for cattle and sheep. The stockmen are very careless and allow their stock to run at large; they graze in the valleys and when these are eaten off go into the mountain. The consequence is that in winter the cattle are driven by the first storm into the valleys which they have already eaten bare, and many starve. If they were kept in the mountains in summer, where there is an endless range, the stockmen would find it to their advantage. Sheep are kept along the water-courses till they have destroyed the grass. I noticed along the Cañon City & Dalles Road, that there was no grass on either side of the road for three miles. Sage-brush and grease-wood had taken the place of the luxuriant bunch-grass. Nine-tenths of Oregon is composed of this rough, hilly country, fit only for stock. They do not feed their stock during the winter, which is often quite severe, depending entirely on the range and unless the winters are unusually severe they come through in good shape.

This is a splendid country for raising horses. They climb to the tops of the mountains in winter, where the snow has been blown off. I noticed a great deal of fine blooded stock. A stallion is given charge of a herd of mares, and he takes them to good grazing ground. The owners often see them but once or twice a year when they brand the colts.

LAWRENCE, KANSAS, February 4, 1884.

THE FIRST GEOLOGICAL EXPLORATION IN LOUISIANA.

E. L. BERTHOUD, C. E.

Among the concessions made by Law's company in Louisiana, in 1719–20, was that one made to Law, and embraced the lands on the Arkansas River, then known as "Arçansas Post," which was the point where Joutel, after La Salle's death, first reached the immediate valley of the Mississippi, and where he found two Frenchmen left there by Touti, La Salle's lieutenant, as a point of observation or rally for that great explorer's benefit.

In 1721 Arçansas Post consisted of four or five palisaded houses, a little guard-house, and a cabin serving as a store-room. In that year, Dumont says that he went with its commander, Capt. De la Harpe, Lieut. Franchomme, Sergeant Bessan and twenty-two men from that Post, to explore the Arçansas valleys in search of a reputed "Emerald rock" on that river. The party ascended the river 250 leagues, and then struck off inland fifty leagues more; they passed through a beautiful country; vast prairies covered with buffalo, stags, deer, etc. They found jasper, marble, and also slate and talc (selenite), very fit for plaster. They also discovered, they thought, a little stream that rolled "*gold dust.*" A salt spring also was found nearly 300 leagues from the sea. It is just possible De la Harpe reached into the country of the Big Bend of the Arkansas; if he did the Nescatunga Salt Plains and Salt Springs were visited by him. He may, perhaps, have been as far as the Wichita Mountains. But the emerald rock yet remains to be found, if it ever existed,—it was most probably carbonate of copper.

This expedition might be called the first geological exploration of Louisiana.

MORRISON, ILL., Feb. 9, 1884.

ED. KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY:

DEAR SIR,—I have just read Prof. G. C. Broadhead's article on "Flint Chips" in the current number of your valuable magazine, and it recalls to my mind a statement I once heard to the effect that there is no flint found in the United States. I have read the same statement in J. P. McLean's work on the "Mound Builders." Before I can accept this statement as true I would like more and better proof in its support. I have found specimens mingled with the drift overlying beds of Niagara rock in this vicinity and also in the gravel on the shore of the Mississippi River at Lyons, Iowa, that corresponds exactly with the most precise definitions for the term flint. I have specimens of flint from the Dover Cliffs, England, which though black in color are translucent along the edges, though more so than some specimens found near this locality.

The questions I would like to ask are: Is real flint found in this country or not, and if so, how can we tell flint from chert without chemical analysis?

Last summer the workmen in a quarry at this place found a fine specimen of a species ot Lepidodendron which I secured and have in my collection; in fact I have four specimens of it. The impression is in rather coarse sandstone belonging to the carboniferous age. The impressions of the bark are absolutely perfect, some of the finest lines being visible. From the same quarry are sometimes obtained specimens of calamites (Canneformis) so perfect that the joints are plainly visible, also the longitudinal flutings. Some of the specimens, most of them in fact, are branched, the branches being constricted near the main trunk, with short joints close to the same, but as it grows outward the branch lengthens and enlarges in diameter, at the same time curving upward until it becomes parallel with the trunk.

I have, in connection with my friend H. Baldwin, analyzed all the native and naturalized plants of this County that we have met with, consisting of nearly 1,000 species. I mean to arrange the work to exhibit at the County and perhaps at the Illinois State Fair.

S. A. Maxwell.

PHYSICS.

THE SWISS EARTHQUAKE OF 1881.

ALBERT S. GATSCHET, WASHINGTON, D. C.

One of the observed earthquakes is the one that occurred in the level parts of Switzerland on the afternoon of January 27, 1881. A tertiary sandstone constitutes the main portion of the Swiss plateau, where the phenomenon was felt in its greatest intensity, the heaviest of the motion being at Berne and in its immediate vicinity.

Prof. Dr. A. Foster, the Director of the Telluric Observatory, at Berne, has gathered a large amount of well ascertained details about it and published them in an interesting quarto monograph of twenty-nine pages (Berne, B. F. Haller) under the title: "*Das Erdbeben der Schweizenchen Wochebene vom 27 Jan. 1881*, (*Berner Beben*). The scientific results obtained by him may be summed up as follows: The principal shock took place at 2h. 19m. 53s. P. M.; it was preceded and followed by lighter oscillations of the soil and occurred at a time when the perihelion and the perigee coincided, though new moon was two and a half days later. The upper culmination of the moon had occurred five hours before. A long period of frost had just given way to a sudden thaw, but there were no disturbances of terrestrial magnetism several days before and after. The whole area set in motion, having a longitudinal extent of 260 kilometres, experienced the shock exactly at the same astronomical time: there was no central shock, for the dislocation following the shock took place simultaneously upon the whole line. In the majority of places it consisted of a short succussory shaking followed by a few lateral and less energetic oscillations, the direction of all being approximatively from east to west. The mean duration was but three to four seconds, the intensity varying between three and eight degrees of the Swiss-Italian seismic scale, and the phenomenon has to be classed with the longitudinal earthquakes of a pre-eminently transversal direction. The noises connected with the seismic phenomena *preceded* the shock, or *were synchronous* with them; none were heard after the shock. South of Martigny (Valois) and north of Mulhouse (Alsace) no disturbance was felt, though oscillations had occurred two weeks before in Southern Germany, Piedmont and Lombardy.

EARLY HISTORY OF THE TELEGRAPH.

Although the electric telegraph is, comparatively speaking, a recent invention, yet methods of communication at a distance, by means of signals, have probably existed in all ages and in all nations. There is reason to believe that among the Greeks a system of telegraphy was in use, as the burning of Troy was certainly known in Greece very soon after it happened, and before any person had returned from Troy. Polybius names the different instruments used by the ancients for communicating information—"Pyrsia," because the signals were always made by means of fire lights. At first they communicated information of events in an imperfect manner, but a new method was invented by Cleoxenus, which was much improved by Polybius, as he himself informs us, and which may be described as follows:

Take the letters of the alphabet and arrange them on a board in five columns, each column containing five letters; then the man who signals would hold up with his left hand a number of torches which would represent the number of the column from which the letter is to be taken; and with his right hand a number of torches that will represent the particular letter in that column that is to be taken. It is thus easy to understand how the letters of a short sentence are communicated from station to station as far as required. This is the pyrsia or telegraph of Polybius.

It seems that the Romans had a method of telegraphing in their walled cities, either by a hollow formed in the masonry, or by a tube fixed thereto so as to confine the sound, in order to convey information to any part they liked. This method of communicating is in the present age frequently employed in the well-known speaking tubes. It does not appear that the moderns had thought of such a thing as a telegraph until 1661, when the Marquis of Worcester, in his "Century of Inventions," affirmed that he had discovered a method by which a man could hold discourse with his correspondent as far as they could reach, by night as well as by day; he did not, however, describe this invention.

Dr. Hooke delivered a discourse before the Royal Society in 1684, showing how to communicate at great distances. In this discourse he asserts the possibility of conveying intelligence from one place to another at a distance of 120 miles as rapidly as a man can write what he would have sent. He takes to his aid the then recent invention of the telescope, and explains how characters exposed at one station on the top of one hill may be made visible to the next station on the top of the next hill. He invented twenty-four simple characters, each formed of a combination of three deal boards, each character representing a letter by the use of cords; these characters were pushed from behind a screen and exposed, and then withdrawn behind the screen again. It was not, however, until the French revolution that the telegraph was applied to practical purposes, but about the end of 1793 telegraphic communication was established between Paris and the frontiers, and shortly afterwards telegraphs were introduced into England.

The history of the invention and introduction of the electric telegraph by Prof Morse is one of inexhaustible interest and every incident relating to it is worthy of preservation. The incidents described below will be found of special interest. The article is from the pen of the late Judge Neilson Poe, and was the last paper written by him. He prepared it during his recent illness, the letter embodied in it from Mr. Latrobe being of course obtained at the time of its date. It is as follows:

On the 5th of April, 1843, when the monthly meeting of the Directors of Baltimore & Ohio Railroad Company was about to adjourn, the President, the Hon. Louis McLane, rose with a paper in his hand which he said he had almost overlooked, and which the Secretary would read. It proved to be an application from Prof. Morse for the privilege of laying the wires of his electric telegraph along the line of the railroad between Baltimore and Washington, and was accompanied by a communication from B. H. Latrobe, Esq., Chief Engineer, recommending the project as worthy of encouragement.

On motion of John Spear Nicholas, seconded by the Hon. John P. Kennedy, the following resolution was then considered:

Resolved, "That the President be authorized to afford Mr. Morse such facilities as may be requisite to give his invention a proper trial upon the Washington Road, provided in his opinion and in that of the engineer it can be done without injury to the road and without embarrassment to the operations of the company, and provided Mr. Morse will concede to the company the use of the telegraph upon the road without expense, and reserving to the company the right of discontinuing the use if, *upon experiment*, it should prove *in any manner injurious.*"

"Whatever," said Mr. McLane, "may be our individual opinions as to the feasibility of Mr. Morse's invention, it seems to me that it is our duty to concede to him the privilege he asks, and to lend him all the aid in our power, especially as the resolution carefully protects the company against all present or future injury to its works, and secures us the right of requiring its removal at any time."

[In view of the fact that no railroad can now be run safely without the aid of the telegraph, the cautious care with which the right to remove it if it should become a nuisance was reserved, strikes one at this day as nearly ludicrous.]

A short pause ensued, and the assent of the company was about to be assumed, when one of the older directors, famed for the vigilance with which he watched even the most trivial measure, begged to be heard.

He admitted that the rights and interests of the work were all carefully guarded by the terms of the resolution, and that the company was not called upon to lay out any of its means for the promotion of the scheme. But notwithstanding all this, he did not feel, as a conscientious man, that he could, without further examination, give his vote for the resolution. He knew that this idea of Mr. Morse, however plausible it might appear to theorists and dreamers, and so-called men of science, was regarded by all practical people as destined, like many other similar projects, to certain failure, and must consequently result in loss and possibly ruin to Mr. Morse. For one, he felt conscientiously scrupulous in giving a vote which would aid or tempt a visionary enthusiast to ruin himself.

Fortunately, the views of this cautious, practical man did not prevail. A few words from the mover of the resolution, Mr. Nicholas, who still lives to behold the wonders he helped to create, and from Mr. Kennedy, without whose aid the appropriation would not have passed the House of Representatives, relieved the other directors from all fear of contributing to Mr. Morse's ruin, and the resolution was adopted. Of the President and thirty directors who took part in this transaction, only three, Samuel W. Smith, John Spear Nicholas, and the writer survive. Under it Morse at once entered upon that test of his invention whose fruits are now enjoyed by the people of all the continents.

It was not, however, until the spring of 1844 that he had his line and its appointments in such a condition as to allow the transmission of messages between the two cities, and it was in May of that year that the incident occurred which has chiefly led to the writing of this paper.

* * * * * * *

MR. LATROBE'S RECOLLECTIONS.

MY. DEAR MR. POE:—Agreeably to my promise, this morning I put on paper my recollection of the introduction of the magnetic telegraph between Baltimore and Washington. I was counsel of the Baltimore & Ohio Railroad Company at the time, and calling on Mr. Louis McLane, the President, on some professional matter, was asked in the course of conversation whether I knew anything about an electric telegraph which the inventor, who had obtained an appropriation from Congress, wanted to lay down on the Washington branch of the road. He said he expected Mr. Morse, the inventor, to call on him, when he would introduce me to him, and would be glad if I took an opportunity to go over the subject with him and afterward let him, Mr. McLane, know what I thought about it. While we were yet speaking, Mr. Morse made his appearance, and when Mr. McLane introduced me he referred to the fact that, as I had been educated at West Point, I might the more readily understand the scientific bearings of Mr. Morse's invention. The President's office being no place for prolonged conversation, it was agreed that Mr. Morse should take tea at my dwelling, when we would go over the whole subject. We met accordingly, and it was late in the night before we parted. Mr. Morse went over the history of his invention from the beginning with an interest and enthusiasm that had survived the wearying toil of an application to Congress, and with the aid of diagrams drawn on the instant, made me master of the matter, and wrote for me the telegraphic alphabet which is still in use over the world. Not a small part of what Mr. Morse said on this occasion had reference to the future of his invention, its influence upon communities and individuals, and I remember regarding as the wild speculations of an active imagination what he prophesied in this connection, and which I have lived to see even more than realized. Nor was his conversation confined to his invention. A distinguished artist, an educated gentleman, an observant traveler, it was delightful to hear him talk, and at this late day I recall few more pleasant evenings than the only one I passed in his company.

Of course, my first visit the next morning was to Mr. McLane to make my report. By this time I had become almost as enthusiastic as Mr. Morse himself, and repeated what had passed between us. I soon saw that Mr. McLane was becoming as eager for the construction of the line to Washington as Mr. Morse could desire. He entered warmly into the spirit of the thing, and laughed heartily, if not incredulously, when I told him that although he had been Minister to England, Secretary of State, and Secretary of the Treasury, his name would be forgotten, while that of Morse would never cease to be remembered with gratitude and praise. We then considered the question as to the right of the company to permit the line to be laid in the bed of the road—the plan of construction at that time being to bury in a trench some eight or ten inches deep a half-inch leaden tube containing the wrapped wire that was to form the electric circuit. About this there was, in my opinion, no doubt, and it was not long after that that the work of construction commenced. I met Mr. Morse from time to time while he lived, and often recurred to the evening's discussion at my house in Baltimore.

The above is the substance of what I have more than once related to other persons. I hope you will persist in your design of putting on paper your own very interesting recollections in this connection, and if what I have contributed of mine is of service to you, I shall be much pleased.

Most truly yours, JOHN H. B. LATROBE.

MARCH 3, 1881.

THE DIVINING ROD.

Prof. Rossiter W. Raymond, in the *Engineering and Mining Journal*, gives the history and traditions of the divining rod at great length, and, summing up, reaches the following among other conclusions:

The application of the rod to the discovery of metals, coal, buried treasure, etc., is shown abundantly to be chimerical. The rules and methods, as well as the asserted performances of its professors, contradict each other, and innumerable failures and exposures have justly covered with ridicule their pretensions.

The transparent humbug of locating wells with the rod, to strike oil at depths from a hundred to a thousand feet, needs no comment. In this case, there are positively no signs by which a given spot can be selected. The experience of neighbors may show a certain area to be productive; and within that area a certain line may be inferred, sometimes, to be the line of a productive channel. But if a keen observer, having gone so far, professes to select a point on that line, he is simply betting on his luck, and, as carried on in Pennsylvania, the bet is a safe one for the oil-smeller who gets a handsome fee if he wins, and loses in the opposite event nothing but an hour or two of time.

The case is somewhat different with the discovery of springs, and (since ore deposits always have been and often still are the channels of springs) of ore deposits. Here we have much stronger and more abundant evidence in favor of the rod, and here, in my judgment, there is a residuum of scientific value after making all necessary deductions for exaggeration, self-deception and fraud.

He then explains that skillful prospectors can scarcely explain how they decide upon the place they are to dig, but that long experience and close observation have enabled them to make good decisions without conscious reasoning, and that in their hands the divining rod would be unconsciously moved by involuntary muscular action in the determined direction. He also thinks that a purely physical effect as of relative cold may be produced on a highly sensitive organization as it passes over a subterranean spring. In conclusion he says of the divining rod:

In itself it is nothing. Its claims to virtues derived from Deity, from Satan, from affinities and sympathies, from corpuscular effluvia, from electrical currents, from passive perturbatory qualities or organic-electric force, are hopelessly collapsed and discarded. A whole library of learned rubbish about it which remains to us furnishes jargon for charlatans, marvelous tales for fools and amusement for antiquarians; otherwise it is only fit to constitute part of Mr. Caxton's "History of Human Error." And the sphere of the divining rod has shrunk with its authority. In one department after another it has been found useless. Even in the one application left to it with any show of reason it is nothing unless held in skillful hands, and whoever has the skill may dispense with the rod. It belongs with "the magic pendulum" and "Planchette," among the toys of children.

Or if it be worthy the attention of scientific students, it is the students of psychology and biology, not of geology and hydroscopy and the science of ore deposits, who can profitably consider it. For us miners and prospectors the advice holds good which was given us 300 years ago by the wise Agricola, the father of our profession, who says the believers in the rod find some veins with it by accident. "But the same people much more frequently lose their pains, and in order to discover veins have to fatigue themselves with digging, not the less than the miners of the opposite school."

MEDICINE AND HYGIENE.

STOVE AND FURNACE HEAT.

DR. A. N. BELL.

So much has been said recently about the germ origin of disease, that people generally are in danger of having their attention diverted from prevalent tangible causes of diseases within easy control, while catching at shadows. First among the controllable causes of ill-health in temperate and cold climates is an excessively variable or foul indoor atmosphere, due to defects in the mode of warming houses. Exposure to a temperature much below that of animal heat for any considerable time always weakens vitality and increases the susceptibility to disease. Hence, the economy of heat is a primary element in the art of preserving health. Of the common means to this end—clothing, houses, and fire—the last only is the subject of this article, and with special reference to the relative merits, from the sanitary point of view, of stoves and furnaces as compared with steam. Simply to obtain the necessary degree of temperature would be an easy matter, but ventilation must be constantly kept in view, and this cannot be secured without some sacrifice of heat. Time was when the open fire-place was regarded as the *conditio sine quâ non* of health; but, as Rumford put it, "while the draughts chill one part of the body, the rest is roasted by the fire in the fire-place, and this cannot but be injurious to health."

A close stove, everybody knows, is simply a hollow cylinder, or box, made of metal, brick, or earthenware, which is heated by a fire within it, and gives out its heat to the air by contact, and to surrounding solid objects by radiation. In an economical point of view it excels all other means of warming. The heated air from a fire-place is available to the apartment for only about twelve per cent of the total amount of heat produced: all the rest passes up the chimney. The close stove, on the contrary, utilizes from eighty-five to ninety per cent of the heat produced, and loses through the smoke-pipe only about as much as the open fire-place saves—ten to fifteen per cent. And herein lies the striking difference between the relative healthiness of the atmosphere heated by a close stove and an open fire-place. The amount of air which hourly passes through a close stove, heated with a brisk fire, is, on an average, equal to only about one-tenth of the capacity of the room warmed, and consequently such stove requires, if unaided, ten hours to effect a change of the atmosphere in every such apartment. Thus stagnant and heated, the air becomes filled with the impurities of respiration and cutaneous transpiration.

Moisture, too, is an important consideration. The atmosphere, whether within doors or without, can only contain a certain proportion of moisture to each cubic foot, and no more, according to temperature. At eighty degrees it is capable of containing five times as much as at thirty-two degrees. Hence, an atmosphere at thirty-two degrees with its requisite supply of moisture, introduced into a confined space and heated up to eighty degrees, has its capacity for moisture so increased as to dry and wither everything with which it comes in contact: furniture cracks and warps, seams open in the molding, wainscoting, and doors; plants die; ophthalmia, catarrh, and bronchitis are common family complaints, and consumption is not infrequent. But this condition of house air is not peculiar to stove-heat. It is equally true of any overheated and confined atmosphere. The chief difference is, that warming the air by means of a close stove is more quickly accomplished and more easily kept up than by any other means. Sometimes, by the scorching of dust afloat in the atmosphere, an unpleasant odor is evolved which is erroneously supposed to be a special indication of impurity, caused by burning the air. It is an indication of excessive heat of the stove. But the air cannot be said to burn, in any true sense of the word, for it continues to possess its due proportion of elementary constituents. Such is the close stove and its dangers, under the most unfavorable circumstances. The Dutch stove is occasionally found in country railroad depots and similar places, where the frequent opening of doors makes amends for its deficiencies. In Russia, and other northern countries of Europe, stoves are frequently built of brick covered with porcelain, with relatively small fire-chambers near the bottom, and with winding smoke-flues which traverse many times through the structure, until nearly the whole of the heat generated is expended in it. The smoke-pipe, now comparatively cool, enters a flue in the wall and carries off the smoke only, while the heated mass of brick continues to retain heat and warm the room long after all the fuel is burned—for from eight to ten hours. If the same quantity of fuel were burned in an open fire-grate or close stove, the heat therefrom would be expended in an hour.

Stoves have been so improved in recent years, in the United States especially, and are obtainable at such moderate expense, that no excuse for the continued use of such as have been above described now exists. Indeed, so important and rapid have been the improvements in the construction of stoves in the United States within the last eight or ten years, that it is difficult to find a market for those of older date. In England, where the people continue to be wedded to open grates, and where most is said by scientific persons against the use of stoves, improvements have been exceedingly slow and complicated, and the practicability of maintaining a sufficient and equable temperature, and a wholesome atmosphere in a room warmed by a stove, is far from being realized; still less, the convenience of warming several rooms at the same time by the same means, hot-air furnaces scarcely being known.

The essentials for healthy stove-heat are a brick-lined fire-chamber, exhaust-flue for foul air, means for supplying moisture, and provision for fresh-air supply. A brick lining is requisite for the double purpose of preventing overheating, and for retaining heat in the stove. For the supply of moisture, the means are simple and easy of control, but often inadequate. An efficient foul-air shaft may be fitted to the commonest of close stoves by simply inclosing the smoke-pipe in a jacket—that is, in a pipe of two or three inches greater diameter. This should be braced round the smoke-pipe and left open at the end next the stove. At its entry into the chimney, or in its passage through the roof of a car, as the case may be, a perforated collar should separate it from the smoke-pipe. For stoves with a short horizontal smoke-pipe, passing through a fire-board, the latter should always be raised about three inches from the floor. A smoke-pipe thus jacketed, or fire-board so raised at the bottom, affords ample provision for the escape of foul air.

The introduction of fresh air is a comparatively easy matter, when by no more special provision, then by a strip of board under the window-sash, closely fitted. The lap of the sash at the middle admits the air with a direction to the ceiling, and, consequently, without draft on any one in the room.

The experiments of Pettenkoffer have shown that under the common conditions of the atmosphere, a very considerable exchange of gases takes place through dry plastered walls, brick, and stone. And it is the common experience of sick persons that they are sensitive to drafts through walls when the wind blows, and that they frequently take cold by exposure to the windy side of the house.

All flues for the exit of foul air should be perfectly smooth and tight. Rough surfaces not only retard but retain emanations which come in contact with them. Moreover, exhaust-flues should never be placed in outer cold walls, because the geatest density of the outer cold air prevents the ready ascent of the warmed and rarefied air from within. Another important consideration is the size of air-shafts. This can only be approximate, however, because the amount of air which will pass through a shaft depends in a great degree upon the relative temperatures of the inner and outer atmospheres, and the conditions of the weather, particularly the direction of the wind. As a practical average, the best observers recommend that the sectional area of both inlet and outlet shafts be twenty-four square inches per head; or, for buildings of three stories, one square inch for every fifty cubic feet of space; rooms below, one square inch for every fifty-five cubic feet; for ground floors, one square inch for every sixty cubic feet. It should be borne in mind that the friction in long flues considerably lessens the extractive power, and that the column of air in the flue increases in density as it ascends. In prisons, where the cubic space per head is comparatively small, the sectional area of the air-shafts should be at least twenty square inches per head.

Open fire-stoves combine the advantages of the open fire-place and the close stove, provide for fresh air, and economize heat. The important improvements in stoves of this kind have not only well-nigh supplanted the open fire-grate in supplying all that was ever claimed for it, but excel it in all the requisites of economy and comfort.

Hot-air furnaces are simply inclosed stoves placed outside the apartments to be warmed, and usually in cellars or basements of the buildings in which they are used. The manner of warming is virtually the same as by indirect steam-heat—by the passage of air over the surface of the heated furnace or steam-heated pipes, as the case may be, through flues or pipes provided with registers. The most essential condition of satisfactory warming by a hot-air furnace is a good chimney-draught, which should always be stronger than that of hot-air pipes through which the warmed air is conveyed into the rooms, and this can be measured by the force with which it passes through the registers. A chimney-draught thus regulated effectively removes all emanations; for, if the chimney-draught exceeds that of the hot-air pipes, all the gaseous emanations from the inside of the furnace, and if it have crevices, or is of cast-iron and overheated, all around it on the outside, will be drawn into the chimney. Closely connected with this requirement for the chimney-draught is the regulating apparatus for governing the combustion of fuel—the draught of the furnace. This should all be below the grate; there should be no dampers in the smoke-pipe or chimney, and all joints below and about the grate should be air-tight. The fire-pot should be lined with brick and entirely within the furnace, but separate from it, so that the fresh air to be warmed cannot come in contact with the fuel-chamber.

It should go without saying that the air which passes from furnaces into living-rooms should always be taken from out-of-doors, and be conveyed in perfectly clean air-tight shafts to and around the base of the furnace. Preferably, the inlet of the shaft, or cold-air box, should be carried down and curved at a level (of its upper surface) with the bottom, and full width of the furnace. Thus applied, the air is equally distributed for warming and ascent through the hot-air pipes to the apartments to be warmed. On the outside, the cold-air shaft should be turned up several feet from the surface of the ground, and its mouth protected from dust by an air-strainer. A simple but effectual way is to cover the mouth with wire cloth, and over this to lay a piece of loose cotton wadding. This may be kept in place with a weight made of a few crossings of heavy wire, and it should be changed every few months. And here, too, outside the house, should be placed the diaphragm for regulating the amount of coid-air supply, and not, as commonly, in the cellar.

As the best means of regulating the temperature and purity of the atmosphere from hot-air furnaces, it is necessary to provide sufficiently large channels for both the inlet of fresh air and its distribution through the hot-air pipes. The area of the smallest part of the inlet (or inlets, for it is sometimes letter to have more than one) should be about one-sixth of a square foot for every pound of coal estimated to be burned hourly, in cold weather, and to prevent, in a measure, the inconvenience of one hot-air pipe drawing from another, the collective area of the hot-air pipes should not be more than one-sixth greater than the area of the cold-air inlet. These proportions will admit the hot air at a temperature of about 120°, when at zero outside, and the velocity through the registers will not exceed five feet per second.

A large heating surface of the furnace is a well-recognized condition of both economy and efficiency. As a rule, there should be ten square feet of heating surface to every pound of coal consumed per hour, when in active combustion; and the grate area should be about one-fiftieth of that of the heating surface. For the deficiency of heat, or the failure of some of the hot-air pipes of hot-air furnaces in certain winds and weathers in large houses or especially exposed rooms, the best addendum is an open fire-grate. With this provision in northerly rooms, to be used occasionally, hot-air furnaces may be made to produce all the advantages of steam-heat in even the largest dwelling houses.

Steam-heat may well be compared with stove- and furnace-heat: stove-heat corresponds to direct radiation by steam, and furnace-heat to indirect. The supply of fresh air from the outside to and over the hot-air furnace, and through hot-air flues into the rooms through registers, is virtually the same as when it is conveyed by means of steam-heated flues in the walls. Exhaust flues, for getting rid of foul air, are equally essential. The stove, as representing direct radiation in the same manner as the steam coil, or plate, in the room, has the advantage over the latter of some exhaust of foul air, however little, even when the smoke-pipe is not jacketed, for the steam-heat has none. In comparison with open stove-heat, steam heat is at still greater disadvantage; for open stoves supply all the qualities of complete radiation—the introduction of fresh air and the escape of foul—to a degree wholly unattainable by steam-heat whether direct or indirect, or by hot-air furnaces, which always require special provision for the escape of foul air.

The advantage of stove and furnace heat over steam may be summed up thus: It is more economical, more uniform, more easy of management, more suitable for small areas to be warmed, and is free from the noises and dangers of steam. Irregularities of the fire in steam-heating are a constant source of inconvenience, and sometimes of danger. The going down of the fire during the night-time, or its neglect for a few hours at any time, is followed by condensation of the steam. On the addition of fuel and increase of heat, steam again flows quickly into the pipes where a partial vacuum has formed, and here, on coming in contact with the condensed water, it drives the water violently and creates such shocks as sometimes occasion explosions; or, at least, produces very disagreeable noises and general uneasiness, and frequently causes cracks and leaks. Hence direct steam heat, which for warming purposes alone is altogether superior to indirect, has been well-nigh abandoned. Indirect steam-heat places the leaks out of sight, but they commonly lead to mischief, and require special and expensive provision for access and repair.—*North American Review.*

INFECTIOUS DISEASES.

The Missouri State Board of Health recently issued a circular pertaining to the regulation of infectious diseases. The document requires physicians to report to the County Clerk all contagious cases within twelve hours after discovery. Doctors are obliged to report the death of patients from such complaints within twelve hours after death, and a failure to comply with this rule is made a misdemeanor. It is made the duty of the County Clerk to notify the State Board of Health of all such deaths that are reported to him, and he is authorized to place a yellow flag and placard on any dwelling where there is an infectious disease. An undue removal of such warnings is made punishable by fine. County Clerks are also given authority to isolate patients and employ nurses for their care, and have the power to compel the removal of persons afflicted with contagious diseases to such places as may be provided for their treatment by the County. They are likewise called upon to cause all persons in the immediate vicinity of a case of small pox to be vaccinated.

Parents or guardians who send children to school from an infected house are made liable equally with teachers who receive such scholars, and who are required to remove them from school. Failure to comply with any of these regulations is punishable by fine not exceeding $25.

METEOROLOGY.

THE CLIMATE OF KANSAS.

PROF. F. H. SNOW, OF THE STATE UNIVERSITY.

The climate of eastern Kansas is not the climate of western Kansas. Any discussion of this subject will be entirely inadequate, which fails to recognize the fact that Kansas is meteorologically divided into two distinct regions, separated from each other by an intermediate area, whose climate exhibits a gradual transition between the eastern and the western sections. The inclusion of two such widely differing regions in one civil commonwealth has its disadvantages as well as its advantages. The striking adaptability of western Kansas to sustain the immense cattle interests of that section adds an important element of prosperity to the State. But the fact that thousands of new comers from ignorance of the climate have attempted to introduce ordinary agricultural operations upon the so-called "plains" and have disastrously failed in the attempt, has placed an undeserved stigma upon the good name of Kansas in many far distant communities and has undoubtedly somewhat retarded immigration during the past few years. It is time for the general recognition of the fact that except in the exceedingly limited area where irrigation is possible, the western third of Kansas is beyond the limit of successful agriculture. Yet this portion of Kansas, upon the basis of one individual to each ten acres has the capacity to continuously sustain an aggregate of nearly 2,000,000 head of cattle. The last biennial report of the State Board of Agriculture represents the total number of cattle in the entire State as less than one and a half millions, which is considerably below the number which might be supported by the western third of the State alone.

The chief elements in a climate are temperature, rainfall, cloudiness, wind and humidity. The principal source of the information here presented upon these topics is the writer's personal observations for sixteen years at Lawrence, which, from its location, fairly represents the eastern third of Kansas.

The mean annual temperature is about 53.5°, which does not differ essentially from that of States to the east of Kansas in the same latitude. But from the annual mean temperatures alone no definite conception of a climate can be formed. The monthly means and the extremes of temperature determine the effect of the climate on human beings. The prominent advantage possessed by Kansas over many agricultural States consists largely in the length of the growing season, during which the monthly mean temperatures are sufficiently high to bring to full maturity a great diversity of crops, while the minimum temperatures are so high above the freezing point as to prevent all danger of damage from untimely frosts. The average date of the last severe frost of spring for the past sixteen years has been April 4th, while the average date of the first severe frost of Autumn has been October 19th, thus giving a period of over six months (198 days,) without frost enough to injure corn or wheat, or any other staple crop. During this period of sixteen years the latest severe spring frost was April 25, (in 1873,) and the earliest date of severe autumn frost was September 17, (in 1868). In the present year, (1883,) the latest severe spring frost occurred on March 29, and the earliest severe autumn frost was delayed until November 1, thus giving a period of more than seven months, (207 days,) of freedom from injurious frosts. Thus ample time has been afforded during each of the sixteen years for the thorough ripening and "hardening" of the corn crop. To this long period of immunity from frost Kansas owes her triumphant position at the present time, as the only one of the great grain-producing States which has raised first-class corn in 1883. This same peculiarity of Kansas climate has enabled our farmers to speedily retrieve their losses from the invasions of the Rocky Mountain locust—so-called "grasshoppers,"—now, happily a thing of the past.

In the spring and early summer of 1875, a large portion of eastern Kansas had been shorn as clean as a threshing floor, by the myriads upon myriads of young locusts. These devouring hosts took their departure the first and second weeks in June. Our courageous farmers, although many of them had already replanted their corn for the third and fourth time, made one more final and successful effort. Corn planted from the 15th of June to as late a date as the 15th of July, yielded bountiful crops, the first severe frost of autumn occurring on the 30th of October—too late to damage the well ripened ears.

In their effect upon the population the summers of Kansas are far less oppressive and exhausting than might be inferred from their frequent length and high temperature. Of the sixteen summers which have come under our observation eight have been cool and eight have been hot. During this period the number of days on which the mercury reached or exceeded 90° has averaged 42 for each year, reaching a minimum of 20 in 1877 and a maximum of 68 in 1881. The cool summers are delightful, and there are important compensations by which the hot summers are rendered far more tolerable than those of States to the east of Kansas between the same parallels of latitude. Among these compensations are the very general coolness of the nights, no matter how hot the days may be; the unusual dryness of the atmosphere, which cools the surface of the body by a more rapid evaporation of the perspiration, and the almost constant brisk movement of the air, which rarely becomes calm.

The autumns of Kansas furnish the most enjoyable weather of the year, the mild Indian summer frequently continuing to nearly Christmas. During the present year (1883) building operations have been carried on without interruption up to the close of December.

The winters of Kansas have enough rigor to protect the population from the chronic languor too often engendered by a southern climate. Without the extreme severity which benumbs the faculties our winter temperature is sufficiently low to impart that healthful stimulus to mental and physical activity which seems essential to the highest development of the human race.

Of the sixteen winters whose records are before us, nine have been of moderate temperature, with mean between 26° and 32°; three have been severe, with mean below 25°, in one winter (of 1873–74) reaching 22.84°, and four have been exceedingly mild, with mean above 32°, in one winter (of 1877–78) reaching 39.54° The average number of days in each year on which the mercury has sunk below the zero point has been seven, the number varying from sixteen in 1872 to one in 1882. The winters generally break up in February, the first wild flowers often appearing before the end of that month. The lowest temperature during the sixteen years was 26° below zero; the highest was 108° above zero on August 5, 1874, giving an extreme range of 134°.

Kansas may be divided into three sections in reference to its rainfall. Eastern Kansas has an average annual precipitation of from thirty to thirty-five inches, according to the locality; central Kansas has from twenty to twenty-five inches while western Kansas has from ten to fifteen inches. In the first two sections the supply is ample to sustain a diversified agriculture, while in the third section it is altogether inadequate for agriculture, although sufficiently abundant to grow the grass for immense herds of cattle and sheep.

Wherever meteorological records have been kept for a long series of years, as at Ft. Leavenworth, Lawrence, Manhattan and Fort Riley, there is indisputable evidence that the effect of settlement has been to considerably increase the amount of rain. This increase is slowly pushing westward the boundaries of the region of successful agriculture, but the increase cannot be beyond a certain moderate limit and cannot be expected to bring the western third of the State within these boundaries. The vapor by the condensation of which our Kansas rains are produced, comes chiefly from the waters of the Gulf of Mexico. The position of the body of water and the direction of the prevailing winds are such that but a small portion of the vapor can be brought to western Kansas.

A peculiar feature of the rainfall of Kansas consists in the fact that only about one-tenth of the annual precipitation occurs in the winter months. In the eastern States the amount of rain, including melted snow, is nearly as large in winter as in each of the other seasons. In Kansas, which has less rain in the winter than any State in the Union except Minnesota and Nebraska, the apparent deficiency is abundantly made good by a more copious supply of rain in spring, summer and autumn than is received by the great majority of the other States.

The distribution of rain through the months of the year is highly conducive to agricultural prosperity. Beginning with February, in which the average precipitation is reduced to its minimum, there is a constant increase in each month until June and July, when the rainfall reaches its maximum and begins to decline, each succeeding month showing a decrease in the average amount until the minimum is again reached in February. It is very rarely the case that the monthly rainfall during the growing season departs from the normal to such an extent as to seriously injure the staple crops. The only approach to a general drouth during the sixteen years of our observations was in 1874, when for several months in succession the rainfall fell considerably below the average amounts.

Kansas can truthfully claim to enjoy a larger amount of sunshine than the eastern States. The records show that the average cloudiness at Lawrence is a little more than 44 per cent. In the New England States the average is 53 per cent, in the southern States 47 per cent. In California the per cent is only 31, while in Great Britain it reaches 71, or nearly three-fourths of the sky.

The average direction of the winds in eastern Kansas is from the southwest. The average velocity of the wind at Lawrence is a little more than fifteen and a half miles an hour. This is sufficiently high to assist materially the proper ventilation of our houses and our clothing, but does not justify the common expression in other parts of the country that the Kansan lives in a continual gale. For the sake of comparison it may be mentioned that the average hourly velocity of the wind in Philadelphia is eleven, at Toronto nine miles; and at Liverpool thirteen miles. The greatest velocity recorded at Lawrence was at the rate of eighty miles per hour, from 3:34 to 3:45 A. M., April 18th, 1880. The average annual distance travelled by the wind at Lawrence is a little more than 138,000 miles. March and April are the two windiest months, the velocity rising to nearly twenty miles an hour. July and August are the two calmest months, the rate subsiding to less than twelve miles an hour.

The amount of moisture contained in the air is an important element of a climate. Much has been said in reference to the dryness of the air in Kansas, and on account of this quality many invalids, especially those suffering from difficulties of the throat and lungs, have received permanent benefit from a residence in this State. During the period of our observations, the average relative humidity has been 68, complete saturation being represented by 100. By this it is meant that upon the average the air contained a little more than two-thirds of the amount of moisture it was capable of containing. This percentage of moisture forms a very desirable mean between the very moist and the very dry, being alike favorable to the healthful condition of man, the domestic animals and the growing crops.

For a more extended discussion of the climate of Kansas, accompanied by complete tables for each month and year, the reader is referred to an article by the writer in the Second Biennial Report of the Kansas State Board of Agriculture, from which article some statements have been reproduced here.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

TEMPERATURE OF THE AIR.	Jan. 20th to 30th.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	—10.	-3.	-5.0	. .
Max	59.	68.	48.0	. .
Min. and Max	24.5	32.33	21.5	. .
Range	69.	71.	53.0	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	21 0	21.4	21 9	21.4
2 p. m.	39.3	34.9	29.1	34.1
9 p. m.	29.5	25.9	22.1	25.8
Mean	27.7	26.23	27.7	27.21
RELATIVE HUMIDITY.				
7 a. m.	91.0	90	. .	90 0
2 p. m.	59.0	74.5	87.6	75 3
9 p. m.	91.5	95.3	91.7	94.17
Mean	63.5	94.212	89.7	82.48
PRESSURE AS OBSERVED.				
7 a. m.	29.152	29.017	28.984	29.163
2 p. m.	29.228	28.183	28.473	27.123
9 p. m.	29.143	28.249	28.781	27.058
Mean	29.173	28.162	28.947	27.428
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles.	3432	2391	1943	7766
CLOUDING BY TENTHS.				
7 a. m.	5 5	8.77	6.6	6.953
2 p. m.	4.4	8.37	5.7	6.183
9 p. m.	3.2	7.33	5.5	5.343
RAIN.				
Inches.	0.25	1.95	0.93	1.043

In the period of this report, from January 20th to February 20th, snow fell on five (5) days, viz: January 26th, February 7th, 12th, 14th and 19th. On the night of the 12th during a storm of sleet and temperature below 20° F. a severe thunder-storm occurred. Although such storms are not unusual here in the winter months, the low temperature and severity makes this one worthy of note.

There were twelve days during the first two decades of February when cloudiness averaged more than 0.8. The 13th and 14th insts. were the coldest days, morning temperature −5° on the 13th.

On the 17th I saw a flock of ten robins. These birds and meadow-larks have been seen about here at intervals all this winter. There were a couple of days following the storm of sleet on the 12th when sleighs were out, but there has been no good sleighing here this winter.

STATE WEATHER BUREAUS.

We have many times had occasion to call attention to the value of a popular system of meteorological observations, particularly in those districts which are annually the scenes of terrible destruction dealt by tornadoes. The areas covered by these dreadful storms are so small that it is only by the closest observation that their development can be detected. We print elsewhere an outline of a system of "State Weather Services," proposed by the Chief Officer of the Signal Bureau at Washington, that commends itself to the attention of the Governors throughout the Union. The good results of a continuous record of atmospheric changes cannot be exaggerated, because there is not an industry in the country that would not derive some benefit therefrom. Not only would the cause of destructive storms be ascertained, but also the investigations as to the sources from which the different diseases dependent on atmospheric phenomena arise would be laid bare.

General Hazen, who since his appointment to the position of Chief Signal Officer, has made several changes in the service that cannot fail to call forth the approval of the public, now proposes a scheme which if developed, will prove of great benefit to every one. Over the broad expanse of territory lying between the Rocky Mountains and the Atlantic coast-line the Signal Service Bureau has about ninety stations, from which are sent to Washington three daily meteorological observations. By charting those reports the location and character of the areas of high and low pressure are discovered, and upon them depend the weather forecasts that are made every day at the central office. Owing to the small number of the stations they must be necessarily be very far apart; hence General Hazen's proposition, which is as follows: Each State in the Union should have an independent Weather Service for the purpose of gathering and utilizing local climatic data. By such a system the people would in time become conversant with physical conditions of every locality and be guided therehy. In the tornado season, the results of observations in temperature and humidity would be invaluable, because they would enable a correct forecast of their development to be made.

The State Weather Service may be wholly volunteer and under the charge of a director or superintendent appointed by the governor, or it may be made a part of the duties of some officer now authorized by law, such as the surveyor-general, the superintendent of public instruction, the president of some State college, etc. The observer in each county may be a volunteer, or it may be made the part of the duty of some county officer to make a daily record and monthly report. Observations should be taken, if possible, in all State, county, and municipal offices and institutions, such as jails. asylums, hospitals, libraries, colleges, high-schools, and water-works, and by toll gate keepers, surveyors, canal-lock keepers, etc. The instruments used should, when practicable, be of uniform patterns, carefully tested before use by comparison with known standards, and should include at least one maximum and minimum thermometer, one dew-point or other hygrometer, and rain-guage, all which, with a supply of blanks and stamped envelopes for one year, need not cost more than $15 per station. The director should be fully impressed with the importance of the work and should issue each month a "review of the weather," as obtained from the State observations. this review to be furnished to each county paper for publication and to each observer within ten days after the close of the month. The Chief Signal Officer will furnish sample forms, instructions for taking observations, price-list of standard instruments, and give any information relative to this subject which the experience of the Signal Service may afford. Systems similar to the above are now in successful operation in Missouri and Iowa, and will soon be organized in Indiana, Kansas, Illinois, and Nebraska. When all the States east of the Rocky Mountains have their separate weather services, and those co-operate with the Washington Bureau, the resultant accumulation of meteorological data will be invaluable. For the benefit of our legislators a specimen "act" on the subject is given below:

An Act to establish a central station of the Iowa Weather Service and for the appointment of a director thereof.—Laws 17, General Assembly, State of Iowa, chapter 45.

Section 1.—*Be it Enacted by the General Assembly of the State of Iowa,* That there be and hereby is established at Iowa City, a central station for the Iowa Weather Service, with Gustavus Hinrichs as director thereof, and in case of his death or disability his successor shall be appointed by the Governor.

Sec. 2.—The duties of said director shall be to establish volunteer weather stations throughout the State and supervise the same; to receive reports therefrom and reduce the same to tabular form, and report the same quarterly to the State printer for publication in the form of the Iowa Weather Reports.

Sec. 3.—That the State printer be authorized to print 2,000 copies of the said Iowa Weather Reports quarterly, 1,000 copies of which shall be distributed by said director and 1,000 copies delivered to the Secretary of State, to be by him distributed in the same manner as other State documents.

SEC. 4.—That there is appropriated the sum of $1,000 annually, or so much thereof as may be necessary, for the purpose of meeting the actual expenses in carrying out the provisions of this measure; but no part of said sum shall be used in payment of salaries to any officer or officers, except for clerk hire and upon the order of said director.

SEC. 5.—This act, being deemed of immediate importance, shall take effect and be in force from and after its publication in the *Iowa State Leader* and the *Iowa State Register*, newspapers published at Des Moines, Iowa.—*N. Y. Herald.*

HISTORY.

ORIGIN OF THE KANSAS ACADEMY OF SCIENCE.

JOHN D. PARKER, U. S. A.

When I was called in April, 1867, to Lincoln College, Topeka, there was no scientific association in Kansas, and no general interest in science apparent in the State. The people of Kansas had suffered intensely in the border strife followed by the civil war, of which at Topeka, there were still evidences in the rifle-pits along the southern edge of the town, and in the palisades still standing at the intersection of Kansas Avenue and Sixth Street.

Prof. B. F. Mudge, of the Kansas Agricultural College, had published a report on the geology of the State, and another report had been published by Prof. G. C. Swallow, late of the University of Missouri; Prof. Frank H. Snow had recently been called to the University of Kansas. Major F. Hawn, of Leavenworth, was working on the meteorology of the State. These scientists and some others were pursuing various lines of scientific investigation, but there was no organization to bring them together to secure the results which flow from association.

Impressed with the necessity of some society to accomplish this purpose, I determined if possible, to organize a State scientific association. After agitating the matter for several months, and not meeting with any encouragement at Topeka, I wrote to Prof. B. F. Mudge, who replied that his heart was with me in the work, but he feared it was too early in the history of the State to organize such a society. Accepting an invitation to visit him during the long vacation, I spent three memorable weeks at his home in Manhattan, when we discussed very thoroughly, during our scientific rambles in the neighborhood, the subject of a State scientific association. Before my return Prof. Mudge had promised to go into the new movement.

Fortified with Prof. Mudge's indorsement and promised co-operation, I returned home, and set the matter before the people of the State through the public press. In due time I circulated and published a "call," which received the signatures of various scientists and public men in the State, to hold a meeting in my recitation room, in Lincoln College, September 1, 1868. A great storm occurred two days before the meeting which seemed likely to interfere with it, but Prof. Mudge came down the day before the meeting full of enthusiasm in the new movement, and the meeting was held at the appointed time with a very small attendance. At this meeting we organized the Kansas Natural History Society, of which Prof. Mudge was elected the first president, and I was elected secretary.

For two years Prof. Mudge and I struggled hard to keep the organization alive, for we had great solicitude in regard to its very existence. Public attention was often called through the public press to the importance of sustaining the new organization, and wherever we lectured in the State we always presented the claims of the Society.

The first annual meeting was held in the Presbyterian Church, at Topeka, but there was a very small attendance and little enthusiasm. It was in fact a very gloomy time with the Society. There was little or nothing in the treasury, and no one seemed to care for science. But Prof Mudge was full of faith in our final success, and said "we must not despise the day of small things." We agreed to go on notwithstanding the discouragements, and determined we would not say "fail" until we actually did fail. The officers were unanimously re-elected, for there was great unanimity in the early history of the Society, when two or three votes settled the whole matter. In those days we were not troubled with any minority reports, and it was usually unnecessary to put the negative of the question, for all had voted in the affirmative.

During the following year we worked faithfully in trying to establish the Society, but with very little encouragement from the public. Everybody was very busy about something else, and science was left to take care of itself.

At the end of two years we received an invitation from Prof. Snow, indorsed by the other Professors of the State University, to hold the annual meeting at Lawrence. We gladly accepted the invitation, and the meeting was so well attended, and such a desire expressed to enlarge the scope of the Society, that I moved resolutions, which were unanimously adopted, that the scope of the Society should be enlarged so as to include every line of scientific investigation and inquiry, and that the name should be changed from the Kansas Natural History Society to the Kansas Academy of Science. General John Fraser stated that papers were read at that meeting by Professors Mudge, Snow, Bardwell and others, which were worthy of any veteran society. The meeting was one of joyful interest on the part of those who had labored amidst so many discouragements, for we believed that the permanency of the organization was now fully assured. The growth of the Society has in fact outrun all our early anticipations, and from this time on the history of the Academy has been more generally known to the people of Kansas. Lovers of science in almost every line of investigation have come forward and gladly carried on the work of the Academy, making original contributions in almost every department of science that have been known throughout the scientific world. But while we greet this ever increasing number of scientists, and give them all honor for their invaluable contributions to science, let us never forget the importance of the work wrought by Professors Mudge and Snow, in the early history of the Society.

The subsequent action of the Legislature in making the Society a State institution, and in giving it rooms in the Capitol building, was unsolicited, but it was a well deserved recognition by the State of the valuable but uncompensated services rendered to science by members of the Academy.

In this connection, I may be pardoned for saying, that the ultimate success attendant upon the organization of the Kansas Academy of Science, gave me encouragement, when I moved to Kansas City, to try and repeat the work there which I had been the humble instrument, with the assistance of others, in doing in Kansas. For seven years, I was permitted to work on, amidst the whirl of a large and growing city, in discouragement, and sometimes in financial embarrassment that almost paralyzed my efforts, in striving and assisting to lay the foundations of the Kansas City Academy of Science, whose interests are so intimately interwoven with those of the Kansas Academy of Science. Life has indeed been a hard struggle, and I have failed to realize many of my early ideals; but if the people if Kansas and Kansas City will continue to cherish these Academies so that they shall become a blessing to multitudes in coming years, and if these Academies will remember that they are closely related in origin, interest and work, and ever bear toward each other those fraternal relations which should characterize scientific brethren, I shall be recompensed beyond any expression of words.

BOOK NOTICES.

Proceedings of the Academy of Natural Sciences of Philadelphia: Octavo, pp. 128. Philadelphia, 1883.

This is Part II, June to October, 1883, and contains the results of much original investigation in different fields by such well known students of natural science as Professors Cope, Leidy, McCook, Heilprin, Meehan, Rand, and others. This society has been in active existence for nearly three-quarters of a century and has published many volumes of valuable transactions, etc. Its quarterly volumes of Proceedings are edited under the direction of the Publication Committee, by Dr. Edward J. Nolan, to whom all applications for them and all other publications of the Academy should be made.

THE COMEDY-BALLET OF GUEGUENCE: Edited by Daniel G. Brinton, A. M., M. D. Octavo, pp. 94; Philadelphia, 1883. Paper $2.00, cloth $2.50.

This is Volume III of Dr. Brinton's Library of Aboriginal Literature, the aim of which is to put within the reach of scholars authentic materials for the study of languages, history and culture of the native races of North and South America. It is a curious and unique work, being, as the editor states, the only specimen of the native American comedy known to him. It is composed in a mixed dialect, mixed low Spanish and corrupt Aztec, difficult of translation, and only valuable as exhibiting the peculiarities and characteristics of the natives, and giving the reader an idea of their humor, as well as of their colloquial language. The rendering of such pieces was, of course, accompanied with songs and dances. Although doubtless of recent origin, such pieces are not common nowadays, and as before stated, this is the only one ever published, as far as is known. It was obtained by the late Dr. C. H. Berendt, who prepared it by comparison of two manuscript copies in 1874.

The translation is preceded by an introduction by Dr. Brinton, in which the ethnology, the local dialects, musical instruments and dramatic exhibitions of Nicaragua are fully discussed. A map and numerous illustrations assist in making the text clear.

Several other volumes of this series are in preparation by noted ethnologists like Prof. A. S. Gatschet, A. F. Bandelier, Ernantez Xahila, and others, all of which will be edited by Dr. Brinton, and will possess rare interest to archæologists and other persons interested in American history.

TIMES OF CHARLES XII: By Z Topelius. 12mo., pp. 349. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.25.

This is the third of the "Surgeon's Stories" announced by us last year, the first and second having been "The Times of Gustaf Adolf," and "Times of Battle and Rest." To these are to succeed three others of similar character, which are now in preparation. The author is Professor of History in the University of Finland, from whose original text these historical romances have been carefully translated.

The volume now before us gives, under the guise of a romance, a very graphic account of the life of Charles XII of Sweden, and the historical and social events of the period between about 1697 and 1718, a period filled with exciting events of a very important bearing upon the subsequent history of Europe. The story is well told and the translation in most respects does justice to the author. The accounts of the great military efforts and achievements of Charles and his generals in Germany, Russia, Norway, etc., are admirably woven about by the thread of the story, which involves the career of the hero Gustaf Adolf Bertelsköld, General Armfelt, Count Horn and other notable personages of the period.

The book has been put forth in very handsome style by the publishers and will doubtless prove a very successful venture.

EARLIER VICTORIAN AUTHORS: Edited by William Shepard. 12mo., pp. 288. G. P. Putnam's Sons, New York. For sale by M. H. Dickinson, $1.25.

Under the title of "The Literary Life" the Putnams are publishing a series of small handsome volumes, edited by Wm. Shepard, of which this is the third. It contains familiar and instructive sketches, anecdotes and personal recollections of such authors as Bulwer, Disraeli, Macaulay, Charlotte Bronté, Irving, Poe, and Harriet Martineau. The introduction, in which our former favorite, N. P. Willis, is freely quoted, is entitled "Literary London in 1835" and is one of the most interesting and entertaining chapters in the book. In it are presented in the gossiping, inimitable style of Willis, pen-pictures of Lady Blessington, Count D'Orsay, Lytton Bulwer, Grisi, Tom Moore and others of the brilliant literary ornaments of British society at their time. These sketches are irresistibly attractive, and no one can fail to finish them after once having commenced them.

TWENTY POEMS FROM LONGFELLOW: Illustrated; quarto, pp. 61. Houghton, Mifflin & Co., Boston, 1884. For sale by M. H. Dickinson, $4.00.

As a model of excellence and beauty in book-making, this volume closely approximates perfection in paper, printing and binding, while the engravings, which are taken from paintings executed by Mr. Ernest Longfellow, the poet's son, seem absolutely unsurpassable in beauty and delicacy of finish. They are the work of Geo. T. Andrew, W. B. Closson, W. J. Dana, E. and J. Clement, John Filmer, N. Orr and F. G. Putnam, and number just fifty. The frontispiece is a portrait of Longfellow, different from anything before published and hence less satisfactory than that to which we have been so long accustomed.

Among the poems selected for so elegant a fitting are: "It is Not Always May," "The Village Blacksmith," "Cadenabria Amalfi," "The Lighthouse," "Moonlight," "Three Friends of Mine," "Mad River in the White Mountains" "Becalmed," etc.

FAMOUS PAINTERS AND THEIR PICTURES: Harry W. French. 4to, pp. 203; fifty full-page illustrations. Lee & Shepard, Boston. For sale by M. H. Dickinson.

Under the title "Gems of Genius" there are collected in this volume copies of fifty of the best paintings of modern days, each accompanied by a page or two descriptive of the artist and his works. The object of the author is to gain from the works of great artists, by social familiarity with them and their masterpieces, instruction, enjoyment and inspiration, and with this in view he has selected his subjects from the most popular studios of Europe in the last generation.

The first and one of the noblest conceptions of all is Kaulbach's Genius of Painting; following this are the Dowie Dens o' Yarrow by Sir I. N. Paton. King Arthur and the Mystic Sword, by James Archer. A Dream of Ancient Venice, by J. C. Hooke, R. A. Death Coming as a Friend, by Rethel. De Block's Reading the Bible. Milton and Galileo in Prison, by Eyre Crowe. Edward Armitage's the Socialist. Buying the Wedding Gown, by Wm. Mulready. The Stirrup Cup, by Faed. The Arrest, by C. Claes. Launching the Life-Boat, by T. Brooks, etc.

The object of the author is a worthy one and has been well executed in the selection of pieces as well as in the descriptive text. The publishers' work has also been well done.

ANIMAL AUTOMATISM AND OTHER ESSAYS: By Prof. T. H. Huxley. No. 53 of the "Library of Popular Science." Price, post-free, 15 cents. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by Kansas City Book & News Co.

In this volume are contained five of the most instructive and interesting of Professor Huxley's later essays: namely, that on the hypothesis that animals are automata, and its history; that on Science and Culture; on elementary instruction in Physiology; on the border territory between Animals and the Vegetable Kingdom; and on Universities actual and ideal.

OTHER PUBLICATIONS RECEIVED.

Animal Automatism, and other essays, by Prof. T. H. Huxley, *Humboldt Library*, No. 53, 15c. Pilot Chart of the North Atlantic for February, 1884, from Commander J. R. Bartlett, U. S. Navy. Report of the Construction of the New Pension Building at Washington D. C., from J. V. Wurdeman. Abstract of an Account of Recent Archæological Excursions in Wisconsin and Ohio, by Prof. F. W. Putnam, from the American Antiquarian Society, October 22, 1883. Announcement of the Correspondence University for 1884. *English Illustrated Magazine*, MacMillan & Co., $1.50. *Ecce Montezuma*, Vol. 1, No. 1, January, 1884, 4to., Albuquerque, N. M., $3.00. Double-Star Observations, 1879–80, at Dearborn University, Chicago, by S. W. Burnham, M. A., reprinted from the Memoirs of the Royal Astronomical Society of England, by the Society, 1883. Bulletin de la Societe De Sciences Naturelles, De Neuchâtel, Tome XIII., La liste des ouvrages reçus, publiée á la fin du Bulletin, tiént lieu d' accusé dé reception. *Missouri School Journal*, Vol. 1, No. 10, 4to., 16 pp , semi-monthly, W. T. Carrington and J. L. Holloway, Editors, Jefferson City, Mo., $1.50. Circular No. 4, Bureau of Education, Recent School Law Decisions, Lyndon A. Smith, A. B., LL. M. *Psyche*, a Journal of Entomology, Vol. 4, December, 1883, Cambridge, Mass., $2.00. Plant-Analysis for descriptions of Plants, by

Geo. G. Groff, M. D., 8vo., pp. 100, Science Publishing Co., Lewisburgh, Pa., 30c. U. S. Consular Reports, No. 36, December, 1883.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Automatic Closer for Electric Circuits.—This simple attachment for telegraph keys, etc., consists of a spring lever so arranged as to always keep the circuit closed when the instrument is not in use. The button-end of the lever rests, nominally, directly over the button of the key. The operator in the mere mechanical act of grasping the button of the instrument, presses down the button-end of the attachment, and so breaks the circuit that it may be rapidly closed and broken by means of the key, as is usual in telegraphing. This attachment has been perfected by Mr. S. J. Spurgeon, of Houstonia.

Automatic Damper for Stoves and Furnaces.—Every one realizes the necessity and understands the operation of the common rotary damper, that is, it is presumed so, still for the benefit of those who may not understand that when a large stove is placed in a small room, the temperature must be regulated in some way. The usual method is to open or close the room-doors, or if the stove-pipe has a damper, to leave off whatever important subject you may be engaged with and to close this damper, then after again becoming absorbed, to be aroused and find the temperature of the room, probably, near zero, and the room full of smoke, then the fire is replenished after the damper is opened, and the whole operation is repeated.

These are the well known characteristics of the hand-damper, and especially when it is used in connection with a soft-coal stove or a cooking-range. A damper has been recently patented, that has after a severe test of several months duration, not only overcome all of the disadvantages connected with the old hand-damper, but it has, by using wood or anthracite coal, cut down the quantity of fuel fully one-half.

The device is a very simple affair, and consists of a hollow circular cast- or sheet-iron chamber, having a pipe flange or collar upon each side. Now within this chamber, a damper is very nearly balanced, and it has a lever or handle attached to it, this lever extends outside of the damper-box, and upon it slides an adjustable balancing weight.

The weight may be set nearer to or further from the point of equilibrium, according to the temperature at which it is desired to hold the room. By a comparison, in principle, of this damper with an ordinary weighing-scales, its operation will be readily understood. When the draft becomes too strong, by reason of unduly rapid combustion, the damper is raised, and the draft stopped, then upon the fire resuming its normal temperature, the damper opens, and allows the products of combustion free egress, until the closing velocity is again reached. The name of the inventor cannot be mentioned at this point.

IMPROVEMENTS IN STEAM BOILERS.—Mr. W. R. Kirk, of this city, has receutly patented a steam pressure-boiler, the design of which is to enable tubular boilers to be easily and thoroughly cleaned and repaired, and it consists in taking a shell of a boiler of the usual form, the ends of the said shell are open, and within each is secured a ring, one of which has an external diameter considerably less than that of the opposite end. Fitted against and secured to the inner face of the smaller ring, is a head-plate which has such diameter as to permit its insertion through the larger ring. This head is secured in place by means of threaded bolts. A second head is in a like manner, fitted upon the outer face of the larger ring, this head has such increase of diameter over the smaller head as to adapt it to the larger opening to be closed. The two heads may receive any desired number of tubes and they are secured at their ends within said heads, and they are preferably placed in position after the heads are bolted to place.

The joints between the heads and the rings are preferably formed by elastic gaskets, in order that they may be easily broken and reformed. When it is desired to cleanse or repair the boiler, the fastenings of the heads are removed, and the entire flue-section is withdrawn through the larger ring, after which each part of the boiler is easy of access and can be readily cleaned or repaired. There is also a very promising method of clearing the scales and sediment from fire-box boilers that has been patented by the same inventor, and to this end it consists, principally, in a steam-boiler composed of a shell and an enclosed fire-box which are separable and have their contiguous walls, secured in relative lateral position by means of sliding interlocking stay-bolts. There are provided at suitable points around the fire-box, rows of radial bolts or studs, the outer ends of these rows are united by means of a flat bar, thus causing it to form for each bolt, a "T"-shaped head. Secured upon the inner face of the fire box shell in a line, radially with each bar, is a bar that corresponds in transverse dimensions to like features of the first-mentioned bar, the grooves and bars are made slightly tapering lengthwise, so that when the fire-box is being placed in position the bars will move easily until near the limit of their motion, and then when the fire-box is in position within the shell, said bars will closely fit into the said grooves so as to not only hold the parts rigidly in position, but also to prevent dirt and sediment from entering. The separation of this fire-box from its shell requires but little time, and by its operations the boiler may be made to last for many years.

CIRCULAR TO COUNTY SURVEYORS IN KANSAS.

PROF. F. O. MARVIN, PROF. CIVIL ENGINEERING, UNIVERSITY OF KANSAS.

POLE STAR TIMES FOR 1884.

DATE.	Upper Culmination.		Western Elongation.		Lower Culmination.		Eastern Elongation.	
	H.	M.	H.	M.	H.	M.	H.	M.
Jan. 1	6	32.5 p m	12	35.5 a m	6	34.5 a m	12	33.5 p m
" 6	6	12.8 "	12	15.8 "	6	14.8 "	12	13.8 "
" 11	5	53.1 "	11	52.1 p m	5	55.1 "	11	54.1 a m
" 16	5	33.3 "	11	32.3 "	5	35.3 "	11	34.3 "
Apr. 1	12	33.7 "	6	32.7 "	12	35.7 "	6	34.7 "
" 6	12	14.0 "	6	13.0 "	12	16.0 "	6	15.0 "
" 11	11	54.4 a m	5	53.4 "	11	52.4 p m	5	55.4 "
" 16	11	34.9 "	5	33.9 "	11	32.9 "	5	35.9 "
July 1	6	36.8 "	12	35.8 "	6	34.8 "	12	37.8 "
" 6	6	17.2 "	12	16.2 "	6	15.2 "	12	16.2 "
" 11	5	57.3 "	11	56.3 a m	5	55.3 "	11	54.3 p m
" 16	5	38.2 "	11	37.2 "	5	36.2 "	11	35.2 "
Oct. 1	12	36.2 "	6	35.2 "	12	34.2 "	6	33.2 "
" 6	12	16.5 "	6	15.5 "	12	14.5 "	6	13.5 "
" 11	11	52.9 p m	5	55.9 "	11	54.9 a m	5	53.9 "
" 16	11	33.3 "	5	36.3 "	11	35.3 "	5	34.3 "

Use local time. Interpolate for intermediate days. Upper Culmination is the time of passing the meridian *above* the pole. Lower Culmination is the time of passing the Meridian *below* the pole. Eastern Elongation is the time when the star is farthest *East* of the pole. Western Elongation is the time when the star is farthest *West* of the pole.

Sine of Azimuth=sine of N. P. D. divided by the cosine of the latitude.

Pole Star's N. P. D. for January 1—16=1° 18′ 14″
April 1—16=1° 18′ 32″
July 1—16=1° 18′ 46″
October 1—16=1° 18′ 23″

SIR:—I would respectfully call your attention to chapter 25, sections 158 and 159 of the Laws of the State of Kansas, and suggest that compliance therewith on your part will further the cause of science and enhance the value of all Kansas land titles.

Any information that can be given from this department will be most cheerfully furnished.

OBITUARY NOTICES.

DEATH OF DR. GEORGE ENGLEMANN.

Dr. George Englemann died February 4th. He had been ill for nearly a year, suffering from Bright's disease, but his last severe illness was comparatively short, and though it was not expected he would survive, his friends were not expecting his death so soon. He had lived in St. Louis since 1835, and for the greater part of that time was a practicing physician, most successful and honored everywhere. But while he was successful as a doctor, his real claim for recognition lies in his scientific researches and discoveries. He was one of the most profound botanists in the country, and was the greatest authority in the world on the cactus. He made several excursions through the West, accompanied by Prof. Asa Gray, of Harvard University, whose reputation as a botanist is of the highest. Dr. Englemann's career as a botanist began shortly after he came to this country, when he was located near Belleville, Ill. He wrote a monograph in Latin upon the habits of a little creeper he found on a hazel bush. It was printed in Germany, and made quite a stir among scientists on account of the minuteness and perfection of the observations. He has fully equalled in later developments all that was expected of him then, and St. Louis has seldom lost a man so truly great. Largely to him is due the honor of having introduced the present method of classification of plants based on microscopical examinations and investigations. His whole heart was given to his work, and the results have been of great benefit to every portion of science to which he devoted his investigations.

Dr. Englemann was born either in Cruznet or Frankfort-on-the-Main. His father was a burgomaster in Frankfort, and was able to give his son a university education. He completed his studies in Germany, and came a young man to a new country.

The St. Louis Academy of Science met at the Washington University, upon the announcement of the death of Dr. Engelmann, and a motion was adopted that the members of the Academy attend the funeral in a body.

Dr. Englemann has been President of the Academy for six consecutive years, and prior to that time he had held the same position for several alternate years. About the last time he attended the Academy he presented a meteorological report of the condition of the weather for every day for forty-nine years, and also giving the mean temperature for each year. He announced that he had been endeavoring to discover some law governing the weather, but had failed to do so. A member of the Academy expressed the hope that the half-century would be completed, when Dr. Englemann replied that he had some misgivings on the subject, a presentiment that appears to have been well founded.

A called meeting of the Medico-Chirurgical Society was held at its hall, 2334 Washington Avenue, to take action on the death of the eminent Doctor, who was one of the early members of the Societv. Remarks on the eminent character of the deceased as a physician and man of science were made, after which the Society adjourned, proceeding to the residence, 3003 Locust Street, in a body, to attend the funeral services. Here, too, assembled the German Medical Society, the Academy of Science and the other bodies of which the Doctor was an honored member. A large number of citizens of other professions were present.

The funeral discourse was pronounced by Reverend Dr. Eliot, Chancellor of Washington University. He dwelt on the indefatigable character of the deceased and his labors in the cause of science. The best monument to his memory, he told his associates in the Academy of Science, would be to build that institution up as he would have had it builded.

The meeting of the St. Louis Academy of Science, held on Monday evening, February 19th, was devoted entirely to honoring the late brother member and was addressed at length by Professor Nipher and Mr. M. L. Gray, after which appropriate resolutions were passed, including one providing for the procuring of a bust portrait, full size, to be kept in the rooms of the Academy. The remarks made were very impressive, and would have been published in this number of the REVIEW if they had been received in time.

DEATH OF PROFESSOR GUYOT.

Prof. Arnold Guyot, Ph.D., died, on February 8th, at his home in Princeton, N. J., at the age of seventy-six years. This eminent geographer was born near Neufchâtel, Switzerland, September 28, 1807, and was educated there and at Stuttgart and Carlsruhe, in which latter place he formed an intimate acquaintance with Louis Agassiz, and with him began the study of natural science, and they together investigated the glaciers of the Alps. Guyot studied theology for three years at Neufchâtel and at Berlin: but being deeply interested in scientific studies, he abandoned his preparation for the ministry and devoted himself to physics, meteorology, chemistry, mineralogy, zoölogy, and botany.

In 1835 he went to Paris, where he resided for five years, passing his winters in study, and the summers in scientific excursions in France, Belgium, Holland, and Italy. He made a tour in 1838 in Switzerland, and first discovered the laminated structure of the ice in glaciers, the motion of the central portion being more rapid than that of the borders, as in streams of water. He showed that the motion of the glacier is due to the displacement of its molecules. These important discoveries were fully confirmed and illustrated by the investigation of Agassiz, Fobes, and others, several years afterward. For seven years he explored the Alps in Switzerland and Italy, to determine the distribution of erratic boulders and the mode of their transportation. He explored a tract three hundred miles long and two hundred miles wide, and delineated eleven different regions of rocks, made over three thousand barometrical observations, and tracked the characteristic species of rock of each basin to their source. These investigations were to have been recorded in the second volume of the "Systéme Glaciaire" by Agassiz, Guyot, and Desor, but the breaking up of the University of Neufchâtəl (where Guyot was professor) by the Revolutionary movements of 1848 prevented this project, and they were never published. A topographical map of the subaqueous basin of the lake of Neufchâtel was prepared by him, the first of the kind ever published.

He was Professor of History and Physical Geography in the Academy of Neufchâtel from 1839 to 1848, when he left Europe and came over to America, soon after Agassiz, and by his persuasion took up his abode in Cambridge and drew immediate attention by a series of lectures deliveered in Boston in 1848–9, which Professor Felton translated for a newspaper. They were afterward published as a book, with the title "Earth and Man," which is still a popular work. Professor Guyot is best known in this country by his series of school geographies, which, appearing between 1866 and 1873, came into wide and general use in schools, and took rank at the head of geographic text-books. Guyot was elected Professor of Physical Geography at Princeton College in 1855, and subsequently Professor of Geology, and he has remained there ever since, being the senior professor of the College. He was the first to determine the true height of Mt. Washington in 1851, of the Black Mountains of North Carolina in 1856, and of the Green Mountains of Vermont in 1857. His contributions to science have been numerous and valuable.—*Journal of Education.*

EDITORIAL NOTES.

IN view of the terrible floods in the Ohio River again this year, public attention is being given to devising means to prevent their re-occurrence. In this connection we invite a re-reading of the suggestions of Rev. Albert E. Wells, of this city, in his article upon "Freshets and Overflows" in the August, 1883, number of the REVIEW.

IN the report on the Production of Swine in the United States, by Mr. Joseph Nimmo, a history of trichina is given, showing that it existed in Europe before the importation of American pork, and communications from the health officers of large cities, and other experts, are printed in support of the assertion that the danger arising from the consumption of pork is infinitesimal. In conclusion, tables are given showing the value of merchandise imported in this country from Germany and France.

THE German sanitary commission, which was sent out to Egypt by the imperial board of health to study the nature, causes, etc., of cholera, has discovered the cholera germ in a water tank at Calcutta, and found in the suburban village, where the cholera made its appearance, the same microscopic organism which has been discovered in the lower intestines of the cholera victims of Egypt.

THE French Academy of Medicine has, with one dissentient voice, pronounced in favor of a repeal of the prohibition of the importation of American pork.

THE tornado that swept over Alabama, Georgia, South Carolina, and North Carolina, last month, was without a parallel in this country, so far as the destruction of life is concerned. In Georgia, where its greatest fury was spent, it is reported that over three hundred men, women, and children were killed outright.

CONGRESSMAN DOCKERY, of this State, has introduced a bill providing for the appropriation of $12,000 for the maintenance of such additional signal stations as may be necessary to secure reports in regard to threatened dangers on account of floods. Should the proposed bill become a law, the people located on the great rivers and their tributaries will be forewarned of danger in ample time to take all possible measures for the safety of life and the preservation of property. From the results of such observations and reports in the past, there is no doubt that the work of the Signal Service could be made of increased value to the people by the methods proposed.

THE laying of the telegraph wires in Washington City underground has proved so successful that when tested by the reflecting galvanometer the insulation has been found perfect.

THE Salina Normal University, of Salina, Kansas, will be ready for the reception of students, September 2, 1884. The University building, now under construction, will be a large, commodious structure, ample for the accommodation of sixty to seventy-five students in its dormitory wing, and of five hundred to six hundred in the college wing. The Institution will be Normal, Scientific, Philosophical, and Classical, and its various courses of study are prepared carefully on that basis.

MR. F. H. FRANKENBERG, of Pueblo, Colorado, is about to utilize the raw soda found in the alkaline lakes of Wyoming Territory, by purifying it and converting it, at Pueblo, into caustic soda, concentrated lye, baking-soda, etc. It is believed that the cheapness and abundance of the material will enable him to manufacture these products on a profitable scale, and possibly glass also.

IN recognition of the good feeling of this Government in purchasing of its salvors the barque "Resolute," abandoned in the Arctic seas by Sir Edward Belcher, May 15, 1854, and restoring it to the British Government in December, 1856, that Government has just presented to the United States the steamer "Alert" to be used in the expedition for the relief of the Greely party early in this year.

THE Kansas Academy of Science has sesected Prof. H. E. Sadler, of the Normal School, at Emporia. to prepare a paper for the next annual meeting on the subject of chemistry, and Prof. Frank Kizer, of the city schools, on ichthyology.

WE have received the January number of the Kansas City REVIEW OF SCIENCE AND INDUSTRY, and find in it many articles valuable not only to the scientist but also to students and teachers, who, if they are at all interested in the scientific progress of the day, cannot afford to be without the REVIEW, which is one of the best journals of its kind published in the country.—*Western Normal Aavocate.*

THE death of Prof. Arnold Guyot, the distinguished scientist, removes a man who, next to Agassiz, was probably the most learned and useful physicist that we have ever had in this country.

IT seems a little singular that most of the scientific journals of the day have announced that the death of General Humphrey occurred November 28th instead of December 27, 1883, the latter being the correct date.

THE remains of Lieutenant DeLong and party arrived at New York on the afternoon of February 20th, and have since been interred with due honors.

PROF. PAUL SCHWEITZER, of the State University of Missouri, writes as follows on February 11th: "I enclose postal order for $5 00 for two years subscription to the REVIEW. Pardon the delay, which was partially caused by my late absence in Europe, and receive my appreciation of your efforts in maintaining a readable and interesting scientific journal."

WOLGEMUTH, the conductor of the Australian Expedition, has told some of the results of his work at a late meeting of the Vienna Geographical Society. He observed 124 auroras, about ten of which were crown-shaped. Among the old lava streams and in the crevices of the old and numerous craters of the island of Jan Mayen he discovered traces of a still progressing volcanic activity, and three times observed well-marked subterranean shocks.

A prize of $2,400 has been awarded by the Turin Academy of Sciences to Mr. Hormuzd Rassam for his discoveries in the field of Assyrian and Babylonian antiquities.

PROF. H. S. PRITCHETT, of the Washington University, St. Louis, on last Monday night, February 25, delivered a lecture on his trip to New Zealand last year with the Transit-of-Venus expedition. The account was pretty much the same as that from his pen published in the February REVIEW, but was illustrated with numerous views. Memorial Hall was filled and the audience was well entertained.

THE suit against General Di Cesnola for alleged frauds in the Cypriote antiquities sold by him to the New York Museum of Arts has resulted in his vindication, which is a source of congratulation, not only for himself, but also for the museum.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

A mass convention of American inventors will be held in Cincinnati, beginning March 25, 1884, in the Great Music Hall and Exposition Building of that city. There is a universal feeling among inventors that something must be done to protect their interests, and the convention to be held will seek to adopt some united form of action, and form state associations. All inventors and patentees are interested in this movement, and all who can attend, and desire to do so, should at once address the chairman of the executive committee, J S. Zebe, editor of the *American Inventor*, 188 West Fifth street, Cincinnati, Ohio.

THE opening paper in the *Magazine of American History* for February, by George Cary Eggleston, is a most effective piece of word-painting, the subject being "Our First Ten Presidents." Dr. Cyrus Thomas, the learned antiquarian, follows with an exceptionally readable essay on the "Houses of the Mound-Builders." Minor Topics contains a stirring letter from Lyon Gardiner Tyler, of Richmond, Va., concerning President relation to the Oregon Question; also a vivid description of "Some of the Cavalry Fights of the Comanches." The departments of Notes, Queries, Replies, Societies, and Book Notices are remarkably well sustained. This number of the *Magazine* is notably strong in all its varied and important features.

OUR former fellow citizen, J. E. Caven, is now publishing the *Popular Monthly* in Chicago, a magazine devoted to first-class literature only. We have received the February number and find its contents able, entertaining, and varied, and its appearance attractive. Price $1.50; clubbed with the REVIEW, $3.00.

THE *Globe-Democrat* says: The recent terrible coal-mine accident in Colorado, has directed attention to the necessity that exists in other states, for better laws and closer surveillance in the matter of mining operations. There is a general neglect in this respect, and no state, perhaps, does what it should to protect the lives of men engaged in mining. No law and no care can make mining entirely safe, of course, but improved systems of inspection and certain punishment for violations of fixed rules as to ventilation, etc., would, no doubt, lessen the number of accidents.

THE *North American Review*, now in its 69th year, maintains its high standing among thinking people by presenting able and reliable articles from the best informed writers of the day upon literary, political and scientific subjects. We copy a portion of Dr. A. N. Bell's article in the February number, upon "Stove and Furnace Heating," being his views of the subject in a discussion of the merits of the heating question between himself and Prof. Trowbridge. Among the most interesting in the March number are: "Is Our Civilization Perishable?" by Judge J. A. Jameson, who considers the several agencies by which the overthrow of the existing civilization might be effected. "A Defenceless Sea-Board," by General H. A. Smalley, is a description of the unprotected condition of the harbors and coast cities of the United States; and though the author employs none of the arts of the rhetorician, his statement cannot fail to awaken the people of this country to the importance of being in peace prepared for war. Other articles are "Literary Resurrectionists," by Charles T. Congdon; "How to Improve the Mississippi," by Robert S. Taylor; and "The Constitutionality of Repudiation," by D. H. Chamberlain and John S. Wise. $5.00; clubbed with the REVIEW, $6.50.

THE *Ausland*, a German weekly magazine of Geography, Ethnography, and Anthropology, published at Munich, has just entered upon its fifty-seventh year, and bids fair to outrun all its modern competitors in usefulness and erudition. In the first number of 1884, the able editor, Prof. Friedrich Ratzel, presents his readers with sketches on the distribution of marine algæ, on Malayan mythology, on Russian ethnology, on Waganda and Wanyoro commerce, on auriferous deposits of Atrato River (Isthmus of Panama), and on Homeric geography. To this is added the most recent correspondence obtained by him from African and Asiatic explorers, written from their fields of research.

IN the *Popular Science Monthly* for March we find, as always, many good things, such as "From Moner to Man," by Frances Emily White, M. D.; "Green Suns and Red Sunsets," by W. H. Larrabee; "Mexico and Its Antiquities," (Illustrated); "Fashion and Deformity in the Feet," by Ada H. Kepley, (Illustrated); "Science *vs.* the Classics," by Prof. C. A. Eggert; "The Chemistry of Cookery," by W. Mattieu Williams, etc., etc. The editorial notes and literary notes are always an attractive feature in this valuable magazine. D. Appleton & Co., $5.00: clubbed with the REVIEW, $6.50.

THE March *Atlantic* presents its usual excellent array of good articles, among which we note the continuation of S. Weir Mitchell's interesting story, "In War Time;" "The Discovery of Peruvian Bark," by Henry M. Lyman; "Don John of Austria," by Alexander Young; "The Girdle of Friendship," by Oliver Wendell Holmes; "The Sources of Early Israelitish History," by Philip H. Wicksteed; "English Folk Lore and London Humors," "The Contributor's Club," etc. Houghton, Mifflin & Co.; $4.00, clubbed with the REVIEW, $5.50.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

THE *Art Interchange*, of February 14th, contains a beautiful design in color—"The Butterfly Fairy." Other attractive illustrations are six designs for a fish set. These are both beautiful and unique. A crab-apple design for a panel, and another, from the Royal School of Art Needlework, at South Kensington, for sketching on linen, are both to be commended. A charming woodland scene is given as a suggestion for crayon work, and another (an artistic marine) as a study for pen-and ink sketch. In the "Notes and Queries" department, house-decoration, oil, mineral, and water-color painting, brass hammering, and kindred art topics are intelligently discussed.

THE March *Harper's Monthly* contains an illustrated article on "St. Louis," that possesses much local interest to western readers; "Hints on Domestic Decoration," by Alexander F. Oakey, well illustrated by the author; "The Drainage of the Ever-Glades," with ten maps, by W. Wallace Harney, besides many other sketches, stories, poems, etc, all illustrated in the most artistic manner. $4.00; clubbed with the REVIEW, $5.30.

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EDUCATION.

THE RELATIONS OF LAW AND MEDICINE.[1]

HON. S. O. THACHER.

The learned professions from immemorial time until a modern era included in three divisions the devotees of religion, medicine and law. Their fortunes have fluctuated with different epochs and exigencies and their relative values, significance and attainments have, by no means, been unvarying and persistent. Their domains have never been entirely distinct, but each has had much to do in regions familiar to one or both of the others. Yet, notwithstanding this communion of domicile, on the whole these pursuits of men have come on together with much forbearance and general good will.

It is quite true that every truth, natural or spiritual, must at the last be reconcilable with, support and fortify every other truth. The house cannot be divided against itself, and if one fact upturns another this last must be held to be a supposition, a mere spy and not a true man.

To disprove this harmony, of old the question was put by scholastic logicians, what would ensue were an irresistible force to meet an immovable body. Whichever way the answer came it was false. But suppositions like these do not affect the general statement that the solid irrevocable affirmations of religion, law and medicine, differing inasmuch as they apply to varying phases of life and

1. Delivered at the 15th Annual Commencement of the Kansas City Medical College, March 4, 1884.

matter, must have for each other the utmost accord. However wide the apparent gulf over it there is a bridge for the feet and between the most celestial truth and the most terrestrial there is a ladder whose golden rounds sustain the ever ascending and descending angels of recognition and friendship.

Something of this thought is in the words of Lorenzo to Shylock's Jessica,

> " There's not the smallest orb which thou behold'st
> But in his motion like an angel sings
> Still quiring to the young eyed cherubim:
> Such harmony is in immortal souls,
> But whilst this muddy vesture of decay
> Doth grossly close it in we cannot hear it.

Some of the old-time learning, confided to these professions in recent days, has passed into the keeping of other orders of proficient experts, and the acquirements of the teacher, the civil engineer and, more than all, of the fully panoplied editor, have either "molested the ancient solitary reign" of these pursuits or have given new force and direction to some parts of their original vocation.

The teacher of to-day is a far different person from the village schoolmaster of Goldsmith, and his field of action is covered with smoking batteries and rigid squadrons, the product of an age transcending in all great elements of progress any that has preceded it. The vast height and depth, the length and breadth of the curriculum of the most ordinary college of the land requires not one but many masters to unfold and impart. As we look in upon the higher circles of the teacher's life, the multitude and amplitude of his researches, in even one department of learning, suggests the mournful reflection of the old German professor of Greek, who, dying, bewailed that he had not given all his life to the dative case. Year after year we behold in our universities the division of chairs, the separating into different heads the investigation of what had before constituted a single line of instruction.

The complex character of the teacher's profession grows apace with its widening scope and importance. Not so distinct in its boundaries as the others, yet of immense importance and value is that profession whence comes the skill and wisdom to apply to the myriad uses of man the laws of nature, which tames the fiery spirits of the air and transforms into faithful and unwearying servants the blind unreasoning forces of the earth.

The profession which marks out the dimensions and mode of erecting a bridge over a turbid, violent river whereby one city shall become great and a dozen others well nigh ruined, which deals with iron lathes, gigantic trip-hammers and molten, metals until out of the commotion there comes into the tidal waters a ship that can cross the Atlantic Ocean in six days, lashed along its furious course by the fires of twenty-five hundred tons of coal, a profession that projects a path for the engine up and along dizzy precipices, through spiral tunnels in solid granite miles in length, which laughs at the efforts of the Pyrenees and the Mediterranean to stay the flight of the steam-horse and boldly takes up the gauge of battle thrown down by mountains covered with eternal snows, and fills their hearts with more piercing shrieks and groans than fell from the lips of Enceladus writhing under Ætna; such a calling may well claim an entrance into the circle of those called learned. Of the power and extent of that intelligence that informs the press of to-day, one may repeat the words of Carlyle:

"Great governors, clad in purple, with fasces and insignia, are governed by their valets, by the poutings of their women and children; or, in constitutional countries, by the paragraphs of their able editors."

It is the "fourth estate" of the French revolution, and though an English journalist, in a recent address, somewhat combats this exalted idea of the puissance of this new power in human affairs, yet even Mr. Hatton yields his assent to this conclusion: "It is not to be denied that the press is absorbing more and more of the power which once belonged to parliament, and is becoming more and more potent in all decisions affecting public interest."

In our own country the widespread intelligence and the reading habits of the masses give to the press, not only in its sphere of proclaiming public opinion as it reports speeches, debates and current events, but in its reasoning, argument and philosophy, the power to create or direct the thoughts of men, of which Carlyle exclaims: "Ever louder rises the plaint of such a multitude; into a universal continual peal of what they call public opinion. What king or convention can withstand it?"

Without entering into any discussion of the extent of the accomplishments, the moral and intellectual brilliance and worth that should inspire the words of this ubiquitous teacher, we may well confess that a profession that can daily produce columns sparkling with humor, weighty with thoughts upon themes of transcendent practical utility, political economy and problems of commerce, revenue and home thrift, or serious with contemplations of those sublime and mysterious subjects whose beginnings are in the sunlight of the To-Day, but whose unfolding and certainty lie amid the mists and silences of the unknown To-Morrow, may well find a name among the vocations of men called learned. And if I am told that this list is still contracted, that there be many more pursuits whose technical knowledge, difficulty and beneficence entitle them to this old-time distinction, I make no denial, but incline to admit the virtue of their claim.

The true preacher, lawyer and doctor find no difficulty in admitting that there are many folds of that shepherd he calls learning, and none are more ready than they to admit that in the realms of practical discoveries, inventions, science, philosophy, and religion, the world is yet, as portrayed by the great Newton, gathering shells here and there among the sands, while the wide ocean lies yet unexplored.

Having thus briefly recognized the equal worth and position of all those who pursue different lines of moral or intellectual investigation and acquisition, I may be permitted and without disparaging any, to dwell for a few moments upon some of the relations that link together the legal and medical professions. The two pursuits have many common lines of thought and history. On many sides and in many ways they glide into or overlap each other.

They emerge from the obscurity of civilizations long since extinct and they come into historic light with formulated systems, theories and principles, betokening research and discovery among people whose cities, temples and homes lie buried back and beyond authentic narrative or even reasonable conjecture.

The physicians of Homer were the sons of Esculapius, the fabled founder of the healing art, and the glimpses we catch of the knowledge of those dim eras, upon which, as yet, no light shines outside of that which flashes from the Iliad or Odyssey, show us advances in the line of organized medical knowledge far beyond the crude ideas of savage or barbarous tribes.

If it is probable that Schliemann has uncovered the site of the Ilium of ancient story, yet to what was sung by "the blind old bard of Scio's rocky isle," he has added nothing that throws into clearer effulgence the polity and wisdom of that distant day.

How settled and advanced were the laws and pursuits, the worship and learning of the nations that peopled the shores of the Archipelago in pre-historic times we still learn from those pages, whose pure refined diction indicate to us that back of Homer were ages of culture and civilization.

The side glances we there obtain of medicine reveal, to use the language of Dr. Payne, that "It already has a history." It was even then "a distinct and organized profession," and possessed a knowledge which must have come from long antecedent experience and observation. The antiquity of the profession doubtless exceeds that of any other. Its mutation and progress have been as marked as any. Who ever looks through the twentieth book of Pliny's Natural History, wherein he declares the medical properties of plants and the proper mode of extracting these virtues and particularly describes the diseases the decoction will cure, will easily see where the patent pill and lotion venders of to-day obtain so much knowledge. Some of these prescriptions read like an advertisement in a nineteenth century newspaper.

For the benefit of some men in great distress and whose "sands of life have almost run out," I give what the author says about the value of an herb he calls Porret. "The blades thereof stamped and laid to with honey healeth all sores and ulcers whatsoever, the biting of any venomous beast, the sting also of serpents are cured therewith." He commends it for deafness, "whistlings and crashing noises in the head." It will cure "headache, for which purpose," he says, "also it is good to poure into the eare when one goeth to bed and lieth to sleep two spoonfuls of the said juice and one of bonie." This medicine destroys pain in the back, hemorrhage of the lungs and consumption. Dropsy and jaundice flee from it and a "cataplasm of it cures green wounds." The author concludes, "finally it scoureth the pipes and cleareth the voice."

As Pliny gives the history of half a hundred other valuable plants equally rich in healing properties, it is a wonder anybody in his day ever thought of death. Through the flowing centuries the theories of medicine progressed with many stoppages and fluctuations until the eighteenth century, when they appear to have gathered into a more unified, intelligible and powerful science.

However we may look upon the different schools and their comparative merits, one can readily assent to the catholic remark of Dr. Payne: "From a theoretical point of view, Hahnemann's is one of the abstract systems pretending to universality which modern medicine neither accepts nor finds it worth while to controvert. In the treatment of disease his practical innovations came at a fortunate time when the excesses of the depletory system had only partially been superseded by the equally injurious extreme of Brown's stimulant treatment. Hahnemann's use of mild, and often quite inert remedies contrasted favorably with both. Further he did good by insisting upon simplicity in prescribing when it was the custom to give a number of drugs, often heterogeneous and inconsistent, in the same prescription."

And yet we also agree that medicine in its largest sense, while claiming a source in an obscured past, and unfolded, amplified and augmented by the genius and labor of untold years, is yet looking to the future for its golden day. Already it is finding the sphere of prevention as wide and as important as that of cure. Before it lie the foes of human life encamped in noxious malaria, fetid sewers, lethal contagion and morbific habits of mind and body, and the tremendous play of spirit upon function and organic life upon the invisible and higher nature are problems for medicine some day to solve.

Into its horizon are drifting great truths and discoveries whose dimensions are only vague conjectures, as the curling smoke above the far away white caps tells the sailor that yonder goes some sort of steam-driven craft, but whether it is a pleasure yacht or the Great Eastern he cannot say. Magnetism, electricity, anesthetics, inoculation, imagination and volition, touching the body and giving it life or death; how wide is the undiscovered country?

The profession not only looks back to Hippocrates and Galen but forward to the day when, in the words of Sir J. Y. Simpson, as quoted in a brilliant article in an English magazine, physicians "shall be familiar with the chemistry of most diseases; when they shall know the exact organic poisons that produce them with all their exact antidotes and eliminations; when they shall look upon the cure of some maladies as simply a series of chemical problems and formulæ; when medical men shall be able to stay the ravages of tubercle, blot out fevers and inflammations, avert and melt down morbid growths, cure cancers, destroy all morbific organic growths and ferments, annul the deadly influence of malaria and contagions, and by these and various other means lengthen out the average duration of mean life."

The new shall transcend the old and the morning twilight brighten into the perfect day. And now if we inquire through what experiences and perturbation has the sister profession of the law come during these thousands of years that medicine has been evolving its present noble position, we are called to note the common history of both, save, as was to be expected the healing art had earlier uses and records.

The assuaging of human ills began before there were regulations for the preservation of the rights of property, the settlement of disputed questions of inheritance, the redress of grievances between men or settled institutions and laws. The very origin of legal principles lies back of all our research, and over this question our law writers differ even more than do our medical theorists over the beginnings of their art.

A sturdy Austrian writer, Dr. Rudolph Von Ihring, insists with intense vehemence that "all law in the world has been obtained by strife. Every principle of law which obtains had first to be wrung by force from those that denied it."

"The law is not mere theory, but living force. And hence it is that justice, which in one hand holds scales in which she weighs the right, carries in the other the sword with which she executes it. The sword without the scales is brute force; the scales without the sword is the impotence of law."

But there are other equally as acute reasoners who hold directly opposite views, one of whom, Savigny, is thus cited by Von Ihring:

"The earliest law has been, the world over, the law of custom.

"This law has neither been created nor sought for. It came into existence of itself, just as language came, and developed internally in the convictions of the people, externally in the order of life.

"The legislature is, so to speak, to the law of custom what the physician is to nature. Nature should help itself; the physician should interfere as seldom as possible, for his presence shows that the normal condition is disturbed and disease exists."

Ranged in antagonistic and imposing array, along this line of debate, are great names, as Hale, Blackstone and others, and their arguments seem entitled to equal weight. But law, like medicine, however unknown in its earliest eras, had its growth, its servitude and exaltation. If the thread of medical research carries us back through the laboratory of the alchemist seeking the fabled elixir of life, and the solvent that should turn iron into gold, or into the chamber of the astrologist finding some relation between the conjunction of planets and the lines of the hand or wrinkles of the brow, whereby the ever haunting mystery of the future may be made an open page, so does the legal clue into the past lead us by courts trying old women "for riding on broomsticks or giving cattle murrain," or where the settlement of a contested right was left to the doubtful result of a personal contest called "wager of battle," and the innocence or guilt of an accused person was solved by various ordeals of water or fire, as exposing him to drowning in cold water, scalding him with hot, or by his walking barefoot over heated plowshares. Nevertheless, all these past centuries have given something besides dross to the solid and well compacted bodies of law and medicine. And the same outlook we find to-day in the one we also see in the other.

Both have a more important and perhaps commanding duty in the present in warding off evil results than in rectifying them. In a graphic sentence Macaulay ascribes to the attention given by the Royal Society after the great plague of 1665, and the great fire of 1666, to the subject of sanitary police, "the changes which, though far short of what the public welfare required, yet made a wide difference between the new and the old London, and probably put a final close to ravages of pestilence" in that country.

Very much of the serious and earnest labor of the lawyer of to-day is in so guiding the complex business of his clients, notably great mercantile establishments, companies and partnerships as to protect them from litigation and ensphere their rights in impregnable contracts and instruments. The law has its prophylactics as well as medicine. But not alone in these general features do these professions have analogies; they have always had intimate relations along that ever widening and extending territory we call medical jurisprudence.

Of course, I do not now allude to the help which now and then the lawyer renders to the doctor when a convalescent patient forgets to pay his bill, being in that regard under the influence or example of that important personage of whom the couplet runs:

> "When the devil was sick the devil a monk would be,
> When the devil was well the devil a monk was he."

Indeed there are quite a large number of persons in all commuities who do not look upon lawyers' fees or doctor's bills as a superlative means of grace. A sermon to such once in a while from the pulpit might do them good, at least it would give them the "benefit of the clergy." The growth, extent and variety of the questions which the student of medicine and the student of law must now master well illustrates and justifies the optimists' belief in the forward and upward struggle of the race.

The educated physician and the well read lawyer find the common problems of their callings increasing in number, complexity and refinement. The volumes on these questions yearly grow apace and fill ampler shelves in the library of the professions. In our day law and medicine are often deeply absorbed with investigations of cerebration. Human law, if not all law as applied to humanity, is pivoted upon the action and motive of beings capable of determining the boundaries of right and wrong and possessing the will to obey the one and reject the other.

The intimate yet veiled connection between the brain and the spirit, a relationship once so unknown that the presence of demoniacal agency was conjured up to account for actions which the science of to-day ascribes to a diseased sensorium, is ever presenting startling or tragic phases.

While yet at the bar it fell to the lot of William H. Seward to show alike his zeal for learning and his devotion to duty when he voluntarily took up the defense of the man Freeman, who had horribly put to death the Van Ness family. The whole region was shaken with horror over the event, and on its being known that the poor wretch whose bloody hand had perpetrated the deed was to be defended by the young and eloquent advocate, who believed the act that of a madman, many of Mr. Seward's best friends tried to dissuade him from appearing in a case whose outcome could only bring down upon his head calumny and detestation. He persevered. Before the court he produced the highest medical testimony, proving the existence of disease, which he maintained had touched the citadel of the man's reason and destroyed it. His labor for the time was unavailing, but before the day for the execution of the doomed man came death entered his cell door, even as Mr. Seward in his remarkable address to the jury told them medical science indicated. Then came the post mortem examination and lo, the dullest could see that the description Mr. Seward had given of the last stage of the diseased brain was based on unerring scientific research.

The press has lately been discussing the question of momentary or emotional insanity as proved in the Nutt trial at Pittsburg. From the general tenor of its reflections one would suppose that this state of mind was a barrier between the act and the doer of it erected with much pains and skill by the two professions. But it is nothing new. The insanity of Mary Lamb, which in a lurid moment made her a matricide, was of this broken nature.

With what weird words does DeQuincey paint this funereal shadow in the lives of the brother and sister: "Peace for you two, Charles and Mary Lamb! What peace is possible under the curse which even now is gathering against your heads? Is there peace on earth for the lunatic, peace for the parenticide, peace for the girl that without warning and without time granted for a penitential cry to heaven sends her mother to the last audit? Thou, also, thyself, Charles Lamb, thou in thy proper person shalt enter the skirts of this dreadful hail-storm; even thou shalt taste the secrets of lunacy and enter as a captive its house of bondage."

The frequency of Mary Lamb's paroxysms of dethroned reason and the lofty and unshrinking devotion of her brother through forty years of this strange life, is one of the most affecting narratives in the history of this dread disease.

Macbeth thus implores his physicians:

"Canst thou not minister to a mind diseased;
Pluck from the memory a rooted sorrow;
Raze out the written troubles of the brain;
And, with some sweet oblivious antidote,
Cleanse the stuffed bosom of that perilous stuff
Which weighs upon the heart?"

Our asylums for the insane are constantly sending from their doors those whose aberrations of mind have proved to be only temporary and susceptible of alleviation and cure. Doubtless the tribunal that finally determines whether the man was so distempered in mind as to be absolved from the consequences of his deed could be constituted out of better material than it usually is; a body of disinterested educated medical men should listen to this expert testimony, and pass the last opinion upon that phase of the case. But the fact remains that insanity, whether congenital and permanent, or only flecking here and there the lucidity of the mind, must ever be considered as an important legal defense to otherwise binding acts. Not only does it avoid the punitory result of an otherwise criminal action, but it affects the validity of all contracts, promises and even the most solemn obligations, when assumed under its disturbing presence.

In this vast field of inquiry within which also lie the often contested questions of imbecility, dotage, undue influence, dementia, inebriety and all those conditions of the intellect which are ranged under the phrase non compos mentis, the lawyer and physician find themselves exploring common ground, the one as a zealous advocate seeking to uphold a certain theory, the other as a devotee of science searching only for the truth.

The magnitude, detail and multiform phases of this investigation into the mental capacity augments with the growth, complexity and strain of civilization. The will of a dead millionaire whose life was replete with gigantic business operations and whose genius for accumulating wealth and selfishly conserving it in himself and his chosen son is manifest to the last, is impugned in a court of justices as being the product of a mind wrought upon by sinister influences and innuendoes until its testamentary capacity has gone. The curtains of damask and velvet that hung so thick around the inner life of the man are torn apart by rude hands and the world beholds what chimeras, whims and often inanities dwelt in the nature of the testator. After such an exhibition of wealth and littleness one is almost led to inquire whether, after all, it is not true, as one of the medical men in the Guiteau trial averred, that hardly any man can be set down as always and entirely sane.

The Colonel Dwight case, involving life insurance to an amount of nearly a quarter of a million of dollars, was lately tried and decided in Central New York, on almost wholly medical testimony which took in its range the laws of life and death in a remarkable degree. And on this same expert opinion are founded policies of insurance and payment of death or accident claims annually reaching into millions of dollars. Every policy of insurance represents a doctor's knowledge and a lawyer's skill. Law and medicine are frequently busied with suicides or homicides produced by poison.

The most exciting investigations grow out of this subtle and almost invisible cause of death. The toxicologist with his locked laboratory, sealed jars and potent reagents finally declares whether the particle of tissue submitted to his tests contained a deadly substance, its nature, and whether its approximate quantity was sufficient to destroy life. And over these questions doctors differ and lawyers grow red in the face in quite an astonishing manner.

This contrariety of opinion upon such a grave subject has subjected the medical profession to severe strictures, and yet if the critic would only examine he would find that usually the diversity of opinion grows out of the wisdom, observation and learning of one witness and the want of it in the other. For it is true that there are charlatans in medicine as there are noodles in law. And does not Burns say:

"E'en ministers that hae been kenned,
In holy rapture,
A rousing whid at times to vend,
And nail't wi' scripture."

But somewhere I must close a review which, carried to the end, would consume days. Burke tells us that there are two and only two, foundations of law: "And they are both of them conditions without which nothing can give it force; equity and utility."

"The one is what Philo with propriety and beauty calls the mother of justice," and the other is that "general and public utility connected with and derived from our rational nature."

And of medicine can we not say the same? Does not a lofty integrity inform all its best efforts? And is not beneficence the solid wall supporting its gilded and resplendent home? At the last it ends in this:

To draw from great nature the mysteries of being and its perpetuity to hold in due and proper balance the reciprocal functions of mind and body, and to smooth the downward path of physical life so that when the end comes we may go away from it,

"Like one who wraps the drapery of his couch
About him and lies down to pleasant dreams."

MINERALOGY AND METALLURGY.

THE EARLIEST USE OF IRON.

JAMES M. SWANK.

The use of iron can be traced to the earliest ages of antiquity. It was first used in Asia, the birthplace of the human race, and soon after the time when "men began to multiply on the face of the earth." Tubal Cain, who was born in the seventh generation from Adam, is described as "an instructor of every artificer in brass and iron." The Egyptians, whose existence as a nation probably dates from the second generation after Noah, and whose civilization is the most ancient of which we have any exact knowledge, were at an early period familiar with the use of iron, and it seems probable that they were engaged in its manufacture. Iron tools are mentioned by Herodotus as having been used in the construction of the pyramids. In the sepulchres at Thebes and Memphis, cities of such great antiquity that their origin is lost, butchers are represented as using tools which archæologists decide to have been made of iron and steel. Iron sickles are also pictured in the tombs at Memphis, and at Thebes various articles of iron have been found which are preserved by the New York Historical Society and are probably three thousand years old. Kenrick, in his *Ancient Egypt under the Pharaohs*, is authority for the statement that Thothmes the First, who reigned about seventeen centuries before Christ, is said, in a long inscription at Karnak, to have received from the chiefs, tributary kings, or allied sovereigns of Lower Egypt, presents of silver and gold, "bars of wrought metal, and vessels of copper, and of bronze, and of iron." From the region of Memphis he received wine, iron, lead, wrought metal, animals, etc. An expedition which the same king sent against Chadasha returned, bringing among the spoil "iron of the mountains, 40 cubes." Belzoni found an iron sickle under the feet of one of the sphinxes at Karnak, which is supposed to have been placed there at least six hundred years before Christ. A piece of iron was taken from an inner joint of the great pyramid at Gizeh in 1837. Both of these relics are in the British Museum. The reference to iron in Deuteronomy iv, 20, apparently indicates that in the time of Moses the Egyptians were engaged in its manufacture, and that the Israelites, if they did not make iron for their taskmasters, were at least familiar with the art of manufacturing it. "But the Lord hath taken you, and brought you forth out of the iron furnace, even out of Egypt." This expression is repeated in I. Kings, viii. 51. A small piece of very pure iron was found under the Egyptian obelisk which has recently been removed to New York.

The use of iron and the art of manufacturing it were introduced into the southern and western portions of Arabia at a very early day, and this may have been done by the Egyptians; it is at least established that some of their own works were located east of the Red Sea. In 1873 the ruins of extensive iron works of great antiquity and of undoubted Egyptian origin were discovered near the Wells of Moses, in the Sinaitic Peninsula.

The country which lay to the south of Egypt is supposed to have produced iron in large quantities. Iron was also known to the Chaldeans, the Babylonians, and the Assyrians, who were cotemporaries of the early Egyptians. Some writers suppose that the Egyptians derived their supply of iron principally from these Asiatic neighbors and from the Arabians. Babylon was built about seventeen centuries before Christ, and Nineveh was of about equal antiquity. Iron ornaments have been found in Chaldean ruins, and Chaldean inscriptions show that iron was known to the most ancient inhabitants of Mesopotamia. In the ruins of Nineveh the antiquarian Layard found many articles of iron and inscriptions referring to its use. Among the articles discovered by him were iron scales of armor, from two to three inches in length. "Two or three baskets were filled with these relics." He also found "a perfect helmet of iron, inlaid with copper bands." In the British Museum there are preserved several tools of iron which were found at Nineveh by Layard, including a saw and a pick. The art of casting bronze over iron, which has only recently been introduced into modern metallurgy, was known to the Assyrians. At Babylon iron was used in the fortifications of the city just prior to its capture by Cyrus, in the sixth century before Christ. In a celebrated inscription Nebuchadnezzar declares: "With pillars and beams plated with copper and strengthened with iron I built up its gates." The huge stones of the bridge built by his daughter, Nitocris, were held together by bands of iron fixed in place by molten lead.

The Book of Job, which relates to a patriarchal period between Abraham and Moses, contains frequent references to iron, even to "bars of iron," "barbed irons," "the iron weapon," and "the bow of steel." In the 28th chapter and 2d verse it is declared that "iron is taken out of the earth." In the 19th chapter and 24th verse the "iron pen," which could be used to engrave upon a rock, is mentioned. Job is supposed to have lived in the northern part of Arabia, in the Land of Uz, which was separated from Ur of the Chaldees, where Abraham was born, by the Euphrates. Iron ore of remarkable richness is still found between the Euphrates and the Tigris.

Moses led the children of Israel out of Egypt fifteen or sixteen hundred years before the Christian era. In the story of their wanderings iron is frequently mentioned. In Leviticus, vii. 9, the frying-pan is mentioned. When the Israelites under Moses spoiled the Midianites they took from them iron and other metals; when they smote Og, the King of Bashan, they found with him an iron bedstead. Canaan, the Land of Promise, was described by Moses in Deuteron omy, viii. 9, as "a land whose stones are iron." Iron is still made in the Lebanon Mountains. In Deuteronomy, xxvii. 5, 6, and in Joshua, viii. 31, the use of iron tools in building an altar of "whole stones" to the Lord is prohibited, which shows that, not only did the Israelites in the days of Moses have a knowledge of iron tools that would cut stone, but that the Egyptians must have possessed the same knowledge. After the Israelites came into possession of Canaan iron is frequently mentioned in their history, some of the earliest references being to chariots of iron, which the Canaanites used in their wars with them, and which were probably armed with iron scythes. Chariots of the same kind were doubtless used by the Egyptians. Frequent mention is made of agricultural implements and tools of iron, and of iron weapons of war. In the description of the armor of Goliath it is said that "his spear's head weighed six hundred shekels of iron." Axes and saws and harrows of iron are mentioned in the reign of David, and axes and hammers and tools of iron in the reign of Solomon. Isaiah also speaks of harrows of iron. Daniel says that "iron breaketh in pieces and subdueth all things." When David, about a thousand years before Christ, made preparations for the building of the temple he "prepared iron in abundance for the nails for the doors of the gates and for the joinings;" and in his instructions to Solomon concerning it he said that he had prepared "brass and iron without weight," and that of gold, silver, brass, and iron "there is no number."

It would appear that the Israelites in the early part of their history were not skilled in the manufacture or manipulation of iron, but were greatly dependent upon their neighbors for iron itself and for the skill to fashion it. In the reign of Saul, because of the oppression of the Philistines, "there was no smith found throughout all the land of Israel; but all the Israelites went down to the Philistines to sharpen every man his share, and his coulter, and his axe, and his mattock." When Solomon came to build the temple he sent to Hiram, King of Tyre, for "a man cunning to work in gold, and in silver, and in brass, and in iron." The Phœnicians were celebrated as workers in all the metals.

In Jeremiah, xv. 12, the question is asked by the prophet: "Shall iron break the northern iron, and the steel?" The northern iron and steel here referred to were probably products of Chalybia, a small district lying on the south-eastern shore of the Euxine, the inhabitants of which, called Chalibees or Chalybians, were famous in the days of Asiatic pre-eminence for the fine quality of their iron and steel. Herodotus, in the fifth century before Christ, speaks of "the Chalybians, a people of iron-workers." They are said to have invented the art of converting iron into steel, but it is probable that, as they used magnetic sand, they made steel mainly. Latin and Greek names for steel were derived from the name of this people. From the same source we obtain the words "chalybean" and "chalybeate."

But other eastern nations doubtless made steel at as early a day as the Chalybians. In Ezekiel, xxvii. 12, the merchants of Tarshish are said to supply Tyre with iron and other metals, and in the 19th verse of the same chapter the merchants of Dan and Javan are said to supply its market with "bright iron." Tarshish is supposed to have been a city in the south of Spain, and Dan and Javan were probably cities in the south of Arabia. The name Tarshish may, however, have referred generally to the countries lying along the western coast of the Mediterranean and beyond the Pillars of Hercules. Dan and Javan may have supplied iron made in the southern part of Arabia, or they may have traded in the "bright iron," or steel, of India. The period embraced in the references quoted from the prophet was about six hundred years before Christ. Both Tyre and Sidon traded in all the products of the East and the West for centuries before and after Ezekiel, and iron was one of the products which they supplied to their neighbors, the Israelites.

The Persians and their northern neighbors, the Medes, made iron long before the Christian era, and so did the Parthians and other Scythian tribes. The Parthian arrow was first tipped with bronze, but afterwards with steel. The Parthian kings are said to have engaged with pride in the forging and sharpening of arrow-heads. Iron is still made in Persia by primitive methods.

India appears to have been acquainted with the manufacture of iron and steel from a very early period. When Alexander defeated Porus, one of the Punjaub Kings, in the fourth century before the Christian era, Porus gave him thirty pounds of Indian steel, or wootz. This steel, which is still made in India and Persia, was a true steel, and of a quality unsurpassed even in our day. It was and still is manufactured by a process of great simplicity, similar to that by which crucible steel is now manufactured. Long prior to the Christian era, as well as for many centuries afterwards, Damascus, the Capital of Syria, manufactured its famous swords in part from Indian wootz. The people of India further appear to have become familiar, at an early period in their history, with processes for the manufacture of iron on a large scale, which have since been lost. It is circumstantially stated that a cylindrical wrought-iron pillar is now standing at the principal gate of the ancient mosque of the Kutub, near Delhi, in India, which is about sixty feet long, sixteen inches in diameter near the base, contains about eighty cubic feet of metal, and weighs probably over seventeen tons. The immense proportions of this pillar are not more striking than its ornate finish. An inscription in Sanscrit is variously interpreted to assign its erection to the ninth or tenth century before the Christian era or to the early part of the fourth century after it. In the ruins of Indian temples there have been found wrought-iron beams similar in size and appearance to those used in the construction of buildings at the present time. Metallurgists are unable to understand how these large masses of iron could have been forged by a people who appear not to have possessed any of the mechanical appliances for their manufacture which are now necessary to the production of similar articles.

The period at which China first made iron is uncertain, but great antiquity is claimed for its manufacture in that mysterious country. In a Chinese record which is supposed to have been written two thousand years before Christ iron is mentioned, and in other ancient Chinese writings iron and steel are both mentioned. Pliny the Elder, writing in the first century of the Christian era, thus speaks of the iron of China, the inhabitants of which were known in his day as the Seres: "Howbeit, as many kinds of iron as there be, none shall match in goodness the steel that cometh from the Seres, for this commodity also, as hard ware as it is, they send and sell with their soft silks and fine furs. In a second degree of goodness may be placed the Parthian iron."

It may be assumed as susceptible of proof that the knowledge of the use of iron, if not of its manufacture, was common to all the people of Asia and Northern Africa long previous to the Christian era. The Phœnicians would carry this knowledge to their own great colony, Carthage, which was founded in the ninth century before Christ, and to all the colonies and nations inhabiting the shores of the Mediterranean. Phœnician merchants obtained iron from such distant countries as Morocco and Spain, and possibly even from India and China, as well as from nearer sources. But in time the merchants of Tyre and the "ships of Tarshish" deserted the places that long had known them, empire after empire fell in ruins, and with the fading away of Asiatic and African civilization and magnificence the manufacture and the use of iron in Asia and Africa ceased to advance. Egypt has probably not made iron for nearly three thousand years, and probably no more iron is made in all Asia to-day than was made in its borders twenty-five centuries ago, when Babylon was "the glory of kingdoms, the beauty of the Chaldees' excellency."—*U. S. 10th Census Report.*

THE SUPPLY OF COAL.

PROF. D. E. LANTZ.

The attachments made by the American Forestry Association to the effect that our forests are suffering rapid destruction and that in a very limited number of years our timber supply will be exhausted, must have caused alarm in the minds of many people who live remote from the coal supply. Then, too, the mass of mining and commercial statistics, published from time to time at our great centers of coal distribution, must have increased the apprehensions as to the sufficiency of the fuel supply of the world.

But now comes the recent report of the U. S. Geological Survey with many consolatory figures on the coal supply of this country and Europe. This shows us that the enormous increase in the consumption of coal does not threaten an immediate failure in the world's supply.

The report places the area of the productive coal fields of this country at 192,000 square miles. That of Great Britain is put at 12,000 square miles. Exclusive of China, the entire production of the world is estimated at 360,890,000 tons. Of this aggregate, Great Britain furnished 154,000,000 tons, Germany furnished 61,000,000 tons, and our own country 92,000,000 tons, two-thirds of which was bituminous coal.

During the last twelve years, the annual product of the mines in the United States has increased 50,000,000 tons; but we have as yet touched only the surface of our coal resources. It is probable that the area of our coal fields is greatly underestimated. A producing capacity of 3,000,000 tons per square mile would be a small estimate of our supply. At this estimate, with an annual consumption of 360,000,000 tons, it would require 120 square miles a year to supply the world; and the coal in the United States alone would furnish this supply for 1600 years.

But the report does not include China, Borneo, Japan, and other countries whose coal statistics are not available. In China, several provinces contain great coal areas. Hoo-Nan alone has 2,700 square miles of anthracite coal fields. German scientists estimate that there is coal enough in China to supply the entire world for some hundreds of millions of years. Even England has coal enough to supply her own needs for three hundred years. In view of all this, it does not at present seem necessary to feel anxious about the supply of fuel in this or any other country.

But Kansans are more directly interested in obtaining their fuel supply cheap. Here at Manhattan, anthracite coal sells at $14 a ton. At the mines in Pennsylvania it costs less than a fourth of this sum. The expense of transportation more than quadruples the original cost. The semi-bituminous coal of Colorado costs us from $7 to $10 a ton. It may be consoling to learn that there is an abundant supply of anthracite coal in the mountains of Colorado, and that efforts are being made to bring this supply to our markets at such rates as will be remunerative to operators, and at the same time within the financial reach of the great mass of consumers.—*Industrialist.*

KANSAS COAL.

Six years ago where the two towns, Pittsburg and Weir City, are now the scene of business activity, and embracing a population aggregating 8,000 to 10,000 people, the country was nothing but raw prairie. Inexhaustible supplies of coal were discovered, and next in turn the workers in lead and zinc ores discovered they could transport the ores to the coal and manufacture them into merchantable lead and zinc much cheaper than bring the coal to the ore deposits. Pittsburg grew, Weir City grew, and around these two industrial centers, in Crawford and Cherokee Counties farm lands have enhanced in value from $5 per acre, six years ago, to $25 and $30 per acre, while the farmers are selling hams of their own raising for sixteen cents per pound, which brought four cents per pound when the smelters were first located; and so on have they found a ready and remunerative market for their labor since manufacturing has been established in their midst.

Without taking into account any other material than coal, what is true of the Second district can be wrought out of the future in other parts of Kansas, for the coal formation is widespread and inexhaustible throughout the State. The mining of coal in Kansas is comparatively an infant industry, one of a few year's growth only; but so far as it has progressed, the enterprise has proved satisfactorily remunerative, and has demonstrated that Kansas coal is the best for all domestic and steam purposes offered in the markets of the West.

Though only an infant industry, the possibilities of coal mining in Kansas with the attendant industries it is bound to attract, are manifestly shown by State Inspector Scammon's report regarding the coal mines, mining and the employment given in Kansas. His report embraces a period extending only from July 1 to December 31, 1883, the law creating his office going into effect on the former date. From the report, the industry in the State is represented by the following figures for the six months of the year beginning July 1 and ending December 31, 1883:

Bushels mined	13,377,875
In tons	535,115
Number of miners	2,833
Number of other employes	671
Total employes	3,504

Quoting the report it shows the wide extent of the deposits, the magnitude of the industry and the fair remuneration to those engaged in the industry.

In Osage County there are eighty-four coal shafts (five are stopes, but here for brevity considered shafts) located as follows:

Osage City and vicinity	31
Peterton	5
Dragoon	3
Burlingame	12
Scranton	17
Carbondale	14

Of this number, ten are worked out or abandoned, and in the month of December twelve were not operating, leaving sixty-two in operation—quite a number of these working but a few men. These shafts all operated by horse-power.

No. bushels of coal mined in Osage County	4,723,376
No. of miners	1,518
No. mine bosses and weighers	127

This classification of men is made because the miners are paid by the bushel and mine bosses and other employes are paid by the day or month.

Amount of coal mined per each miner, 3,110 bushels; per day for each miner, allowing 150 working days, twenty-one bushels; amount of money paid miners, $330,500; per miner, $217. Mining bosses and laborers not included, just actual diggers paid that amount.

Had the demand for coal been good and mining active the business would have been easily one-third larger and these figures correspondingly larger.

In addition to above amount of coal there was of stripped coal in the vicinity of Scranton and Carbondale, 707,153 bushels. Ninety teams and 120 men in stripped coal.

Thus, in Osage County, the output of coal for the last six months of 1883, was 5,429,520 bushels.

Miners employed	1,564
Laborers and strippers	201
Total	1,765

This does not include operators, superintendents, office-men, etc.

The coal mines in Cherokee and Crawford Counties are generally considered one coal district, the mines being located in the northern part of Cherokee and southern part of Crawford County: they are properly considered one district, and in this report I combine the two counties and give the business and output as one district.

There are twenty-five shafts (two of which are stopes); of these all but two are in operation.

Located north of Columbus	1
Newcastle	1

Stillson	1
Scammonville	4
Weir City	8
Pittsburg	5
Litchfield	2

Of these fourteen are operated by steam-power and eleven by horse-power.

Output of coal, bushels	5,796,877
No. of miners	817
Pit-bosses and employes	215
Amount mined per each miner, bushels	7,095
Per day each miner, allowing 150 working days, bushels	47
Amount paid miners	$217,000
Amount paid each miner	205

The average amount of coal mined by each miner appears small, but this calculation is made from the number of miners at work in November, which is larger than an average of the six months would be. The business would have been one-third larger had the demand warranted it.

Stripped coal in this district, 235,000 bushels, employing thirty-five teams and sixty men; total output in district, 6,031,877 bushels.

Number actual miners	835
Engineers, laborers and strippers	277
Total	1,112

Operators, superintendents and office men not included.

Leavenworth County, bushels		953,699
No. of miners	200	
Other employes	162	
Total		362
Penitentiary shaft, bushels		504,064
No. of miners (convicts)	131	
Laborers	15	
Total		146

There are several smaller mining districts in the State from which I have partial returns, and from some I have none. The reports I have combined in the following statement from Ellsworth, Russell, Neosho, Franklin, Bourbon and Linn Counties.

No. of bushels of coal mined	458,715
No. of miners	103
Laborers	16

Kansas has the wealth of Colorado's gold and silver mines in her coal mines, when fully developed, and seconded in their productive power by the manufactories, they will attract attention and capital in the near future.—*Kansas City Journal.*

TIN ORE.

The public has so often been advised of the discovery of tin deposits of commercial value through premature and in some instances groundless reports that it is scarcely in a humor to credit such statements now, even though they come from respectable authorities. Casserite tin, it is known, occurs in several widely distant localities in the United States, but inasmuch as capital has never been largely enlisted in developing the occurrences the notion obtains that they are of mineralogical interest only, and as regards most of them this is undoubtedly true. Still the possibility of building up a domestic tin-plate industry, should really valuable deposits be discovered, encourages the hope that somewhere in our vast domain tin occurs in such quantities and of such quality as to be commercially valuable.

The most promising occurrence of tin ore thus far made known probably is in the neighborhood of Custer City, Dakota. This district was visited by Prof. Blake some time ago, and from a letter of his to the *Engineering and Mining Journal* we quote as follows:

* * * Since my former communication upon the discovery of tin ore in the Black Hills of Dakota, other localities have been found. One especially, upon Spring Creek, is worthy of notice. The ore occurs there not only in alluvial deposits, in crystalline grains and masses about the size of grains of corn, but in veins of considerable extent and regularity. Samples sent to me show tin stone (black tin) disseminated in a gangue or veinstone of white quartz, with a little white mica in small crystals, thus approximating to the composition of typical "griessen." The chief vein is said to be about three feet wide, and to be traceable, but with occasional breaks and interruptions for a mile or more. It traverses a mica slate. * * * Development work has begun on the Etta or Tin Mountain claims, and the ground opens in a very encouraging way, showing large masses of the griessen, well charged with casserite. A mill has been contracted for and will soon be erected for the purpose of crushing and concentrating this ore. As the concentrations will be very pure and of high grades it is proposed to ship them to a smelter until arrangements are made for smelting at the locality.

Prof. G. F. Randall, of London, England, has also visited this district, and expresses the belief that "the tin mines of the Harney Range will control the markets of the world."

In the Temescal Range, San Bernardino County, California, 400 or 500 tin claims were reported located a year or so ago, but only one mine, the Cajaica, was developed to any extent. Very little has been said of the Temescal Range of late, from which it may be inferred that the yield of tin has fallen below expectations, and that work has been abandoned on most if not all of the claims. An analysis of the Temescal ore made by Dr. F. A. Genth gave the following results: Silicic acid 9.82, tungstic acid .22, oxide of tin 76.15, oxide of copper .27, oxides of iron and manganese, lime and alumina 13.54; total 100.

The tin occurrence upon which development work has been most actively and energetically carried forward in this country is that upon which the Broad Arrow Mines are located, near Ashland, Clay County, Alabama. The ore in that locality occurs both in lodes and as stream tin, and has been uncovered in four places, and these four open quarries constitute the Broad Arrow Mines. The tin stuff ranges from a trace up to two per cent, averaging one and a half per cent; and is said to be readily concentrated, and is besides free from all traces of arsenic and sulphur. Reduction works have been erected near the quarries since regular work began at the mines, March 2, 1883, the intention being to produce from gneiss ore carrying one and a half per cent tin about 500 pounds of crude pig tin a day. It is our information that the venture has not thus far been a commercial success.

Quite recently it has been noised about that tin ore has been discovered in Rockbridge County, Virginia. The ore is said to be found in Irish Creek, a few miles from the line of the Shenandoah Valley Railroad, near Vesuvius and Midvale Stations. Owing to the altitude of the locality, 2,700 feet above tide water, work can only be carried forward during warm weather, and as yet enough has not been done to determine the extent of the deposit. The ore has been cut at several points by shafts, however, and its richness pretty well determined by numerous analyses. It is of the variety known as casserite, or binoxide of tin, according to one authority, and from a specimen broken from the vein showed M. tin 63.583, M. iron 1.680, silica 8.415, sulphur .066, arsenic .301, titanium distinct trace. Other analyses gave varying results. One by Prof. A. S. McCreath of the average across the cut, taking tin stuff, quartz and wall rock, gave M. tin 31.63; one by Prof. Silliman, of Yale, of the best casserite sample gave M. Tin 68.00; one by Prof. Potter, of St. Louis, gave M. tin 63.81.—*Age of Steel.*

Influence of Scientific Studies.—While it must be conceded that force of expression and faculty in the communication of thought are best to be acquired through the philosophical, dialectical, rhetorical studies and exercises which in the main compose the curriculum of older institutions of our country, I believe it to be equally true that the faculties of clear perception, of careful discrimination, and of just generalization are developed by the study of natural history, of chemistry, of physics, as they can be through no other educational means.—*Gen. F. A. Walker, Boston.*

ENTOMOLOGY.

DISTRIBUTION OF THE COLEOPTERA OF KANSAS.

WARREN KNAUS.

The beetle fauna of Kansas is, in many respects, extensive and varied. This may seem to be the more remarkable, when we take into consideration the fact that the general surface of the State is almost entirely uniform throughout; no mountain ranges that serve to mark the habitat of distinct coleopterous tribes and families; no considerable elevations even, but a continuous undulating plain, covered over a great part of the surface by grass only, the forests being confined to the margins of the streams over the eastern half of the State, and scarcely existing at all over the western half.

This sameness of surface and vegetation,—the tendency of which is toward the uniformity of the beetle fauna,—is however, in almost direct contrast to the diversity incident on the geographical situation of the State. The late Dr. J. L. Leconte, in his geographical subdivision of the coleopterous fauna of the United States, says in effect;—that the whole region of the United States is divided by meridional lines into three, or perhaps four, great zoölogical districts, distinguished each by numerous peculiar genera and species, which, with but few exceptions, do not extend into the contiguous districts.

The central district, according to Leconte, extends from the prairies west of Iowa, Missouri and Arkansas, westward to the Sierra Nevadas.

Since the beetles of this region have become better known, however, it is, I think, generally considered that the Rocky Mountain region and the plains at its eastern base constitute a separate division, the coleopterous fauna of which is entirely different from that in the central division.

According to this division Kansas is located practically in three faunal regions, and her beetle forms are varied accordingly. The eastern portion of the State has many representatives from the eastern division of the United States; the central portion has a fauna of its own, and the western portion partakes largely of the fauna of the plains. Her fauna is still further increased by the addition, along the southern boundary of the State, of a number of forms peculiar to the subtropical fauna of the southern States. Contrary, therefore, to an early expressed opinion of one of our most noted coleopterists, Kansas is characterized by the variety and richness of her beetle families. The total number of species and varieties of Kansas coleoptera up to the close of 1883, I have summarized as follows:

Families.		Species and Varieties.	Families.		Species and Varieties.
1.	Cicindelidæ	32	38.	Duprestidæ	55
2.	Carabidæ	255	39.	Throscidæ	5
3.	Haliplidæ	3	40.	Elateridæ	73
4.	Dyticidæ	36	41.	Rhipiceridæ	3
5.	Gyrinidæ	5	42.	Dascyllidæ	7
6.	Hydrophilidæ	27	43.	Lampyridæ	23
7.	Trichopterygidæ	2	44.	Telephoridæ	25
8.	Staphylinidæ	141	45.	Malachiidæ	18
9.	Pselaphidæ	6	46.	Cleridæ	32
10.	Sylphidæ	18	47.	Lymelexydæ	1
11.	Scydmænidæ	2	48.	Cupesidæ	1
12.	Corylophidæ	6	49.	Ptinidæ	23
13.	Scaphidiidæ	9	50.	Spondylidæ	1
14.	Lathridiidæ	4	51.	Cerambycidæ	122
15.	Dermestidæ	16	52.	Bruchidæ	21
16.	Endomychidæ	5	53.	Chrysomelidæ	229
17.	Tritomidæ	9	54.	Tenebrionidæ	58
18.	Sphindidæ	1	55.	Allecullidæ	8
19.	Cioidæ	5	56.	Lagriidæ	1
20.	Erotylidæ	17	57.	Pyrochroidæ	1
21.	Atomariidæ	11	58.	Anthicidæ	26
22.	Cucujidæ	6	59.	Melandryidæ	15
23.	Bitomidæ	4	60.	Mordellidæ	34
24.	Colydiidæ	9	61.	Meloidæ	34
25.	Rhyssodidæ	1	62.	Oedemeridæ	4
26.	Rhizophagidæ	5	63.	Rhynchitidæ	9
27.	Trogositidæ	9	64.	Attelabidæ	2
28.	Nitidulidæ	30	65.	Byrsopidæ	1
29.	Phalacridæ	7	66.	Otiorynchidæ	22
30.	Coccinellidæ	49	67.	Curculionidæ	162
31.	Cistelidæ	2	68.	Brenthidæ	2
32.	Parnidæ	3	69.	Calandridæ	26
33.	Elmidæ	3	70.	Scolytidæ	7
34.	Heteroceridæ	6	71.	Anthribidæ	7
35.	Histeridæ	41	72.	Apionidæ	3
36.	Lucanidæ	7			
37.	Scarabeidæ	132		Total Species and Varieties	1,975

The total number of forms of Kansas coleoptera so far as identified, exceeds those of any other State or Territory, except I believe, Michigan with about 3,500 forms, and the District of Columbia with 2,600.

In glancing over the above summary, we notice at once the large number of forms in the first family, the Cicindelidæ. Out of a total of about one hundred forms in North America north of Mexico, of this family, one third are taken in Kansas. This large number necessarily includes many of the most desirable species for the cabinet of the collector; among which may be mentioned the Amblychila Cylindriformis, Say., of western Kansas, the largest, and until within a few years, the rarest of North American tiger beetles. Two other tiger beetles that have been taken abundantly in the last two or three years, are C. Circumpicta, Laf., southeast Kansas, and C. Belfrangei, Sallei, of central Kansas. These are both salt-marsh or fluviatile species.

The ground-beetles (carabidæ,) are found more abundantly over the central and eastern divisions of the State, being so far as known, more restricted toward the west. This family has been studied more closely than any other in the State, and stands at the head in the number of its forms.

The water beetles, (Dyticidæ and Hydrophilidæ,) are also more common throughout the eastern half of the State. Another numerous family, very abundant in eastern Kansas and extending westward, is that of the short-winged scavengers, (Staphylinidæ). One of the most extensive families in its diffusion throughout the State is the Scarabeidæ. The large Copris Carolina, Linn., of this family is found in the east; the splendid "Goldsmith Beetle" (Cotalpa Lanigera,) from east to west. And the giant of North American beetles—the Hercules—(Dynastes Tityus,) is taken in the extreme southern part of the State. The other families are of general distribution. The species of the eastern fauna disappearing frequently and giving place to the fauna of the plains, are those of the Buprestidæ, Elateridæ, Cerambycidæ, Chrysomelidæ, Tenebrionidæ, Meoidæ, and Curculionidæ families. Of these, the last five families contain in the western half of the State, many large and interesting species not found in eastern Kansas. This makes western Kansas—possessing as it does so many species typical of the plains fauna—one of the most desirable collecting grounds in the United States.

As yet the coleopterous fauna of the State has received, except in very restricted localities, but very superficial study, and the student and collector will find a rich field for investigation for years to come.

MEDICINE AND HYGIENE.

STEAM-HEATING.

PROF. W. P. TROWBRIDGE.

To the architect and sanitary engineer of the present day the terms warming and ventilation have certain technical meanings, and when employed together refer to systematic arrangements and appliances in the construction of dwellings, public buildings, churches, and halls of audience, by which not only may suitable temperatures be maintained in these structures, but proper quantities of pure and fresh air supplied continuously. It may be laid down as a fundamental principle that the warming and the ventilation of dwelling-places are equally indispensable to health, and that they are, to a great extent, inseparable in their relation to each other, and, ordinarily, in the appliances by which they are effected.

Four modes of heating, which furnish at the same time different degrees of ventilation, comprise all in common use, viz.: the open fire-place, the close stove, the hot-air furnace, and the steam-heating apparatus. A comparison of these methods involves, for each, the cost of the apparatus and its durability, the cost of fuel and attendance, and the efficiency of the apparatus for heating and ventilation.

The open fire and the stove furnish means for a constant supply of heat, through combustion of fuel, within the room to be heathed. The open fire gives off its heat to the walls and objects in a room only by radiation from the burning fuel, all the air that passes the heated surfaces of the fire-place going directly up the chimney. Hence, this method is inefficient for heating, especially when the walls of the room in which the fire is placed are greatly exposed to outside cooling influences. Moreover, much more air than is necessary for combustion passes up the chimney, from the very nature of its construction; and as this air must pass through the room to the chimney, it is difficult in general to avoid cold currents of air. Remote corners are apt to receive little heat directly, and the full effect of the open fire for a dwelling, requiring as it must, a fire for each room, is attained only at a great expense of fuel. While the first cost of the fire-place may not be great, the cost of fuel, except when such open fires are mere adjuncts to some other system, renders this mode of heating, as houses are now constructed and occupied, quite out of the question for the ordinary householder. As regards ventilation, however, the open fire is of all systems the most admirable.

The second mode of heating, the close stove, is doubtless of all modes the most universally practiced at the present day. Whether the stove be a simple structure of cast or wrought iron, having an interior chamber for the combustion of fuel, with a plain wrought-iron pipe to lead away the gases of combustion, or whether this simple structure be incased or provided with additional chambers and pipes for the more extended circulation of the heated gases, and to furnish the greatest possible heating surface, the statistics of manufacture alone furnish evidence that there is some especial advantage in this mode of heating which commends it to popular favor. It is not difficult to account for the preference: the stove can be placed at little expense in any room of any building where there is a flue for carrying off the smoke and the gases of combustion. The activity of the fire can be modified at will to suit any degree of external temperature; and as it is generally employed with the minimum amount of ventilation, and often with almost none at all, the economy of heat is all that can be desired. But in proportion as an active and sufficient ventilation is demanded, this efficiency of heating disappears; and since the usual practice is to trust for ventilation to the accidental influx of air through crevices in the window and door casings, the use of stoves is quite sure to lead to a vitiated atmosphere. Owing to the fact that the heating appliances of both the open fire and the stove are confined almost entirely to the room or apartment in which the fuel is burned, the heating of a building comprising many apartments, by these methods, can only be accomplished by increasing the number of fires or stoves. The economy which might be practicable for a single room then disappears to a great extent, owing to the increased cost of attendance, as well as waste.

Two modes of heating are in vogue by which the demands of economy and comfort are then met, viz.: the hot-air furnace and the steam-heating apparatus. The hot-air furnace is simply an encased stove outside of, and away from, the apartments to be heated, generally in the cellar or basement of a building. The casing or chamber within which the stove is placed is put in communication with the external air by an inlet conduit, which serves the double purpose of furnishing air for combustion and for supplying a number of rooms with heated air. To effect this two-fold purpose, there is a chimney direct from the stove for the removal of the gases of combustion, and one or more flues leading from the air-chamber around the stove, with branches for the different apartments, for that portion of the air which comes in contact with the heated surfaces of the stove and casing, and which then passes to the rooms. The air is usually heated to a temperature of 250° to 400°, and by mixture with cold air may be brought down to 150° to 200°, at which temperature it will enter the rooms. Air at these high temperatures must be further reduced in temperature and mingled with cold air in the rooms to be warmed, and for effecting this object reliance is generally placed on the accidental leakage at doors and windows. The expulsion of the heated air is accomplished by a spontaneous draft through flues from the heated apartments to the roof, or into halls and thence to upper stories.

A single furnace may thus heat very economically an ordinary dwelling; but the disadvantages and defects of the system are numerous. Beyond a certain limited distance from the furnace the difficulty of conveying heated currents in this manner increases very rapidly; and where there are branch ducts leading to many rooms, one branch may overpower another, causing excessive heat in one room and a deficiency in another. The proper ventilation of apartments is difficult, and the highly heated currents, having an increased capacity for moisture, are apt to convert the rooms to be heated into drying chambers, to an extent that is neither agreeable nor healthful. A few open fires, arranged to produce proper ventilation, mitigate very much some of these evils. For large buildings several hot-air furnaces must be provided, and the economy is proportionally diminished.

All of the above described methods have been supplanted to some extent, in this country at least, by steam-heating apparatus, or its practical equivalent in limited circuits, the hot-water apparatus. Even for ordinary dwellings, this system is being gradually extended; while for large blocks, such as apartment houses, hotels, manufacturing establishments, school-houses, and other large structures, the system is so greatly in demand as to have given rise to new and extensive industries devoted to the manufacture and installment of the necessary apparatus.

Steam heating is characterized by the fact that the heat is generated in the furnace of a boiler either within or without the walls of the building to be heated, the heat of combustion being transferred to water, which, being vaporized, constitutes the medium by which the heat is conveyed in comparatively small pipes to the points where it is utilized for heating purposes. Two distinct methods of utilizing this heat are practiced. In one the steam pipes are carried, by the most convenient course, directly into the room or space to be heated, where, by convolutions of the pipes, or what are known as radiators, an extended heating surface is furnished to the room. These coils, or radiators, give off heat both by radiation and by contact with the air, which is kept slowly circulating, as in the case of a close stove; and it is evident that only a feeble, or at least uncertain, ventilation is possible, except through special arrangements made for introducing fresh air. These heated coils are, in effect, identical with close stoves, the only difference being that the surfaces of the coils can never be heated to a degree higher than that of the steam,—practically, never higher than 310° nor lower than 215° or 220° Fahr., while the surface of the close stove may, under some circumstances, approach 950°. Active and sufficient ventilation may be attained with these coils, however, if they are placed in such a way that cool air, introduced through openings,—as, for example, under windows—will mingle directly with the heated air rising from the radiators, and then be deflected upward to be mixed with the general circulation, and discharged through ventilating flues. Of course, such active ventilation can only be attained at the expense of additional heat.

The other method, called by a strange misconception "indirect radiation," consists in conveying the steam from the boiler to small chambers constructed for the purpose, in the basement, directly beneath the rooms to be warmed. Here the steam pipe is extended into a coil, or an equivalent arrangement, by which a large amount of steam-heated surface is exposed. Flues for heated air lead from the roof of the chamber to the various rooms to be heated; an inlet duct for fresh air enters the bottom of the chamber, and the coils, or "radiators" are so arranged that the air in rising comes in contact with the heated surfaces, and passes to the apartments to be warmed with the temperature increased to 70° or 100° Fahr. Low temperature currents only are generated; and as the proper action of the apparatus can be kept up only by a continuity of flow into and out of the space to be heated, the two effects of heating and ventilation are most effectively conbined.

A comparison of these various methods must include the cost of the apparatus, the cost of attendance, the cost of fuel, and the incidental advantages and disadvantages belonging to each. The open fire-place possesses the advantage of giving thorough ventilation, but it is the most expensive in fuel. The close stove is highly advantageous in point of economy, where there is little ventilation, and as this is apt to be the rule, it is perhaps the least healthful of all methods as generally applied. Both of these methods become costly in attendance as well as in fuel when the heating of dwellings of many rooms is required, and are inapplicable to large structures and public buildings as they are now constructed. The hot-air furnace system is of all the most difficult to manage, so far as uniformity and control of temperature is concerned. The danger from fire, the dust, the defective ventilation, and the impracticability of heating more than a limited space by a single hot-air furnace are other defects inherent in this system. Steam heating involves greater first cost in apparatus than any other system. When this cost and the cost of attendance and repair are taken for a series of years, however, it is conceded that there is but little choice between hot-air furnaces and steam-heating apparatus as regards economy.

The special advantages of steam heating are:

1. The almost absolute freedom from risk of fire when the boiler is outside of the walls of the building to be heated, and the comparative immunity under all circumstances.

2. When the mode of heating is the indirect system, with box-coils or heaters in the basement, a most thorough ventilation may be secured, and it is in fact concomitant with the heating.

3. Whatever may be the distance of the rooms from the source of heat, a simple steam-pipe of small diameter conveys the heat. From the indirect heaters underneath the apartments to be heated, a vertical flue to each apartment places the flow of the low heated currents of air under the absolute control of the occupants of the apartment. Uniformity of temperature, with certainty of control, may be thus secured.

4. Proper hygrometric conditions of the air are better attained. As this system supplies large volumes of air heated only slightly above the external temperature, there is but little change in the relative degree of moisture of the air as it passes through the apparatus.

5. No injurious gases can pass from the furnace into the air flues.

6. When the method of heating is by direct radiation in the rooms, the advantages of steadiness and control of temperature, sufficient moisture and good ventilation, are not always secured; but this is rather the fault of design, since all these requirements are quite within the reach of ordinary contrivances.

7. One of the conspicuous advantages of steam heating is that the most extensive buildings, whole blocks, and even large districts of a city, may be heated from one source, the steam at the same time furnishing power where needed, for ventilation or other purposes, and being immediately available also for extinguishing fires, either directly or through force pumps.

It is only to be remarked, finally, that the most thoughtful among our physicians and sanitary advisors realize with anxiety the fact that there is a growing abuse of all these systems, except the open fire, in providing too much heat and too little ventilation. There is no mode of heating which lends itself to the correction of this evil so readily, however, as the steam-heating method. With proper care on the part of architects in arranging inlet ducts for fresh air, and ventilating flues heated by steam coils to accelerate the draft, any desirable degree of ventilation with low temperature currents may be secured. Such arrangements should, however, be studied in advance, and form principal elements in the design of a building, instead of being wholly subordinate, as is commonly the custom, to less important architectural features. It should be regarded as a fundamental principle in architecture, that the first and most important problem to be studied, after the general design of a building is determined, is the proper positions and magnitudes of heating and ventilating appliances for the structure as a whole, and for each room in particular; and not only should the details of the main and cross walls be modified and adapted to these arrangements where it is necessary, but no question of mere architectural propriety or appearance, nor even of convenience in use, should be allowed to interfere with objects so important to health as good and sufficient warming and ventilation.—*North American Review.*

ENGINEERING.

THE OHIO RIVER FLOOD OF 1884.

REV. ALBERT E. WELLS.

Every year we are led to expect a flood on the Ohio River. It appears from the papers that an annual record of these overflows has been kept since 1832. Yearly for half a century has some part of the valley been flooded. Now it is a river of great utility, the instrument of an enormous trade, the drain of one of the most fertile valleys in the world; a valley thickly settled by a thrifty and intelligent people, none more so in our country, and by fifty years experience it is known that there will be an overflow. It is time that some reflections should be drawn from so regular an occurrence. And so we have an abundance of press items and advice upon the subject. The one seeming most sensible to me of those that have come under my notice is that of Capt. J. P. Walker, of the United States Army. He suggests a system of reservoirs, and so practically endorses the article in your magazine of August, 1883, over my signature.

The valley of the Ohio contains 207,111 square miles. Its rainfall is given as forty-three inches to the square foot. Its total annual catch will therefore be

143,679,798,960 cubic feet.[1] The streams of the valley must expect to carry one-third of this bulk, i. e. a daily average should give the streams a supply of 131,214,428 cubic feet. A rainfall of six inches over the entire valley is a dreadful calamity, and that is not far from the estimate given of this flood. Experience with this valley shows with great certainty that the break-up of winter will be the annual occasion of great overflows. This year it reached a greater magnitude than ever before known. Let the estimate be one-tenth of its catch, 14,367,979,896 cubic feet, getting out of the valley in thirty days, or at the rate of 4,789,326,632 cubic feet a day. Now we have no power of handling this immense bulk of water after it gets in motion. But this is not all. This is the estimate upon clean water. It is very far from being that by the time it reaches the principal streams and the main river. Things that will come to the top are visibly floating in the shape of drift; things that will not water-log, i. e. gravel and silt, are clogging the flow and filling the space it should occupy.

The bed of this river affords sufficient room for any supply of water to pass that ought to find access to it. Its lowest depth and narrowest width between Pittsburg and Louisville are to its highest and widest safe gauge as 1 to 1320. If this margin of expansion be not enough no digging or leveeing of human devising will long hold its floods in restraint. If we can reduce this variation in flow from 1 to 10, a great deal would be gained. A vast improvement to the useful purposes of the river if the variation between extremes were not greater than from 1 to 3. For illustration, say its lowest stage be 400, its highest should not exceed 1200 in cross section. If by well-placed catches averaging eighty acres to every 25,000 drained, having a vertical margin of from 7 to 10 feet between their low and high water discharges, that the one should not exceed the other more than ten times, we would I think find a solution of the troubles now besetting the drainage of the Ohio Valley.

The streams of the Ohio Valley have no storing capacity, but being narrow, deep, and for the most part of steep slope, they hustle their catch of water into the main stream with undue haste. Room should be found in the smaller streams and near the top of each watershed for storing its extreme catch, say a six-inch rainfall, so that all of it would not leave the watershed for thirty days. A 1,000 acre watershed in this valley would give a daily flow of 990 cubic feet. A 25,000 acre watershed twenty-five times that, 24,750 cubic feet, daily flow. Under the circumstances of the flood of 1884 the catch of the watershed would be 2,709,750 cubic feet, over 100 times its daily output. It should be made to stand upon the order of its going over sixty days, i. e. for sixty days the reservoirs should have an outflow of nearly twice the average for the year. Make the stream capable of delivering two and a half times the 24,750 cubic feet, with

1. Though this seems a great array of figures is it the smallest I can make. And I am sure that the larger figures would only make the demand more evident for handling the bulk in detail. One estimate of this total annual catch gives the vast bulk of 20,689,887,828,600 cubic feet. This would greatly increase the daily average; but either set of figures is vast enough to demand thoughtful consideration, and that too in the line indicated by the article.

a rate of current not exceeding six or seven miles an hour. These things would be gained: Time for the catch of the lower basins to get out of the way a little and freedom from the silt of the upper basin. As the streams are now the catch of the watershed of 25,000 acres goes out of the basin in five days, to the utter confusion of the streams and valleys below it.

If we begin with a careful survey of every watershed and at the head of every hollow build our way out for its catch of water and make its storage capacity equal to the demands that we find made upon it, we work with reasonable certainty of success. The water-supply is known by measurement as we come into the lower valley and the time that it will take to reach the main river. This calls for considerable land. Yes, eighty acres to every 25,000, yet that is not much more than is now rendered useless by these ungoverned streams and open drains. For the local utilities that may be wrought by a competent engineering of the watercourses, see article "Rural Engineering," Kansas City REVIEW for December, 1883.

The opening of land to cultivation has had a great influence in increasing the liability to floods and overflows in the valley of the Ohio. It was originally covered by a dense forest that gave up the rainfall to the streams much more slowly than open fields. Yet in 1832, before this forest had been much destroyed there was an overflow. It is not at all likely that this valley will ever be relegated to forest again. The suggestion given here and advised by the army officer would seem to lie within the power of our people to carry out. That Congress can do much, I doubt. That it ought to do something is manifest, for it is a matter of national importance; but the parties having the matter under their keeping are those units of our commonwealth, the town and the county. Congress has but few rights which a farmer, a county judge and a surveyor in Pennsylvania or West Virginia are bound to respect. And if these benefits are ever to come to the people of this beautiful land, they must come through their own action, under the watchfulness of those immediately concerned.

In addition to proper catch-ponds care is required by the streams. Neglect of them is sure to bring a penalty. The drain of the unit of area that we have taken, 25,000 acres, will be required under an inch of rainfall to carry 225,606 cubic feet. There should be no unnecessary obstruction to the passage of such a bulk. It should not be allowed to reach the stream in disorder, nor be thrown into disorder after getting there by a too great rapidity of current and accumulated drift and silt. There should be a penalty for fouling a stream. In uniting with other streams care should be taken that they meet in a reservoir or pool. It need not be large, but there should be room for settling of the waters so that the outlet would not be crowded. Four areas of 25,000 acres is a watershed that will give ample supply of water for many a useful industry. A daily flow of 99,000 cubic feet at a rate of three and a half miles an hour is a stream that will afford many a pleasant row, and drive many a mill. Especially if you can hoard a supply over night, and if you can measureably control its supply. Ten such areas under control will form a river of useful navigation if it receives in the same line of drainage the catch of smaller watersheds, for a width of three miles each side of it.

Subjecting the tributaries of the Ohio River to such control would not be a difficult task for the éngineer corps. Obtaining the consent of the people of that region, would be a much harder task for the politician. In his behalf allow me again to quote my statesman DeWitt Clinton: "Every judicious improvement in the establishment of roads and bridges, increases the value of land, enhances the price of commodities and augments the public wealth." The grand work of his life was the Erie Canal. The statesman who will do for the Ohio Valley the difficult but grand object, the complete control of its water-courses, in behalf of the safety, the welfare, the commerce, and the beauty of a most delightful land, will deserve the lone of a grateful people.

THE PANAMA CANAL.

Count de Lesseps, although now seventy-nine years of age, may live long enough to see the waters of the Atlantic and Pacific united by means of the great ship-canal across the Isthmus of Panama with which his name will be forever associated. Whether he is spared to witness the completion of this, his greatest work or not, he will take his place in history with Fulton and Franklin and the other great benefactors of mankind through whose genius the possibilities of commercial intercourse have been indefinitely enlarged.

The report of Lieut. Raymond P. Rogers on the progress of the work on the inter-oceanic canal, which the Secretary of the Navy sent to the Senate a few days ago, leaves little doubt but that this stupendous work will be completed during the present decade, and Count de Lesseps himself thinks that it will be ready for ships in four years. Lieut. Rogers is of the opinion, however, that the colossal cuts in the Culebra section cannot be made in so short a time. Although this section is only a mile and a quarter in length, nearly thirty-three million cubic yards of earth and rock must be removed.

Dredging out the harbor at Aspinwall and Panama and constructing basins and quays at each end of the canal constitute no inconsiderable part of the work. A new channel for the Chagres River must also be dug along a considerable portion of the route, so that for twenty-seven miles on the Atlantic slope there will be practically two canals—one for ships and one to drain off the water of the Chagres and its tributaries. Of course this adds immensely to the cost of the work.

On the Atlantic side the difficult part of the work is to drain off the superfluous water, and on the Pacific side to cut through the rocky hills. In some places the cuts will be sixty-two feet in depth and 117 feet wide at the top. The cost of excavation in these cuts is from fifty-seven cents to $1.53 per cubic yard. From Matchin to the Pacific, a distance of about fourteen miles, these costly cuts are quite frequent. The whole length of the canal is forty-five miles, but the last two or three miles run along the shore of the Panama Bay, and the ship channel will be made by simply dredging out the Bay.

Although a Frenchman is at the head of this great work, and most of the capital is furnished by Europeans, yet American ingenuity is largely drawn upon for the active propelling force. Without the American dredging machines it would take so long to dig the canal that it would almost be impossible to raise the necessary capital, the possibility of earning dividends being too remote. With the American dredging machines the excavating is done with such rapidity as to bring the completion of the work within a reasonable period.

There are American dredging machines and steam excavators and American contractors all along the line. In some places a single one of these machines is throwing out earth at the rate of 5,000 cubic yards a day. Temporary railroads must be built at every cut, and, in fact, wherever it is necessary to carry the excavated material to a dumping ground. At the Emperador section, which is only three miles long, twelve locomotives are at work hauling away the earth thrown out by the excavators. In the Gorgona section an immense dam and reservoir are being constructed, which will receive the waters of the Upper Chagres.

About 15,000 men, mostly from Carthagena and Jamaica, are employed on the canal. The mortality among them has not been as great as was expected. The Europeans have suffered some from the climate. The rainfall at Aspinwall last year was 118.02 inches, and at Panama 36.62 inches. Twenty-five and a half inches of rain fell at Aspinwall in the month of August. Although he has no accurate information on the subject, Lieut. Rogers believes that $40,000,000 have been already expended on the canal. This is one-third of the estimated cost. Whether the remaining $80,000,000 will be sufficient to complete the work is problematic.—*National Republican.*

RIVER IMPROVEMENTS.

WM. H. MILLER.

The improvement of the Mississippi River is a subject in which the people residing in the valley of that stream have felt more or less interest from the time of the earliest settlement. The first effort in that direction was made at New Orleans within a short time of the first settlement there, and consisted of the construction of a short levee to prevent the inundation of the village by the annual floods. This form of improvement continued with a gradually increasing interest until the outbreak of the late civil war. After the Louisiana Territory became American possessions, and the settlement of the valley made the protection of the low lands more of an object and provided the wealth and population to prosecute such improvements, they were carried forward with greatly increased energy, and by State and local aid were pushed forward with such magnitude that by the year 1858 twenty-two hundred miles of levee had been constructed, extending along both sides of the river substantially from Cairo to the Balize, and covering all exposed and dangerous points except one reach on the west bank of the River in the New Madrid and St François River country of Missouri and Arkansas. With the outbreak of the war in 1861, these improvements stopped and much of that which had been made fell into bad repair during that struggle, and beyond some repairs little has been done at it since.

During the era in which these improvements were being made, the object most had in view was to protect the rich agricultural lands in the immediate vicinity of the river subject to inundation by annual floods. The river and its tributaries, the Missouri, Ohio, Illinois, Tennessee, Arkansas and the Red Rivers were all great channels of commerce, being navigated by steamboats which provided transportation for both passengers and freight. The steamboat was a very great improvement upon any method of transportation previously employed, but their expensiveness and inadequacy had not yet been shown by the competition of railways, hence the necessity of improving the navigability of the river had not made itself apparent. Soon after the close of the war this defect became prominent, railways extending from the Mississippi Valley to the Atlantic seaboard having diverted the course of commercial movements from the river channel.

As a remedy for this defect and to provide the cheaper transportation which water-courses afford Capt. James B. Eads, of St. Louis, proposed the improvement of the channel of the Mississippi so that it could be navigated with barge lines instead of steamboats, and the opening of one of the outlets into the Gulf, which constitute the Mississippi delta, so that the largest sea-going craft might enter into the deeper waters inside the bars. Under authority and by aid of the National Government this improvement was begun at South Pass, consisting of a system of jetties, to confine the water into a narrower channel and thus cause it to do its own dredging. The conclusion of this work was so successful in providing a sufficiently deep channel, and also in showing the practicability of such improvements on the river that it was then proposed to extend it to all shoal places along the Mississippi and its navigable tributaries. With this view the Mississippi River Commission was instituted by Congress for the Mississippi River proper, and able engineers of the Army were detailed to take charge of the improvements of the tributaries.

The first work to which the Commission and the engineers addressed themselves was the surveys of the river, geographically, hpdrographically, and hydrometrically, with a view of determining the extent of the improvement to be made, its ultimate cost and methods. These surveys having been completed, it was found that the Missouri River and the Mississippi below the mouth of the Missouri, was in character substantially the same stream, easy of improvement and requiring substantially the same methods. These two streams, as far down as Lake Providence at least, run through an alluvial and sandy soil. They have great fall and hence a rapid current, which rapidly cuts away the banks wherever it strikes them, thus filling the water with sediment. The water striking one shore is deflected to the opposite, like the rebound of a billiard ball from the cushion. Being thus thrown from side to side, the water in making crossing has naturally less fall and a wide area of channel width over which to spread, thus forming shallow places or bars. This gives the river the appearance of a succession of deep pools between which intervenes a shallow. As was said by Hon. Robert S. Taylor, of Indiana, a member of the Mississippi River Commission, in an address before the Merchant's Exchange, of St. Louis, if the water could be lifted out of the bed of these rivers so that the true shape of the channel could be seen, it would be found to be a succession of deep hollows divided by high sand-hills, the ridge of the latter lying crosswise of the stream.

The problem of improvement for purposes of navigation thus resolved itself into two. The first consists of protecting the wasting banks and thus preventing the shifting of the channel, and by stopping the erosion to reduce the sediment. The second was to provide methods for narrowing the channel at the shallow places and thus causing the river to dredge them out itself and thus deepen the channel. The means adopted by the Commission in the Mississippi and by the engineers on the Missouri consists of a revetment of the wasting banks; that is to say a mattress-work of willows and other brush is woven with wire and spread along the wasteing bank from the bottom of the channel to the low-water mark. Above this the steep bank is sloped. So far as this means has been applied on the Mississippi it has proven efficacious. Whether it will do so in the more sandy soil of the Missouri and under the erosive action of its more rapid current does not yet appear to have been fully demonstrated. The means employed in the second case—the deepening of the shallow—consists of the construction of jetties similar in character to those employed at South Pass for the restriction of the water and to procure its scouring effects. This has proven efficacious in the Mississippi but has not yet been sufficiently tested in the Missouri. All who understand the stream, however, entertain a doubt of its efficacy, but the engineer in charge, Major Charles R. Suter, is sanguine that it will provide in the Missouri a minimum depth of water of twelve feet.

Another form of improvement required on the Mississippi, and perhaps on the Missouri also, consists of the closing of "chutes" or by-channels, at islands, so as to confine the water to one channel. This is done by driving piles across the heads of such channels and filling in between with brush up to the low-water level. This causes the river to form a bar in such channels below such works and thus with comparatively little work and expense, utilizes the river power to dam such channels. This has proven very efficacious in the Mississippi and can hardly do otherwise on the Missouri.

The cost of the whole improvement cannot now be definitely estimated. It was at first supposed that $40,000,000 or $50,000,000 would be adequate for the Mississippi, and Major Suter estimated the cost of the improvement of the Missouri at $10,000 per mile, making a total of about $8,000,000 for that part of the river between Sioux City and St. Louis. Whether such sums will be adequate depends somewhat upon the way in which the appropriations are made by Congress. Much work has been done on the Missouri which has been found useless because the appropriations were so far short of the estimates for the locality to which they were applied that the work was insecure and washed away. True economy in this respect demands adequate appropriations, so that the work done may be completed and well secured between floods. It depends also somewhat upon the skill of engineers in estimating the strength and character of the works required to resist the powers of the river. The methods are to some extent experimental, and in some instances mistakes have been made, resulting in the loss of the works. Mistakes of this kind, in working upon a stream so little understood as this river, are inevitable but the experience so far had is a guide, and a guard for the future. These sums seem enormous, and the possibility that they may not prove inadequate makes people and Congressmen timid about entering upon a work involving such outlays. However, for a people who have given nearly two hundred million acres of land worth not less than twice these figures in money, and who have guaranteed bonds to the extent of over $100,000,000 more for Railroads such expenditures should not be alarming. It must be remembered that the object in the one case is the same as in the other—to provide transportation facilities for the people, as a means of increasing the prosperity of their industry. The Government having adopted the policy of making such improvements, and the results so far having fully warranted it, there should be no hesitation on account of the sums now required, provided it can be made clear that the results will justify the expenditure in this particular case.

The railroad system of the United States, constructed by private capital, is now very extensive, and is adequate to handle the products of the people. Why then spend so much public money to make this river improvement? Because it provides cheaper transportation for cheap, bulky products than the railroads now or ever can provide. This fact may be illustrated by a quotation of estimates contained in a memorial to Congress presented in 1882, by representatives of the Missouri River Improvement Association. These estimates took Kansas City as their initial point and the grain of the Missouri Valley alone as their base, and finding that the rail rate east of the seaboard was thirty-three cents per bushel on wheat and twenty-eight cents per bushel on corn, while the barge-rates to New Orleans, and additional ocean-carriage from New Orleans to Europe was fifteen cents per bushel, it was found that the water carriage offered a saving of eighteen cents per bushel on wheat and thirteen cents per bushel on corn. Finding then that the Missouri Valley country produced in 1879—the census year crop—61,117,379 bushels of wheat, and 414,379,526 bushels of corn it was found that the saving by the employment of water transportation would have been $64,865,229 for that one year alone. True, all the products of the valley would not have been thus moved, but since the price of grain in the Missouri Valley is the European price, less carriage and cost of handling, this sum would have been the value added to the products of our grains by the employment of water transportation. If we consider the extent of agricultural product in the

Valley of the Mississippi and its navigable tributaries, and apply to it such differences for one year only, the saving makes such enormous figures as to make the most extravagant estimates of the cost of the improvement appear quite insignificant. Indeed, the benefits derived from the aid granted railroads afford no comparison with it.

Another fact which bears strongly upon this branch of the subject is that the bulk of our exports consists of agricultural products. According to statements made by Hon. Joseph Nimmo, Chief of the Bureau of Statistics of the Treasury Department, products of agriculture made up $500,000,000 of our exports in 1882, while products of manufacture made up but about $103,000,000. And what is more inportant in this connection was the further statement of Hon. Joseph Nimmo that ninety per cent of this agricultural product came from the Western States, that is, the Mississippi Valley States, the other ten per cent being presumably the cotton of the Gulf States and the wheat of California, for the eastern and manufacturing States consume all their agricultural products and more.

Such being the facts in this case and such the benefits to be secured it seems that there should be no hesitation on the part of Congress to make the appropriation, especially since the treasury is in a plethoric state, and Congressmen are puzzled to know what to do with the money or how to prevent its accumulation without cutting off duties which would leave important industries to suffer. It certainly seems that there should be no hesitation on the part of the people, and that their duty to themselves clearly points to the demand that their members of Congress should make this river improvement a matter of paramount consideration, or give place to others who will do so.

ANTHROPOLOGY.

RELICS OF THE SANTA BARBARA INDIANS.

REV. STEPHEN BOWERS, PH.D.

Point Concepcion is 250 miles southeast of San Francisco. Here the shoreline of the Pacific trends eastwardly, and for the distance of nearly 100 miles runs nearly due east and west. Parallel with the shore-line and about thirty miles distant is a chain of islands, four in number, the smallest of which is but a few hundred yards wide and five miles long. The largest is twenty-two miles long by about five miles in width. The counties of Santa Barbara and Ventura, including the islands, embrace the territory in which lived what we may denominate the Santa Barbara Indians. Further out in the ocean are other islands once inhabited by Indians, but whether they belong to the Santa Barbara stock is not known.

Our first historical knowledge of these Indians dates back 342 years, or to the year 1543, when Cabrillo discovered this coast. He represents this portion of California as thickly populated with Indians, and somewhere not far from the town where the writer is living and dating this communication, he speaks of a large Indian town called by the natives, *Xucu*, but which he named De los Canoas, because of the great number of canoes owned by the Indians at that place. While anchored here two Indians came on board of one of his vessels and pointed out twenty-five Indian towns, the names of which Cabrillo records.

For 100 miles along this coast between Point Concepcion and Point Magu, the writer has examined about one hundred rancherias, or sites of old Indian towns. Back in the mountains and along the streams in the territory above mentioned they are also abundant, while the islands are literally covered with their shell-heaps or kitchen débris.

This genial climate and the abundance of food produced by land and ocean made this a desirable spot for the Indian, who is naturally antagonistic to labor. The sea yielded abundance of fish, mollusks and water-fowl, while the foot-hills and mountains contributed much game. In their shell heaps may be found every variety of mollusks now known here, prominent among which were edible clams and the *haliotis*, all of which still exist along the sea-shore. The bones of whales, seals, sea-lions, sharks, black-fish, porpoises and many other fish are prominent in the old rancherias; also the bones of water-fowl, deer, bears, etc. This section was the Indian paradise of the Pacific coast. When the Jesuit Missions were founded here a century ago the islands and the mainland teemed with multiplied thousands of Indians, but now none are left to tell the story of their existence. They rapidly faded away before another form of civilization. Most that we can now learn of this race is obtained from their burial places, which were generally located in the midst of the village. They seemed to have had but one method of burial and that was to draw the knees up against the breast and place the face downward, burying one on top of another. In some places in a radius of a rod or less the writer has exhumed a hundred skeletons. These were found from one to four feet below the surface, and in some cases, six and even eight feet.

It is most likely that all the earthly effects of the individual were buried with the body, but only the stone, bone and shell implements and ornaments remain. In some rare instances the writer has discovered ornaments of redwood, which of all California wood is probably most durable. Coarse cloth has also been found with the skeletons. After the Missions were established the Indians were probably buried in the cemeteries of the priests, and it is not likely that burials have taken place in the rancherias later than seventy years ago. It is known that the last of the Indians were removed from the channel islands nearly seventy years since, yet thousands of skeletons have been dug up on these islands in a fine state of preservation, while the shells in the rancherias still retain their markings perfectly.

The relics found with the dead often show superior workmanship. Mortars of sandstone were made by dressing the outside to the shape of a cast-iron kettle, such as are used for sugar or soap making, after which the block of stone was excavated, often leaving the sides but little more than an inch in thickness in a specimen twenty inches or two feet in diameter. These mortars varied in size from a few inches to thirty inches in diameter, and were used in triturating acorns, etc., for food. The pestles were made of the same material and varied in length from five to thirty inches. They were made with much care, gradually sloping from the base to the smaller end, where there was often left a raised bead or knob, and sometimes two or three. Ollas or cooking vessels were carved out of crystalized talc and would hold from one to six or eight gallons. They were sometimes globular in shape and again bell- or pear-shaped, the sides thin and the mouth surrounded with a raised bead or ornamented with chevrons, or both. Some of these were as perfect as if turned in a lathe. Tortilla stones were made of the same material. They would average about seven or eight inches in length and width, but were in the shape of a keystone, and about one inch in thickness. A hole was drilled in the smaller end for handling them when hot. They were heated in the fire, and the dough being rolled thin was rapidly baked. Some who have eaten tortillas pronounce them very good.

But the most beautiful specimens are those made from serpentine. Cups, bowls, pipes, and many ornaments were made from this mineral. The cups and bowls were from about two to twelve inches in diameter, variously shaped, and sometimes with handles similar to the old fashioned skillet. Some of these described a perfect circle and were finely polished. The pipes were cone-shaped, varying in length from two to twelve inches. A bone mouth-piece was inserted in the smaller end and it was smoked cigar fashion. The ornaments were various but usually pendants. Most of the serpentines used contained seams of chrysolite, and when polished were very handsome. Some of the finest arrow heads and spear-points I have ever seen were found in the burial places. They were manufactured from white and black chert, jasper, chalcedony and obsidian. I found one spear point manufactured from dark brown chert but one inch in width and over twelve inches long, very accurately made in every particular. Many most delicately finished arrow-heads with double barbs and indeed, a great variety of shapes have been found on the mainland and on the islands, which were probably used as ornaments in the hair and on different parts of the body. The wearing of them in the hair is referred to by Cabrillo.

In a burial place on the Santa Ynez River I exhumed some two hundred skeletons in a radius of about fifteen feet. With these occurred twenty-eight sandstone mortars holding from about two quarts to more than two bushels; forty-four pestles from a few inches to more than two feet in length, made of sandstone, polished and ornamented. They exhibited a great variety of finish, no two being exactly similar at the smaller end. There also occurred twenty ollas manufactured from steatite or crystalized talc, which were used for cooking vessels. They would hold from one to five or six gallons. This burial place yielded forty-four cups or bowls made principally from serpentine. I also found twenty-six pipes which indicated the smoking propensities of this people. Also eight spear-points, twelve arrow-heads, one asphaltum jug, five cement cups made from the vertebræ of large fishes, twenty-four metal knives nearly destroyed by rust, six arrow-smoothers, ten tortilla stones. Besides these occurred stone knives and drills, bone whistles, a copper spear, charms, and tubes of stone and at least a half bushel of beads, wampum, ornaments of shells, bone and stone, a description of which would require a whole volume.

SAN BUENAVENTURA, CAL., March 4, 1884.

THE AZTECS.

CAPTAIN E. L. BERTHOUD.

Within a few years it has been a very common custom to call all the semi-civilized Indians of New Mexico, Arizona, and Colorado, Aztecs, and all the remains and ruined buildings of these Territories and States, Aztec fragments of former advancement. To a large extent we consider this nomenclature as a misnomer, and that on the best evidence obtainable there is no good proof of such affiliation.

Clavigero, in his "Historia Antiguade Mejico," tells us that from the most authentic accounts, traditions, and from other proof obtained by the earliest as well as later writers on the history of Mexico and its conquest by Cortez, that about the year 1160 of our era, the Aztecs, as a nation whom history has rendered famous, inhabited a place called Aztlan, a region which as shown on Mercator's Authentic Map of 1569, was situated north of the Gulf of California; Azt in the Aztec language signifying "water." That one Huitziton, a Cacique, chief or head man of that nation, once on a time evidently wishing to influence the nation to remove their local habitation, seems to have devised the following plan:

Noticing a sparrow (Pajarillo) that from a tree emitted a cry that sounded precisely as the Aztec word "Tihui Tihui," which in that language is in its meaning the same as the Spanish word *vamos*, "let us go," and informing another influential leader named Tecpaltzin of this phenomenon, the fact was interpreted by them to their nation as a warning from supernatural influences to guide their conduct. The Aztecs obeyed and began their wanderings, which lasted many more years than the Israelitish wanderings from Egypt to Caanan. They first went northeast, probably passing the great Colorado, then proceeded southeast to the Rio Gila, where they resided for a period, where yet the ruins of buildings can be seen; thence they wandered to latitude 29° about 250 miles northeast of Chihuahua. This place is known now as Casas Grandes, from a very large building which yet remains, having been erected by the Aztecs during their perigrinations.

From this place they turned south, crossed the Tarahuma Mountains, and reached Hueiculhuacan, called to-day Culiacan, about 24½ South latitude. Here they remained three years. From this town they changed their course to the east; reaching Chicomozloe, supposed to be a town about twenty miles from Zacatecas, where yet is seen a large building erected by the Mexicans.

From Zacatecas, traveling south, they went to Colima, then turning east from Zacatula they lived in the mountains near Tuluca, thence they directed their journey north, reaching in 1196 the noted town of Tula.

They remained nine years in Tula, and then eleven more in other neighboring localities, reaching Zampanco in 1216, fifty-six years from their departure from Aztlan, remaining seven years in Zampanco; from Zampanco they went to Tizajocan, then to Tepeyac, then to near the shores of Lake Tezcuco near where afterwards was built the city of Mexico. Here they lived twenty years. Being much vexed here they moved to Chapultepec about the year 1243.

Here being attacked and conquered by the nation of Colhuacan, they were all enslaved about the year 1314. After aiding the Colhuans or people of Colhuacan to overcome the Joqumilcos the Colhuans, indignant at the human sacrifices of the Aztecs, for which prisoners of war were used, ordered them out of the country. The Aztecs pleased, traveling northwards, established themselves at Mexicaltzinco, a place between the two lakes. Here, the locality not suiting them, they removed farther from the Colhuans and passed to Iztalco, in close proximity to their future city of Mexico. Here they lived two years, finally settling on the spot where, seeing an eagle sitting or a nopal or cactus growing on a rock, they called the place Tenochtitlan, calling afterwards the city erected there Mexico, which was begun by human sacrifices in the year 1325, one hundred and sixty-five years from their departure from Aztlan. This then is the condensed story of their wondrous pilgrimage, which Betemcourt says was 2,700 miles in length.

How then can we, by any possible turn, bring our Aztecs, as some have tried, into Colorado, Arizona, and New Mexico, yes, even to the Mississippi River, in the person of the extinct Natchez, or even have transmuted the Mound-builders of the Ohio Valley and the Upper Mississippi into the Aztecs, who, driven out, went southwest into New Biscay, or Aztlan, thence to the lakes of Tezcuco, migrations of pure fancy; hypotheses founded on transcendental history.

The Pueblos of Arizona, New Mexico and Colorado worship the Sun and keep a sacred fire in an estufa. They have a tradition obtained from Spanish intercourse of a fabulous person called Montezuma. The serpent was also a sacred emblem, and we believe the Zunians have traces of former sacrifices. All are industrious, all have a *quasi* semi-civilization, and all know how to cultivate the soil and raise stock. On these points of similarity is the whole fabric built that makes them Aztecs by name, not by any direct act.

THE UPRIGHT ATTITUDE OF MANKIND.

Every one must have heard or have read of the supposed perfect adaptation of the human frame to bipedal locomotion and to an upright attitude, as well as the advantages which we gain by this erect position. We are told, and with perfect truth, that in man the occipital foramen—the aperture through which the brain is connected with the spinal cord—is so placed that the head is nearly in equilibrium when he stands upright. In other Mammalia this aperture lies further back, and takes a more oblique direction, so that the head is thrown forwards, and requires to be upheld partly by muscular effort and partly by the ligamentum nuchæ, popularly known in cattle as the "pax-wax."

Again, the relative lengths of the bones of the hinder extremities in man form an obstacle to his walking on all-fours. If we keep the legs straight we may touch the ground in front of our feet with the tips of the fingers, but we cannot place the palms of the hands upon the ground and use them to support any part of our weight in walking. Not a few other points of a similar tendency have been so often enlarged upon, in works of teleological character, that there can be no need even to specify them at present.

But till lately it has never been asked "Is man's adaptation to an upright posture perfect?" and "Is this posture attended with no drawbacks?" These questions have been raised by Dr. S. V. Clevenger in a Lecture delivered before the Chicago University Club, on April 18th, 1882, and recently published in the "American Naturalist." This lecture, we may add, cost the speaker the chair of Comparative Anatomy and Physiology at the Chicago University!

Dr. Clevenger first discusses the position of the valves in the veins. The teleologists have long told us that the valves in the veins of the arms and legs assist in the return of blood to the heart against gravitation. But what earthly use has a man for valves in the intercostal veins which carry blood almost horizontally backwards to the azygos veins? When recumbent these valves are an actual obstacle to the free flow of the blood. The inferior thyroid veins which drop their blood into the innominate are obstructed by valves at their junction. Two pairs of valves are situated in the external jugular, and another pair in the internal jugular, but they do not prevent regurgitation of blood upwards.

An anomaly exists in the absence of valves from parts where they are most needed, such as the venæ cavæ, the spinal, iliac, hæmorrhoidal, and portal veins.

But if we place man upon all-fours these anomalies disappear, and a law is found regulating the presence or absence of valves, and, according to Dr. Clevenger, it is applicable to all quadrupeds and to the so-called Quadrumana. Veins flowing towards the back—*i. e.*, against gravitation in the all-fours posture—are fitted with valves; those flowing in other directions are without. For the few exceptions a very feasible explanation is given.

Valves in the hæmorrhoidal veins would be useless to quadrupeds; but to man, in his upright position, they would be very valuable. "To their absence in man many a life has been and will be sacrificed, to say nothing of the discomfort and distress occasioned by the engorgement known as piles, which the presence of valves in their veins would obviate."

A noticeable departure from the rule obtaining in the vascular system of Mammalia also occurs to the exposed situation of the femoral artery in man. The arteries lie deeper than the veins, or are otherwise protected, for the purpose—as a teleologist would say—of preventing serious loss of blood from superficial cuts. Translating this view into evolutionary language, it appears that only animals with deeply placed arteries can survive and transmit their structural peculiarities to their offspring. The ordinary abrasions to which all animals are exposed, not to mention their onslaughts upon each other, would quickly kill off species with superficially-placed arteries. But when man assumed the upright posture the femoral artery, which in the quadrupedal position is placed out of reach on the inner part of the thigh, became exposed. Were not this defect greatly compensated by man's ability to protect this part in ways not open to brutes, he, too, might have become extinct. As it is, this exposure of so large an artery is a fruitful cause of trouble and death.

We may here mention some other disadvantages of the upright position which Dr. Clevenger has omitted. Foremost comes the liability to fall due to an erect posture supported upon two feet only. Four-footed animals in their natural haunts are little liable to fall; if one foot slips, or fails to find hold, the other three are available. If a fall does occur on level ground there is very little danger to any mammal nearly approaching man in bulk and weight. Their vital parts, especially the heart and the head, are ordinarily so near the ground that to them the shock is comparatively slight. To human beings the effects of a fall on smooth, level ground are often serious, or even deadly. We need merely to call to mind the case of the illustrious physicist whom we have so recently and suddenly lost.

The upright attitude involves a further source of danger. In few parts (if any) of the body is a blow more fatal than over what is popularly called the "pit of the 'stomach.' In the quadruped this part is little exposed either to accidental or intentional injuries. In man is quite open to both. A blow, a kick, a fall among stones, etc., may thus easily prove fatal.

Another point is the exposure and prominence of the generative organs, which in most other animals are well protected. Leaving danger out of the question, it may be asked whether we have not here the origin of clothing? The assumption of the upright posture may have made primitive man aware of his nakedness.

Returning to the illustrations furnished by Dr. Clevenger we are reminded that another disadvantage which occurrs from the upright position of man is his greater liability to inguinal hernia. In quadrupeds the main weight of the abdominal viscera is supported by the ribs, and by strong pectoral and abdominal muscles. The weakest part of the latter group of muscles is in the region of Poupart's ligament, above the groin. Inguinal hernia is rare in other Vertebrates because this weak part is relieved by the pressure of the viscera. In man the pelvis receives almost the entire load of the intestines, and hence Art is called in to compensate the deficiencies of Nature, and an immense number of trusses have to be manufactured and used. It is calculated that twenty per cent of the human family suffer in this way. Strangulated hernia frequently causes death. The liability to femoral hernia is in like manner increased by the upright position.

Now, if man has always been erect from his creation,—or, if that term be disliked, from his origin,—we have evidently nothing to hope from the future in the way of an amendment of this and other defects. But if we have sprung from a quadrupedal animal, we have by degrees adopted an upright position, to which we are as yet imperfectly adapted, the muscular tissues of the abdomen will doubtless in the lapse of ages become strengthened to meet the demand made upon them, so that the liability to rupture will decrease. In like manner the other defects above enumerated may gradually be rendered less serious.

A most important point remains: the peritoneal ligaments of the uterus fully subserve suspensory functions. The anterior, posterior, and lateral ligaments are mainly concerned in preventing the gravid uterus, in quadrupeds, from pitching too far forward towards the diaphragm. The round ligaments are utterly unmeaning in the human female, but in the lower animals they serve the same purpose as the other ligaments. Prolapsus uteri, from the erect position, and the absence of supports adapted to that position, is thus rendered common, destroying the health and happiness of multitudes.

As a simple deduction from mechanical laws it would readily follow that any animal or race of men which had for the longest time maintained an erect position would have straighter abdomens, wider pelvic brims with contracted pelvic outlets, and that the weight of the spinal column would force the sacrum lower down. This, generally speaking, we find to be the case. In quadrupeds the box-shaped pelvis, which admits of easy parturition, is prevalent. Where the position of the animal is such as to throw the weight of the viscera into the pelvis, the brim necessarily widens, these weighty organs sink lower, and the heads of the thigh-bones acting as fulcra permit the crest of the ilium to be carried outwards, whilst the lower part of the pelvis is at the same time contracted.

In the innominate bones of a young child the box shape exists, whilst its prominent abdomen resembles that of the gorilla. The gibbon exhibits this iliac expansion through the sitting posture which developed his ischial callosities. Similarly iliac expansion occurs in the chimpanzee. The megatherium had wide iliacal expansions due to its semi-erect habits; but as its weight was in great part supported by the huge tail, and as the femora rested in acetabula placed far forwards, the leverage necessary to contract the lower portion of the pelvis was absent.

Prof. Weber, of Bonn, quoted in Karl Vogt's "Vorlesungen über den Menschen," distinguishes four chief forms of the pelvis in mankind,—the oval in

Aryans, the round among the Red Indians, the square in the Mongols, and the wedge-shaped in the Negro. Examining this question mechanically, it would seem that the longer a race had remained in an upright position the lower is the sacrum, and the greater is the tendency to approximate to the larger lateral diameter of the European female. The front to back diameter of the ape's pelvis is usually greater than the measurement from side to side. A similar condition affords the cuneiform, from which it may be inferred that the erect position in the Negro has not been maintained so long as in the Mongol, whose pelvis has assumed the quadrilateral shape owing to the persistence of spinal axis weight for a greater time. This pressure has finally culminated in forcing the sacrum of the European nearer the pubes, with consequent lateral expansion and contraction of the diameter from front to back. From the marsupials to the lemurs the box-shaped pelvis remains. With the wedge-shape occasioned in the lowest human types there occurs a further remarkable phenomenon in the increased size of the fœtal head accompanying the contraction of the pelvic outlet. While the marsupial head is about one-sixth the size of the narrowest part of the bony parturient canal, the moment we pass to erect animals the greater relative increase is there seen in cranial size, with a co-existing decrease in the area of the outlet. This altered condition of things has caused the death of millions of otherwise perfectly healthy and well-formed human mothers and children. The palæontologist might tell us if some such case of ischial approximation by natural mechanical causes has not caused the probable extinction of whole genera of Vertebrates. "If we are to believe that for our original sin the pangs and labour of childbirth were increased, and if we also believe in the disproportionate contraction of the pelvic space being an efficient cause of the same difficulties of parturition, the logical inference is that man's original sin consisted in his getting upon his hind legs."

This subject is not without direct applications. Accoucheurs cause their patients to assume what is called the knee-chest position, a prone one, for the purpose of restoring the uterus to something near a natural position. Brown-Sequard recommends, in myelitis, or spinal congestion, drawing away the blood from the spine by placing the patient on his abdomen or side, with hands and feet somewhat hanging down. The liability to *spina bifida* is greatest in the the human infant, through the stress thrown on the spine. The easy parturition in the lower human races is due to the discrepancy between cranial and pelvic sizes not having been as yet reached by those races. The Sandwich Island mother has a difficult delivery only when her child is half white, and has consequently a longer head than the unmixed native strain.

At present the world goes on in its blindness, apparently satisfied that everything is all right because it exists, ignorant of the evil consequences of apparently beneficial peculiarities, vaunting man's erectness and its advantages, whilst ignoring the disadvantages.

The observation that the lower the animal the more prolific (not universally true!) would warrant the belief that the higher the animal the more difficulties encompass its propagation and development. The cranio-pelvic difficulty may perhaps settle the Malthusian question as far as the higher races of men are concerned, by their extinction.

If the facts brought forward by Dr. Clevenger cannot be controverted, they seem to prove that man must have originated by gradual development from a four-footed being. Had he been created an erect, bipedal animal, as we find him, his structure would have been not in partial, but in perfect, adaptation to the conditions of that attitude. That some of the peculiarities of his structure are better in harmony with a horizontal than a vertical position of the spinal colum, is perhaps the strongest argument against the theory of direct creation and the radical *toto cœlo* distinction between man and beast that has yet been advanced. We cannot at the moment lay our hands upon any thorough and trustworthy account of the valves in the veins of the sloth: as that animal spends its life hanging, back downwards, the structure of the veins would be interesting in this connection.—*London Journal of Science.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Owing to mistakes in copying the reports of temperature and pressure as given last month were erroenous and a corrected statement of these items is herewith given.

	Jan. 20th to 30th.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
TRI-DAILY OBSERVATIONS.*				
7 a. m	21.0	20.8	15.4	18.1°
2 p. m	39.3	34.9	29.1	33.1
9 p. m	29.5	25.9	22.1	24.9
Mean	27.7	26.8	22.17	25.4
PRESSURE AS OBSERVED.†				
7 a. m	29.152	29.054	28.984	29.063
2 p. m	29.228	28.985	29.978	29.064
9 p. m	29.145	28.974	29.008	29.042
Mean	29.175	29.013	28.991	29.059

* Temperature Corrections of Feb. Report. † Barometric Corrections of Feb. Report.

March has proved a cool month up to the date of this report and the signs of vegetation suited to spring are yet scanty.

Unusually high wind prevailed on the 10th and 11th, reaching a velocity of over sixty miles per hour. The rains of the past ten days have brought the ground into fine condition for starting the grass and crops provided the weather shall be warm and without too much rain.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Feb. 20th to 29th.	Mar. 1st to 10th.	Mar. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	—1.	10.	20.	10.3
Max	76.	60.	61.	62.6
Min. and Max	.	. .	. .	. .
Range	68.	50.	39.	52.3
TRI-DAILY OBSERVATIONS.				
7 a. m.	22 6	19.8	31.7	24.70
2 p. m.	43.3	37.0	50.4	43.83
9 p. m.	31.3	26.9	38.6	32.27
Mean	32.4	29.9	40.2	34.17
RELATIVE HUMIDITY.				
7 a. m.	. .	.82	.93	.87
2 p. m.	.	.76	.89	.58
9 p. m.	. .	.89	.95	.92
Mean	. .	.82	.76	.79
PRESSURE AS OBSERVED.				
7 a. m.	29.020	29.019	29.014	29.018
2 p. m.	29.080	29.987	29.033	29.033
9 p. m.	29.070	29.032	29.067	29.056
Mean	29 060	29 013	29.035	29.030
MILES PER HOUR OF WIND.				
7 a. m.	25	16.7	23.7	21.8
2 p. m.	19	21.6	29.3	23.3
9 p. m.	9	18.4	20.3	15 9
Total miles.	2890	4867	5914	. .
CLOUDING BY TENTHS.				
7 a. m.	6 0	8.8	6.4	7.1
2 p. m.	4.5	7.3	6.9	6.2
9 p. m.	4.4	5.7	5.4	5.2
RAIN.				
Inches.	.00	.19	1.65	1.84

THE WEATHER OF THE PAST SEVENTEEN WINTERS.

PROF. F. H. SNOW, UNIVERSITY OF KANSAS.

The following table gives the chief characteristics of the past seventeen winters. During this period five winters have had a lower mean temperature and a larger number of zero days than the winter just closed, six winters have had a larger number of winter days, but only one has had a lower minimum temperature. The rainfall (including melted snow) of the past winter has been three-fourths the average amount; the fall of snow has been slightly above the average depth; the cloudiness has been more than two per cent above the mean; the wind has exceeded its average by more than 5,000 miles; there has been a single thunder-shower (the average number); there has been one more fog than usual; and the barometer has exceeded its average height.

Winter of	Mean Temperatures.				Min. Temp.	Max. Temp.	Winter days.	Zero days.	Snow, inches.	Rain, inches.	Thunder storms	Mean Cloudiness.	Miles of wind.	No. of Fogs.
	Dec.	Jan.	Feb.	Season.										
1867—68 . .	34.50	23.67	35.71	31.29	– 7.0	72.0	48	3	6.50	.	1	. .	. . .	1
1868—69 . .	24.29	30.50	30.63	28 49	–16.5	65.0	58	5	25.25	6.47	1	48.11	. . .	6
1869—70 . .	29.92	29.43	35.42	31.59	– 4.0	69.0	36	2	8.50	1.57	0	49.83	. . .	7
1870—71 . .	28.70	28.86	35.30	30.95	–10.0	71.5	42	8	21.50	4.26	2	54.55	. .	6
1871—72 .	24.91	24.35	30.44	26.57	–12.0	61.0	53	11	14.50	2.11	0	47.63	. .	5
1872—73 . .	19.93	18.61	30.26	22.93	–26.0	62.0	61	17	30.00	4.76	1	45 78	35,293	3
1873—74	31.37	28.01	27.05	28.96	– 2.5	67.5	49	1	21.00	7.69	3	58 70	34,652	6
1874—75 . .	31.01	15.60	21.92	32.84	–16.5	55.0	72	14	11.50	2.09	1	50.77	34,364	2
1875—76 . .	39.35	34.70	37.80	37.28	– 5.0	74.5	34	2	0 25	4.48	3	43.16	43,057	2
1876—77 . .	23 60	25.60	39.65	29 62	– 9.0	66.0	50	6	14 00	2.40	0	44.60	27,959	3
1877—78 . .	44.43	33.97	40.22	39.54	7.5	68.0	15	0	3.00	8.12	4	53.19	28,042	0
1878—79 . .	23.05	23.49	34 06	26.87	–16.0	74.0	54	13	25.25	2.76	0	45.59	27,502	2
1879—80 . .	26.23	41.23	37.58	35.01	– 9.0	67.0	36	2	3.00	4.92	2	41.75	37,543	11
1880—81 . .	25 84	21.60	25.78	24 41	–12.0	61.5	64	6	24.00	5.37	0	55 62	35,995	8
1881—82 . .	40.10	32.68	41.65	38.14	5.0	73.0	17	0	5.00	3.26	0	50.82	36,259	5
1882—83 . .	31.25	19.65	27.92	26.27	–14.0	67.0	57	9	14.50	4.28	1	55.61	34,366	8
1883—84 . .	33.72	20.99	28.03	27.58	–21.5	63.0	50	8	16.00	3.18	1	47.33	39,790	6
Mean . . .	30.13	26.64	32.91	29.90	–10 8	66.9	47	7	14.34	4.23	1	49.57	34,568	5

WEATHER PROVERBS.

S. A. MAXWELL.

A copy of Signal Service Notes, No. IX, "Weather Proverbs," lies before me, and in looking it over I am by turns amused, instructed, and disgusted; amused as Heraclitus used to be at the follies of mankind, disgusted as Sam Johnson was, by popular ignorance, and instructed when I find a truth hidden away like a pearl in a heap of refuse shells.

I do not criticise either the book or its author; since, as I understand, the compilation was made merely with a view to condense in book form all the weather-sayings of the peoples of different ages and nations, omitting nothing on account of its absurdity. My purpose will be to explain the cause or causes of certain phenomena taken as storm-forecasts, and also to prove the falsity of others too frequently relied on as infallible.

In the very able paper by the Hon. Ralph Abercromby with which Part I of the book begins, I find some statements which at least suggest the following explanations. He speaks of the "winds backing around in front of a depression to the south from the southwest," just as if this was what it really *does* do, when in fact it must move in the opposite direction, viz: from southeast to southwest, since the areas of barometric depression move almost invariably in an easterly direction, both in this country and in Great Britain. A curious fact concerning the winds about a storm-centre is this, that, of two places on the same latitude the one the farthest west will first experience an east wind on the approach of a storm-area.

"A good hearing day is a sign of wet;
Much sound in the air is a sign of rain."

Why? Is it not because in a rainy time, the air moves in different currents with different densities, on account of which the vibrations are not readily transmitted upward, but are confined to the lower stratum of air? The lower stratum would not be altogether unlike a drain-tile tube through which a mere whisper can be heard fifty yards. I would not consider Tyndall's theory that audibility was due to the homogeneity of the atmosphere, but to the reverse, unless we are to understand the word horizontal before homogeneity.

The sound of thunder and of the firing of heavy cannon is not conveyed so much through the atmosphere as through the very crust of the earth, and hence the proverb applies less to sounds of this character, than to others of less intensity.

In Mr. Scott's discussion of the above named paper, he said that no one had as yet been able to forecast the amount of rain that would fall at a given place on a given day, and that inability to do so was apparently owing to ignorance of the conditions of the upper atmosphere. Now it must be conceded that for any area, say for 500 square miles, having equal length and breadth, in a level country like northern Illinois, the conditions of the upper air must be uniform in clear weather, and yet a storm may occur in one portion of such an area, and rain fall to a depth of two or three inches, while other parts are for the time rainless. Hence it would seem that our ability to foretell the *amount* of daily rainfall would not be enhanced by knowing the conditions of the upper air.

Mr. Abercromby states that the ice-film which forms the cloud in which the halo is formed is only produced *in front* of cyclones or thunder-storms, and for that reason is a sign of rain. The fact is, the halo is formed whenever the rays of the sun or moon are intercepted by the ice-film and may be *before* the storm-cloud, *after* it, or a thousand miles from it. Almost any of the cirri or cirro-strati will exhibit the halo, its brightness depending upon the number form, arrangement and movement of the frost-crystals composing the cloud.

"Anvil clouds are very likely to be followed by a gale of wind." Now what are meant by "anvil clouds"? I am sure I do not know. There are frequently seen in summer along the horizon, clouds the shape of which very perfectly represents the form of an anvil, and these are probably referred to. These clouds are small thunder-showers from fifty to one hundred and fifty miles distant and deserve especial study. One may learn by watching these clouds how the "horn" of the anvil always points forward, and how after dark the lightning will gild, not this part, but the rear and sides of the cloud, and also, by assuming the distance, we may tell the velocity of the storm. When one sees a cloud of this type he may know of a certainty that the storm, or more properly shower, will not pass over his locality, since it takes the direction that the anvil points, hence it would be hard to see why these clouds indicate a "gale of wind." To an observer in front of such a cloud there is no anvil form at all; the "horn" not forming any part of the outline of the cloud. This form of cloud is developed when the ascending currents carry the clouds into strata of air moving more rapidly than those below. At first the cloud is but slightly leaned forward, but by and by the "fan cloud" spreads out from the top, and moves rapidly forward. It is the cirro-stratus in its first stages, though the margin is often a cirrus. It is this cloud that produces the halo before the snow-storm, as a rule, but rarely before a storm in summer, as it then has too great density. The typical anvil cloud in this locality, is rarely seen except in the north or south, with the point extending eastward.

"If you see a cloud rise against the wind, when that cloud comes up to you the wind will blow the same way that the cloud came." This shepherd-proverb, like the ordinary rules for spelling, is seriously hampered by "exceptions." It applies only to the thunder-storms of summer, not to any storms of the other seasons. The great rain- and snow storms of winter and spring come up from the southwest during the prevalence of easterly winds, which do not change for hours, possibly days, after the storm begins.

"Black clouds in the north in winter indicate approaching snow." If by this is meant a *bank of black clouds* then I would say that in all my experience I never knew the rule to hold good. A bank of clouds in the southwest in winter gradually darkening toward the horizon, is a very good indication of a snow-storm when there is an easterly breeze and the mercury ranges from 15° to 30° above zero.

> " If clouds be bright 'twill clear to-night,
> If clouds be dark, 'twill rain you hark."

Reference is probably made to the appearance of clouds in the evening after a heavy rain, when the Sun shines up under the edge of the cloud and gilds its base. This would not be so very bad,—the proverb would doubtless turn out right at least fifty one times in a hundred.

> " If the woolly fleeces strew the heavenly way
> Be sure no rain disturbs the summer day."

If the first clouds, cumuli, which condense in a summer morning, are light colored above and dark beneath, it indicates heat, and the chances for rain are good; but when the morning cumuli are dull and uniform in color, it signifies cool weather and no rain. These are among the most reliable indicators of the weather that I know of, and taken in connection with the direction of the wind one can forecast the weather for twenty hours in nine cases in ten correctly. I might say further that clouds that are absorbers of sunlight are signs of fair weather and those that are good reflectors are signs of foul weather. The reason for this is evident,—the denser the cloud the better reflector it forms and the more nearly does it approach a saturated condition. The reason that cumuli sometimes have their bases flattened is on account of the different temperatures of the several strata of air. The stratum immediately beneath the cloud being warmer than the one in which the cloud floats, has a greater capacity for absorbing watery vapor, hence this remains invisible and the form of the cloud in the stratum above is modified accordingly.

"Clouds floating low enough to cast shadows on the ground are usually followed by rain." Nonsense. All clouds of any magnitude or density cast shadows in the daytime and the most brainless originator of weather proverbs ought to know it.

"One Saturday change of the moon is enough, as it is always followed by a severe storm." According to this whenever the moon changes on Saturday a large portion of the earth must be swept by severe storm, since the moon changes over a large part of the earth usually on the same day. This of course does not tally with the facts observed,—some portions of the earth never having severe storms at all, and when severe storms do occur they extend but a comparatively short distance. But I had not intended to speak of this class of proverbs, since no person of intelligence puts the least faith in such as refer to special days of the week or the year.

"If rain commences after nine it will rain next day." From this we must assume that if it commence before nine it will *not* rain the next day. Suppose a storm moving east reaches Lawrence, Kansas, at eight, Kansas City at nine, and Independence, Mo., at ten, then by this proverb the track of this storm, east of Kansas City, must on the day following be drenched with rain, while the portion westward must "go dry."

"Rays of sun appearing in a cloud forebode rain." With regard to this phenomenon, commonly called the "sun's drawing water" the author says, "This phenomenon is, in fact, caused by the image of the sun being reflected in an intervening cloud, the reflected image radiating in the cloud" This is all a mistake. As I stated in an article in the REVIEW some two years ago, this phenomenon is caused when the sun shines through rifts in the clouds,—the light streaks being produced by light reflected from particles of vapor exposed to sunlight. The dark lines of course are the parts shaded by clouds. These lines are generally seen when there is a background of dark clouds. Lines quite analogous to these are produced when sunlight enters a dark room through a slit in the blinds. The dust floating in the air takes the place of the watery vapor as the reflecting medium. Sometimes streaks of alternate light and dark sky are seen extending from the horizon at the point where the sun has just set, to the opposite point, and these are caused by clouds still below the horizon, their shadows giving rise to the dark lines, the light being produced by the sunlit portions. Since these shadows extend often from one hundred to two hundred miles, it shows that the clouds producing them must be large and sharply defined. Generally, the lines are produced by storm-clouds, hence their appearance may well be said to indicate an approaching storm.

So much for weather proverbs. It is to be hoped that these old sayings will nearly all be forgotten in the good time coming, when instead of placing dependence on musty old rhymes of nonsense, people will learn the few general laws of storms, and with a little additional knowledge which observation alone affords, be able to forecast for themselves with all needful accuracy the changes to which the weather of our latitudes is ever subject.

MORRISON, ILL., March 10, 1884.

ASTRONOMY.

CELESTIAL PHENOMENA FOR APRIL, 1884.

PROF. W. W. ALEXANDER, KANSAS CITY, MO.

There will be visible in the evening during this month seven, or all, of the principal planets in the solar system. To begin with Mercury (the first in order of distance from the Sun,) it may be seen from the 20th until about the 30th in the western sky, from 7:30 to 8:45 by our standard time, its position will be 20° north of west at the time it sinks below the horizon. The point on the horizon at which it will set on the 29th exactly coincides with the place of sun-set. This elongation will be rather more favorable than usual for seeing it, from the fact the position of the Earth with reference to this planet's orbit enables us to observe it at a much greater distance from the Sun than usual. On the 25th it will be nearly 21° east from the Sun.

VENUS.—A description of the position of this planet is almost unnecessary; even the most casual observer cannot fail to notice it if he should take a glance at the western sky; it is by far the most brilliant object to be seen except the Sun or Moon. During the whole time its light will be increasing, from the fact that it will be rapidly approaching the Earth, being some thirty millions of miles nearer by the end than on the first of the month; it will be bright enough at any time to be seen with the naked eye in the daytime, it will be on our meridian about three hours after the Sun, or at 3:20 P. M. standard time, and at an elevation of 76°; this is a very high elevation being only 14° south of the zenith. It will be moving rapidly eastward across the heavens reaching conjunction with Saturn on the 12th, it will pass to the north 4° 13′. It also has a decided motion northward, it will enter the constellation Taurus on the 3d and by the 6th it will be nearly in line with Aldebaran, Saturn and the Pleiades. Aldebaran is a bright red star of the first magnitude and the only bright one in this constellation.

The above conjunction will aid in locating Saturn the next in order from west to east across the sky; this planet will not be favorably situated for observation this month, and therefore will not present us with any facts worthy of note. By the last of the month it will be near the Sun and only visible for a few minutes during the evening twilight.

JUPITER and Mars will be close together on the 1st and both will pass the meridian in the evening twilight. The first to pass will be Jupiter, at 7:24 P. M. followed by his ruddy companion in forty minutes; their elevation at transit will be 72°, both are decreasing in size and brilliancy. The moons of Jupiter will be a very attractive feature of this planet's phenomena during this month; over forty transits, occultations, eclipses, etc., will be visible at different times from Kansas City.

URANUS will be in a fine position for evening observers; it will be in R. A. 11h. 44m. on the 1st, declination north 2° 33′, it will retrograde 4m. in R. A. during the month. On the evening of the 7th the Moon will be a few degrees south of this planet.

NEPTUNE will be very close to the Sun, too near to be observed. It will be occultated by the Moon on the 26th.

The Moon will pass 5° south of Mercury on the 26th at 8:00 o'clock in the evening, the evening of the 27th will find her near Saturn; the 28th near Venus, and the 30th Jupiter, and the next evening Mars.

VELOCITY.—I.

EDGAR L. LARKIN.

If a mass be let fall, it will be found at the end of one second to be moving with a velocity of 32.106 feet per second. Since gravity causes the motion, this velocity becomes a measure of the earth's attraction. The force of gravity on the surface of a sphere is equal to the quotient of its mass divided by the square of the radius. The mass and radius of the earth are each equal to 1; the mass of the Sun is 333,426 and radius 109.44. Hence,—for respective gravities on the earth and sun:

The Earth, $=1$ divided by the square of $1=1\div1=1$.

The Sun, $=333,426$ divided by the square of $109.44=333,426\div11,978=27.836516$.

Therefore,—a stone dropped on the sun's surface will acquire at the close of a second, a velocity$=32.106\times27.836516=893.75$ feet$=.16927$ of a mile per second. This falling velocity is that motion generated in bodies let fall from an elevation not exceeding a few miles from the solar surface.

The question arises, how great velocity would be displayed by masses approaching the sun from immense distances such as planetary distances. One might ask with what velocity would a cosmical mass make impact on the sun upon arrival from some solitude beyond the solar system, say from a space half way to the nearest star, or 10 trillion miles. Since imagination has no limit, why not inquire with what motion a mass would strike the sun that had fallen from an *infinite* distance, or what is the same, had been falling forever! This motion can be readily computed because the intensity of solar gravity is known, and it is also known what gravity is required to evolve any given rate of motion. Terminal velocity must have a limit even if the mass fell an infinite distance, since no force can exceed itself, an expression which may be given thus:—the attraction of the sun cannot cause greater velocity than it is able—if such statements fall within any rule of logic. The utmost motion that can be imparted by the sun to a body reaching its surface is equal to the square root of the product of twice the sun's gravity multiplied by its radius. Twice gravity= .16927×2=.33854×433,197=146,682 whose square root=382.95607 miles= 2,022,008 feet per second. It is with this appalling velocity that a cosmic mass will strike the sun on arrival from infinite distance!

This is one of the most important constants discovered by astronomers; by its use, many problem wherein gravity, space and motion are factors can be solved without extended computation, and in this note it will be made equal to G.

Having found final velocity from infinite distance, it is easy to determine terminal motion from finite distance.

From finite,—the velocity is equal to G multiplied by the square root of the quotient obtained by dividing twice the distance less 1, by twice the distance. This comes from the fact that the velocity of a body approaching the sun is at any instant equal to a constant velocity multiplied by the square root of the space fallen through, divided by the square root of the distance between the body and the centre of the sun. Let us find velocities of collision with the sun of masses that fall from several finite distances. We will call these distances r, and express them all in terms of the solar radius.

Take r=1, that is—a distance=the sun's radius or 433,197 miles from its surface. From the formula we have—square root of twice 1 less 1 divided by twice 1=square root of 1÷2=.7071065×G=270.79 miles=1,429,776 feet per second. That is, a stone taken into space a distance equal to the radius of the sun and let fall will strike the sun with this velocity. But 382.95607÷270.78= 1.414213 which is an important number because it is the square root of 2. We have arrived at the fact that,—velocity of fall from infinite space, is to velocity of fall from a distance equal to the radius of the sun, as the square root of 2 is to 1; i. e. as 1.414213 is to 1—only 40 per cent greater. This 270:79 miles velocity seems to possess peculiar properties; and the thought arises, may it not be found by other processes? Making trial we find that 433,197×.16927=73330 whose square root=270.79 miles.

But, here we multiplied the radius of the sun by the force of gravity and secured the same result by taking the square root of the product. From mechanics, we know that the radius of a revolving sphere multiplied by the intensity of gravity on its surface, equals the square of the velocity with which its equator must revolve in order that centrifugal tendency generated by such velocity of rotation will equal gravity. Therefore, a stone on the equator of the sun will not loose its weight until the revolution of the sun reaches an equatorial velocity of 270.79 miles per second, a velocity 224 times more rapid than it has. Whence it appears,—that a mass reaching the sun from a fall through a distance equal to its radius acquires velocity equal to a velocity of rotation sufficient to evolve centrifugal tendency equal and opposite to the sun's attraction. But 1.414213÷2 =.7071065×G=270.79 miles; therefore the velocity generating power of solar gravity exerted within a distance from its surface equal to its radius is about 70 per cent of the entire amount exerted throughout infinite distance.

Having velocity of impact from infinite space and from one radius of the sun in distance, let us learn terminal motions from other finite terms of solar radii.

Here is a table of velocities generated by falling bodies at instant of collision with the sun from several distances all computed from above formula which we repeat to make familiar. For 2r, we find—square root of twice 2 less 1÷by twice two=square root of 3÷4; for 3r, square root of twice 3 less 1÷by twice 3 =square root of 5÷6. and so on.

Column I gives distances from the sun's center, II the squares of velocities, III the square roots of the numbers in II which roots are the velocities of impact expressed decimally, and require to be multiplied by G to find the figures in IV, which are real velocities in feet per second:

I. Distances from the Sun.	II. Squares of Velocities of Impact.	III. Square roots of II or velocities Decimally.		IV. Final Velocities at Collision.
r	.5	.7071065	×G =	1,429,776.
2r	.75	.866	×G =	1,751,039.
3r	.833	.9128	×G =	1,845,689.
4r	.875	.9358	×G =	1,892,195.
5r	.9	.95	×G =	1,920,908.
10r	.95	.9746	×G =	1,970,649.
100r	.995	.997	×G =	2,015,942.
200r	.9975	.99875	×G =	2,019,481.
214r	.997668	.9988325	×G =	2,019,647.
1,000r	.9995	.99975	×G =	2,021,502.
2,000r	.99975	.99987499	×G =	2,021,755.
6,440r	.9999146	.99995724	×G =	2,021,921.
10,000r	.99995	.99997499	×G =	2,021,957.
100,000r	.999995	.999997499	×G =	2,022,003.
1,000,000r	.999995	.9999997499	×G =	2,022,007.
10,000,000r	.9999995	.99999997499	×G =	2,022,008.
20,000,000r	.999999975	.999999997499	×G =	2,022,008.

This table demonstrates vividly the law that gravity varies as the inverse square of distances; and that velocities are as the square roots of spaces traversed. Because gravity varies inversely as the squares of distances, a limit is reached where increase of distance fails to have effect in accelerating terminal velocity. That limit as may be seen is a distance equal to about 1,000,000 solar radii, for an increase of 9,000,000 radii adds only one foot per second to terminal motion. If a mass be let fall at a distance of 20,000,000, it will reach the sun with the same velocity within a fraction of a foot per second as though dropped at a distance of 10,000,000 radii of the sun.

This is clear—for if 2,022,008 be multiplied by .99999999 the product is equal to itself; no change being produced in the product if we increase the number of .9s to infinity. This is equivalent to the assertion that 1 is the limiting velocity of fall on the sun i. e. 382.95607 becomes 1; from the principle that any constant can be made unity. We make the solar constant equal to one, when column III gives less velocities in regular progression.

In the table—214r, is the earth's distance, hence, a mass falling on the sun from a distance equal to that of our world will strike it with a velocity only 361 feet less than if it had fallen from an infinite distance.

The distance 6440r, is that of Neptune, whence, a mass will dash on the sun with but 87 feet less velocity than if it had been falling forever; while 20,000,-000r, or in round numbers 10 trillion miles, represents half the distance to Alpha Centauri the nearest star. A stone let fall at a distance from the sun of 10 trillion miles will plunge into its fiery wastes with the same velocity it would have acquired had it been falling since the universe was made. Gravity at any distance from the surface of a sphere is equal to gravity on its surface divided by the square of the given distance. Since we expressed solar gravity in terms of velocity i. e. 893.75 feet or 10,725 inches per second, we can find the velocity of a falling body at any distance at the end of the first second of its fall. If we square 20,000,000 and divide 10,725 inches by the square, the quotient will be .0000000000268 of an inch per second velocity that a falling body will acquire at the close of one second at a distance of 10 trillion miles, a velocity such that a mass moving at that rate will require 1,182 years to fall 1 inch. In these researches we find velocity infinitely slow and rapid. If we make the limit of distance one-half that to the nearest sun, then initial and terminal motion will lie within the limits of .0000000000268 inch and 382.95607 miles per second. And it is by such calculations as these that we hope to learn something of the sidereal structure. We have considered the most simple variety of motion—that on a straight line; but before we can comprehend all is in the great subject of velocity we must make computation of other modes of motion, such as that displayed on ellipses, parabolas and hyperbolas.

NEW WINDSOR, ILL., March 13, 1884.

BOOK NOTICES.

THE UNITY OF NATURE: By the Duke of Argyll. Octavo, pp. 571. G. P. Putnam's Sons, New York and London, 1884. For sale by M. H. Dickinson, $2.50.

This work is to some extent a sequel to the author's admirable discussion of "The Reign of Law," published first in 1866, inasmuch as in that volume he expressed an intention of following the chapter upon Law in Politics by one upon Law in Christian Theology. When, however, he came to reflect upon the magnitude of the subject he speedily discovered that not only could it not be treated in a single chapter but that a whole book would be insufficient for the purpose without extended preliminary study and investigation. The object of the present work, therefore, is "to trace the connection between the reign of law and the ideas which are alike fundamental to all religions and inseparable from the facts of nature." The author proposes in this volume to offer a solution of some of the problems which perplex us most in this inquiry, through the scheme of the unity of nature, assuming that if these problems are not entirely soluble in this light, they are at least broken up by it and are reduced to fewer and simpler elements. "He says, "The following chapters are an attempt to follow this conception along a few of the innumerable paths which it opens up, and which radiate from it through all the phenomena of the universe, as from an exhaustless center of energy and of suggestion."

In order to give the reader a somewhat full idea of the comprehensivess of the work, we call attention to the titles of the thirteen ample and exhaustive chapters which are comprised in it, viz:—General Definitions and Illustrations of the Unity of Nature—What it is and What it is Not; Man's Place in the Unity of Nature; Animal Instinct in its relation to the Mind of Man; On the Limits of Human Knowledge; On the Truthfulness of Human Knowledge; On the Elementary Constitution of Matter in Relation to the Inorganic; The Elementary Constitution of Matter in Relation to the Organic; Man as the Representative of the Supernatural; On the Moral Character of Man; On the Degradation of Man; On the Nature and Origin of Religion; On the Corruptions of Religion; Recapitulations and Conclusion.

As will be seen by our readers the scope of this treatise is vast, and the student of it will wonder at and be impressed by the extensive knowledge displayed by its author. In the consideration of the various branches of the subject every department of knowledge is drawn upon with equal readiness and accuracy, whether it be physics, chemistry, biology, physiology, history, logic or metaphysics, while the summing up in the last chapter is able, forcible, and apparently unanswerable. The style of the author is clear, simple and logical, and his treatment of the subject fair and candid. A copious table of contents and a complete index are not the least valuable portions of the work.

DISEASES AND INJURIES OF THE HORSE: Compiled and Edited by F. O. Kirby. Illustrated; octavo, pp. 332. William Wood & Co., New York, 1883. For sale by M. H. Dickinson.

This is one of the volumes of Woods' Library of Standard Medical Authors, and for owners of horses and veterinary surgeons it will be found eminently useful. It is a practical manual, prepared by the compiler after sixteen years experience of the diseases and injuries of the horse, and it is copiously illustrated with colored plates and wood cuts showing various forms of diseases, the instruments for and manner of treating them. The very best writers upon the subject have been freely drawn from and it is now offered as better adapted to the wants of horsemen than any work that has preceded it. It is handsomely printed and bound, thus being alike creditable to writer and publishers.

WHAT I SAW IN EUROPE: By S. O. Thacher. 12mo., pp. 153. Kansas Publishing House, Topeka, Kansas, 1883.

In the summer of 1883 Judge Thacher and family made a vacation excursion through Spain, Portugal, Tangier and southern France, afterwards returning through the more usually travelled route *via* Italy, Switzerland, Germany, the British Isles, etc. This volume is made up from the letters written by him to the Lawrence *Journal*, from time to time, and is published, not for sale, but for the entertainment and gratification of his friends. The author is a close observer, and though his trip was necessarily hasty, he found time to see and note much that is not the regular stock in trade of cicerones and guide-books. We have only space to say that the work is written in a free, flowing style and a genuine Kansas (which means cosmopolitan) spirit. The impression produced on his mind is summed up as follows: "There are few if any aspects of our life, our habits and institutions that do not excel those found abroad, while the elasticity, the freedom and noble equality of American citizenship compel even foreigners who once lived in the United States to unite with the returning traveler in his laudation of the land where there is no vast standing army, no titled aristocracy, no entailed estates, no State-paid priesthood and no barrier between the lowliest birth and the loftiest position."

VAGABONDIA:—A LOVE STORY: By Frances Hodgson Burnett. 12mo., pp. 392. Jas. R. Osgood & Co., Boston, 1884. For sale by M. H. Dickinson.

This is a reappearance of "Dolly," published in 1873 by Peterson, but revised, corrected and re-christened. It is a story of a family of artists and governesses, straitened in circumstances but contented with their lot and happy in the society of other artist and writers in London, whose careless, jovial and improvident methods furnish the title of the book. "Dolly," who is the chief heroine and most brilliant member of the family, is engaged to a newspaper writer, named Griffith, who is smart, shabby and jealous. She is invited, as an attraction, to an evening party given by the rich Lady Augusta, where she meets Mr. Ralph Gowan, whom Griffith had described to her as "a complacent idiot in a chronic state of fatigue," but whom she found to be a gentleman of education and taste, and who was particularly attracted to her. Mr. Griffith becomes insanely jealous without cause, which condition is greatly aggravated by certain accidental complications growing out of an ill-advised love affair of sister Mollie's in which Dolly and Mr. Gowan figure suspiciously to him, and disappears, leaving Dolly to become ill almost unto death. Gowan sees through the trouble and generously searches Griffith out just in time to save Dollie's life, discovers that Mollie is, after all his fate: rich relatives opportunely come to the relief, all marry appropriately and settle down in comfortable affluence, etc. Around this meagre plot a very readable story is woven, perhaps not fully equal to some of Mrs. Burnett's later productions, but yet interesting and brilliant enough to absorb the attention of almost any reader for a few hours very pleasantly.

THE RESOURCES OF THE ROCKY MOUNTAINS: By E. J. Farmer. 12mo., pp. 190, flexible cloth. Leader Printing Company, Cleveland, Ohio. For sale by M. H. Dickinson, $1.00.

Mr. Farmer has put a great deal of useful information upon the mineral, agricultural, grazing, timber and other resources of Colorado, Utah, Arizona, New Mexico, Wyoming, Idaho, Montana and Dakota, into this little book. To the people of the West, who are so abundantly supplied with hand-books, guide-books, etc., by the various railroad companies whose lines lead thitherward, it may not seem to "supply a long felt want," but it may be of use to Eastern readers to know that it is regarded here as reliable and accurate. It contains a well ar ranged compilation of valuable information drawn from authentic sources and is very cheap at the price asked for it.

THE WORDS OF CHRIST: By John Bascom. 12mo., pp. 220. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.50.

President Bascom, as writer and lecturer, has placed before the public some eight or ten volumes which have elevated him to a high rank among modern thinkers, and this work will strengthen that position, at least with the orthodox readers of the day. It is an effort to turn attention, quietly, fairly and considerately, but directly, to the words of Christ, as holding the theory and the only sufficent theory of spiritual growth, the force, and the only sufficient forces wherewith to secure that growth. As the author says, whatever else may be doubtful it is not doubtful that the spirit of the Gospels is the regenerative power of the world. In the measure in which this is seen to be true will all doubts and difficulties take a secondary and remote position, and the path of life and the promises of life lie plainly before us."

The subject is discussed under the following heads: Personality in the Words of Christ; Rationality in the Words of Christ; Spirituality in the Words of Christ; The Law of Truth; the Law of Love; The Law of Consecration; Individual Growth; Social Growth; Growth of Society, Historically; The Natural and the Supernatural.

We commend the work to all calm, dispassionate, earnest truth-seekers.

OTHER PUBLICATIONS RECEIVED.

Reports on the Meteorology of Oakland, Cal., for 1882–3, J. B. Trembley, M. D. Report on Wind-Velocities at Lake Crib and Chicago, H. A. Hazen, Government Printing Office. Vibration of Rain-fall West of the Mississippi River, H. A. Hazen, Government Printing Office. Study of Meteorology in High Schools of Germany, Austria and Switzerland, Frank Waldo. Report on Lady Franklin Bay Expedition of 1883, by Ernest A. Garlington, Signal Office. The Elements of the Heliograph, by Frederick K. Ward, Signal Office. The Special Characteristics of Tornadoes, by John P. Finley, Signal Office. Weather Proverbs, 1883, by H. H. C. Dunwoody, Government Printing Office. The Correspondence University Announcement for 1884, January. Abstract of Account of Archæological Excursions in Ohio and Wisconsin, by F. W. Putnam. Catalogue of Officers and Students of Yale College, 1883–4. Second Annual Catalogue of Hamilton College, 1883–4, Rev. Henry Darling, D. D., LL.D., President. The Birth and Growth of Myth, by Edward Clodd, F. R. A. S.; price 15c, *Humboldt Library*. New Carboniferous Fossils, Bulletin No. 2, by Wm. F. E. Gurley, February, 1884. *Of Work and Wealth*, by R. R. Bowker, Publisher, 4 Morton St., New York. Observations of the Comets, 1880–1–2, Prof. Ormond Stone, A. M., and Herbert C. Wilson, Cincinnati, Ohio, 1883. Kansas, with Information concerning Agriculture, Horticulture, and Live Stock, Wm. Sims, Sec'y, Topeka, Kansas. Suggestions on Library Architecure, American and Foreign, J. L. Smithmeyer, Washington, D. C. Bulletin of School of Classical Studies at Athens, by Wm. N. Goodwin, Boston, Mass.

SCIENTIFIC MISCELLANY.

A VISIT TO THE AFFLICTED CATTLE REGION OF KANSAS.

S. B. BELL, M. D.

[We received this article too late to use the whole, but give the results of Dr. Bell's observations, the conclusion being that he found no evidences of the existence of the dreaded "foot and mouth disease," but believes that the greater part, if not all, of the trouble has arisen from freezing and lack of food and water.]—Ed. Review.

Upon entering the herds the first impression was the general thin, bony, gaunt, skeleton, shadowy, dried-up, wrinkled, condition of the cattle. * * * * * * * * After a general survey of the situation I spent half a day searching for epizootic aphtha. I thought I would pick out a bad case and test it thoroughly by inoculating twenty animals. I inoculated four only. I looked in vain for an eye or mouth symptom. Not a tear, not a sign of mouth trouble, no swollen tongue, no salivation, not a slobber, not a sore. No lesion of mouth, lip, tongue, roof, or palate. Some had had blistered gums, but the blisters were perfectly healed, with only a mere trace of discoloration of the gums. There was not an ulcer, pustule, pock or pimple that I could find in the herds. There were no chancres, with deep hardened base as represented in the printed cuts.

Their mouths were abnormally white, owing perhaps to their rigidly enforced dietetic regulations. There were abundant lesions of cold horns, trimmed ears as if by a pair of scissors. There were hollow tails and dead tails, dropped tails, and dropping tails. Their bellies are hollow as that of a hungry wolf—their horns as whistles and their bones as clear of marrow as a bird's. They are almost bloodless—the organisms that should have gallons of rich blood have only pints of impoverished blood. There will be a shower of tails and hoofs on the Neosho this spring, and perhaps all through the high prairies of the west. But the great, sad, sorrowful lesion is of feet and toes: one hundred and thirty-two cattle of all kinds in three herds, Keith's, Hindman's and Trebinow's, affected in the feet and legs. Whenever affected at all, the part so affected is entirely dead and dried up and separated by sloughing the dead part from the living unless the bones and tendons hold them together—which is the case remote from joints. The separation is as perfect in all as if a surgeon had commenced an amputation by the circular method—cut down clean to the bone and then left his patient without sawing off the bone. At the ankle joints the amputation is complete without the aid of surgery. There is little swelling and the stumps and raw surfaces are granulating and healing—healthy sores, as the doctors say; that is, there appears to be no tendency to spread and extend up the involved legs—no erysipelas or blood-poisoning. There are twelve to eighteen bad cases, the balance are all convalescent, and with good care and feeding, will soon be fit for beef, (or bologna sausage).

One hundred and twenty-nine are affected in the hind feet. When the fore feet are affected the hind feet of the same animal are much more affected.

*   *   *   *   *   *   *   *   *

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Iron Paving-Brick.—A paving-brick or block consisting of a cast-iron shell filled with concrete and having yielding surfaces or strips interposed between the iron shell and the concrete filling, has been patented by Mr. J. M. Glenn, of Cincinnati, Ohio.

Corn-Harvester, Etc.—In the usual method of cutting corn or cane, the stalks are grasped by one hand and a heavy corn-knife is wielded with the other, but Mr. G. E. Alinder, of Athol, Dakota, now comes forward with a very simple and novel apparatus for use in this work, inasmuch as the knife is attached to the boot or shoe of the operator.

Process of Fire-Proofing and Preserving Wood.—According to a method recently patented by Mr. W. W. Robinson, of Ripon, Wis., the material to be treated is subjected to a bath in a boiling solution of salt, quick-lime, sulphate of iron, mineral paint and sulphur, subsequently the wood is dried, then coated with a hot solution composed of mineral paint, whiting, glue and quick-lime mixed with linseed oil.

Safety-Vault for Banks.—This is a very heavy and presumably quite secure chamber for valuables. It is constructed of hard cast-iron blocks, each say one foot square, and firmly dovetailed together; strong vertical rods assist to bind the different courses of blocks into a substantial solid mass. The door slides in a steel-lined recess and the lock- and bolt-work is located in a correspondingly lined recess in the opposite side of the door-way. The door consists of a single block of hard cast-iron having imbedded therein a perforated wrought-iron case. In case over-security should be demanded, the entire outer and inner surface of the vault may be provided with a lining of steel. The inventor is Mr. John T. Hough, of Chicago, Ill.

Patching Fire-Hose.—Mr. G. W. Towle, of San Rafael, Cal., has patented a patch for bursted fire-hose and it consists of a segmental plate of metal conforming to the size of the hose to be patched, and adapted to be placed over the rupture and locked in place by means of clamping-bands also of metal. Under a heavy pressure, and if at a fire of any considerable dimension and danger, the hose are liable to burst and necessitate the stream to be stopped until the ruptured section can be removed from the line and a new one substituted therefor. This may allow the fire to gain such destructive headway that it cannot be controlled before an unlimited amount of property and possibly human life has been destroyed while on the other hand, by the simple application of a patch to the ruptured hose, which operation requires but a few seconds, and to the detriment of the fire, this delay would be avoided.

Apparatus for Producing and Burning Gas.—A steam boiler is provided with a suitable super-heating attachment, from which a supply of steam is drawn as required by the process, which consists in addition to the above described boiler, of two or more coal-coking or gas-producing furnaces, together with the requisite valves and connections between the boiler, furnaces and holder. In the operation, gas is produced suitable for cooking, heating and other purposes, by passing air through ignited gas-producing coal in such a manner as to produce perfect combustion at the lower stratum of the glowing mass, thus forming comparatively pure carbonic acid, then converting the acid so formed into carbonic oxide, and at the same time, distilling off the heavy hydro-carbons by passing the carbonic acid up through the mass of coal, after which super-heated steam is introduced into the gaseous products, and finally passing the products down through a bed of incandescent carbon, by which latter operation the previously introduced steam is decomposed and forms an additional volume of fixed carbonic-oxide and hydrogen. Recently patented by Mr. L. D. York, of Portsmouth, Ohio.

EDITORIAL NOTES.

This is the closing number of the seventh volume of the Review. We have no space for comment, but refer any reader who doubts its utility as a popular science magazine to the index which accompanies this issue. We shall hope for a large increase of subscribers with the beginning of the next volume. Please read the prospectus on fourth page of cover.

We were much gratified by a day's visit from Prof. E. D. Cope, the eminent palæontologist and co-editor of the *American Naturalist*, on the 28th ult. He was on his way to the City of Mexico and stopped over for the night train. On his return in the latter part of the month he will, if possible, deliver an address before our Academy of Science in compliance with an urgent invitation.

The U. S. Signal Service is engaged in a careful and extended investigation concerning the history, origin and development of tornadoes, and asks the co-operation of observers, librarians, newspaper editors, etc., in obtaining facts of all kinds bearing upon the subject. All such items should be addressed to Sergeant John P. Finley, Signal Corps U. S. A., Washington, D. C., who will promptly furnish instructions, blank forms, etc.

D. H. TALBOT, a well-known scientist of Sioux City, Iowa, has prepared a memorial or open letter to Congress, urging the propriety and importance of establishing in the National Park, a grand Zoological Garden, where the various species of wild animals of at least the north-west can be collected and their habits studied under far more favorable circumstances than anywhere else. It is a valuable suggestion, and the naturalists of the country should aid in carrying it into effect.

MR. F. A. SAMPSON, one of the contributors of the REVIEW, delivered an interesting address at Sedalia on the 12th of February, in advocacy of the establishment of a Natural History Society there. Missouri presents a wonderful field for naturalists and such societies; wherever organized, can find an abundance of material to work upon and can be of the greatest service to science in general, and at the same time assist in the developem nt of the resources of the State.

JUDGE F. G. ADAMS, Secretary of the Kansas State Historical Society, has learned that in 1856 an Englishman, named Buckeridge, published some views of this city and points in Kansas, and is very anxious to ascertain whether or not any of our older citizens possess any of them.

ON the 4th ultimo the Kansas City Medical College held its 15th annual commencement. Addresses were delivered by Judge S. O. Thacher, of Lawrence, Kansas, Professor J. H. Van Eman, M. D., and Professor T. B. Lester, M. D., and diplomas granted to fifteen young gentlemen. On the 13th inst. the Medical Department of the University of Kansas City, held its third annual commencement. Addresses were delivered by the President of the Board of Regents, Rev. N. Scarritt, D. D., and by Professor J. M. Allen, M. D. The degree of Doctor of Medicine was conferred upon thirteen young gentlemen. On the 14th inst. the Hospital Medical College held its second annual commencement. Addresses were delivered by Hon. R. T. VanHorn, Prof. J. Thorne, M. D., Mrs. Emma J. Kimmell, and Rev. J. H. Savage; the latter upon "Reform and Progress in the Colleges." Diplomas were granted to nine members of the graduating class.

THE tornado season has commenced, and, what is a little singular so far, the localities affected have been principally east of the Mississippi River.

THE late Prof. J. Lawrence Smith's private collection of meteorites, the largest in the world, has been bought by Harvard College for $10,000.

DR STEPHEN BOWERS, who is now a resident of San Buenaventura, California, authorizes us to say that the article we copied from the Santa Barbara *Independent* is utterly false, so far as it relates to Indian skulls having been found with false teeth and the finding of mortars and pestles of agate. Dr. Bowers has visited the collection said to have contained these finds, and pronounces it a fabrication for which the reporter of the above named paper alone is responsible. No such things have ever been found among the Santa Barbara stock of Indians.

The arrival at Kansas City on the 27th ult. of the first through train from the City of Mexico. was an occasion of much rejoicing, as this road adds another grand feeder to our commerce. The trade of New and Old Mexico has always been a source of profit to this city, in fact was the origin of it in the days when it was merely a landing for steamboats discharging their cargoes of freight for the distant points in those States. The immensity of this trade in the future is incalculable.

THE whole northern half of the western addition to the University of Missouri, is to be used as a scientific museum. Prof. G. C. Broadhead, former State Geologist of Missouri, has recently spent several months in overhauling and arranging the immense quantity of specimens on hand there, some of which have been packed away in cellars and out-buildings for the past twenty years.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Central Baptist* of St. Louis, Mo , is among our exchanges. It is the leading Baptist paper west of the Mississippi River. It has an able editorial corps, with contributors and correspondents in all parts of the world. It is firm in its devotion to Baptist principles, yet kind and courteous in its discussions. It is brimful of news, religious and secular, and has special Departments for Family, Farm, Science, Education, Literature, Sunday-schools, Missions, Markets, etc., etc. It publishes the sermons of Spurgeon and other great preachers. Price, $2.00 per year. To ministers, $1.50. Specimen copies free.

THE *Atlantic Monthly*, for April, opens with the second chapter of Mr. Craddock's story, "Drifting Down Lost Creek." There follows a paper on presidential nominations, by Oliver T. Morton. The interesting serial stories, "A Roman Singer," "En Province," "In War Time," are each continued. N. S. Shaler contributes an original and highly suggestive theory upon the red sunsets. George Parsons Lathrop has a poem entitled, "Night in New York." The above gives only a portion of the varied table of contents that is offered in the present number.

THE January issue of *Van Nostrand's Engineering Magazine* was the first number of the thirtieth volume. It is, as we have often said, the best periodical for practical and skilled engineers published in this country, and as such deserves their generous support. That it has not received it, however, is quite evident from the following remarks by the publisher: "The continuance of its publication will depend, therefore, very much upon its support for the present year. If our educated engineers can afford to permit its discontinuance from lack of adequate support, the publisher certainly can afford to do so, to his advantage." It is to be hoped that so valuable a magazine will not be allowed to fail for want of support, when there are so many engineers in the country who not only can readily afford to take it, but who also actually need such an one for the sake of keeping up with the progress of the scientific and technical work in their profession.

THE REVIEW OF SCIENCE AND INDUSTRY at Kansas City is about to begin a new volume under favorable auspices. This journal now ranks next to the *Popular Science Monthy* in this country, which it very much resembles in size and form. The REVIEW is ably edited, has a wide contributing patronage from American scientists and is a credit to the West.—*Chicago Saturday Evening Herald.*

PROF. W. P. TROWBRIDGE, of the School of Mines, Columbia College, contributes to *Harper's Monthly* for April a very important and timely paper on Modern Sanitary Engineering, full of valuable suggestions relating to the water-supply of large cities, the sewerage of large inland and coast towns, the subsoil drainage of cities, house-drainage, and ventilation.

THE *North American Review* for April, has, among its other papers, a discussion by N. Dingley, Jr., M. C., and John Codman, as to the decline of American shipping. Rev. Dr. Phillip Schaff writes upon the development of religious freedom. Julian Hawthorne takes up the subject of literature for children. Rev. Drs. Mortimer and Heber Newton discourse upon recent critcisms of the Bihle.

THE *Medical Index*, is the title of a new journal just started in this city. It is handsome in appearance and solid in contents. It is edited by Drs. J. B. Browning, F. F. Dickman, and N. A. Drake, and managed financially by Drs. J. W. Elston and A. P. Campbell. Forty pages; monthly: $2.00 per annum.

SOME bold and ingenious (amateur) engineer proposes over the instials of C. L. O., in the St. Louis *Republican* of February 27th, to prevent floods in the Lower Mississippi by diverting the water of streams above into channels: For instance to "tap the Missouri River at Kansas City and by a channel convey it through to the Neosho River at a point near Ft. Scott, a distance of about seventy miles, and thence through that stream to the Arkansas River, about one hundred miles. The water could be so regulated that it would make the Neosho and Arkansas navigable without permitting them to overflow and not interfere with navigation on the Lower Missouri and Mississippi."

To this scheme Professor G. C. Broadhead replies in the same paper of March 1st: "The gentleman probably has not visited Kansas City, nor has he travelled across the country for one hundred and twenty-five miles southwest to the Neosho River at Neosho Falls, nor down that stream to its junction with the Arkansas. Probably he may imagine it would be easy for the Missouri to leap three hundred and fifty feet above the valley at Kansas City to reach the summit, twenty-five miles southwest, and should also remember that, although the Neosho River lies in a broad valley, yet we find that the surface of Kansas gradually rises westward and railroad elevations and Gannett's tables inform us that nowhere in the State of Kansas does the valley of the Neosho descend as low as the elevation of Kansas City above the sea. At the State line the Kansas valley is seven hundred and sixty-three feet above the sea; at Neosho Falls the valley of the Neosho River is one thousand feet, at Parsons nine hundred and twenty feet and the crossing of St. Louis and San Francisco in the Indian Territory about seven hundred and fifty feet above the sea."

PROFESSOR M. W. HARRINGTON, Director of the Observatory of Michigan University, announces the publication of the *American Meteorological Journal* about May 1, 1884. It will be a monthly of 32 pages, octavo, published by Dr. W. H. Burr, of Detroit, at $3.00 per annum. Contributions are solicited from meteorologists everywhere.

THE *Art Interchange* of March 2th contains two colored studies by Miss Caroline Townsend—one suitable for decorating a hand-bag, and the other for stenciling or embroidery. A beautiful design for ceiling decoration also appears in that issue, also a study of a toad, designs for a set of fruit d'Oyleys, several designs for small articles in brass repousse work, designs of thistle for cup and saucer decoration, and a panel design of humming-birds.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

Washington D.

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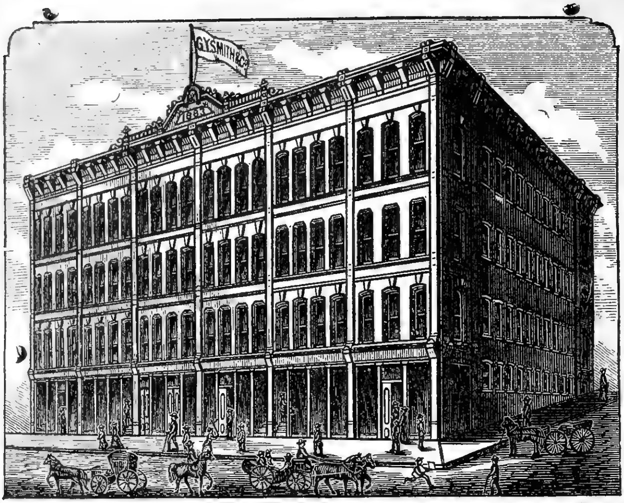

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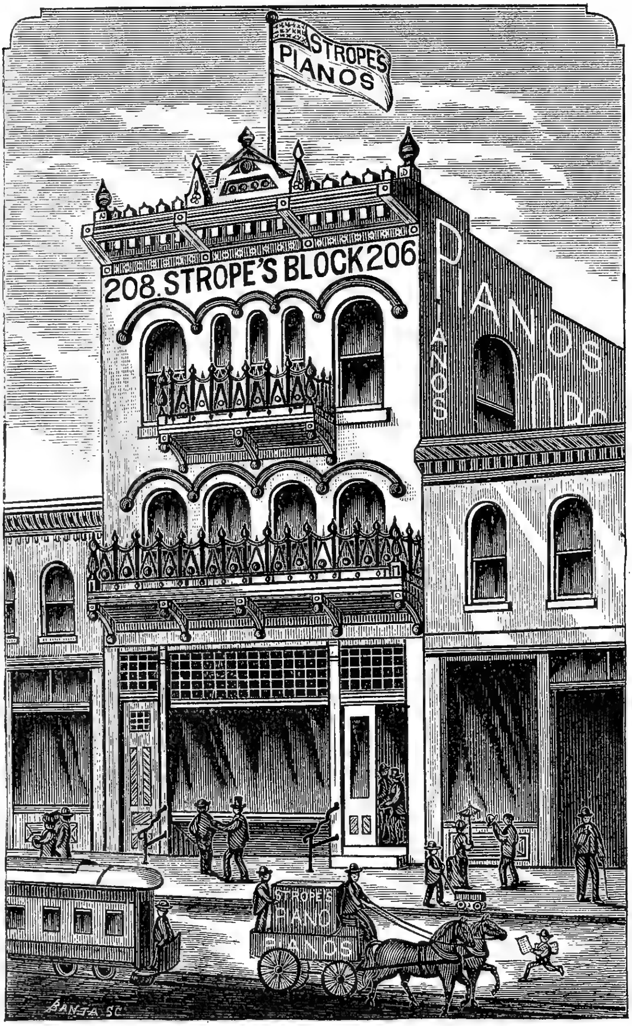

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