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NOTES.

THE first papers on "Sunbeams" and 'The Mystery of Creation" were published in our August number. In this number the two articles are completed.

WE have especial pleasure this month in giving our readers an article from the pen of our energetic and talented friend, Dr. George M. Meacham, of Tokio, Japan. Dr. Meacham's work for the past seven years has been principally among the young men—Japanese students—and he has had peculiar advantages in gaining an acquaintance with the progress, the present condition, and the prospects of education among this advancing nation. The second part of his article will be of great interest to young men, and young women as well, who are looking away across the Pacific for fields of usefulness. Who will help him?

THE great scientists have come and gone, have seen and been seen. They have had a grand, a glorious holiday trip, and Canadian capital has paid the bill. We do not begrudge the cost; the money has been well laid out, and will in time return in many fold. Interest has been aroused in Canadian affairs, attention directed to our scientific and literary institutions, some of our savants have been brought into contrast with English savants, and a new glory has been thrown around our own ambitious Royal Society. How long before Canada will be able to send across the ocean six hundred men and women of equal ability and fame, led by a Thomson, a Rayleigh, a Temple or a Roscoe? These men were brought over to see our people and our country. Some of us have seen and heard them, and these far-off celebrated thinkers have before us taken the form of real, living men. Canadians will be well repaid if they remember, "What men have done men can do."

THERE is no visitor more unexpected, more unwelcome, yet more regular, than Death. Just as we have completed our month's work and are about to lay by our pen with the satisfaction of work completed, a jarred note breaks in upon the harmony and proclaims another chord of life is snapped asunder. For the third time since the inauguration of our JOURNAL have we to dip the pen in darker ink to record the absence of another friend. After seven months' illness Joseph Adam Clarke, M.A., B.Sc., died at Smith's Falls August 26th, 1884, aged thirty-five. He graduated some years ago at Victoria University as a Bachelor of Arts, since which time he has been most of the time engaged in high school teaching. Being an ardent and zealous lover of natural science he afterwards returned to college and completed the science course. It was at this time that we became intimately acquainted with him. He then was appointed head master of Smith's Falls high school, afterwards married, and through ill-health was compelled to resign his position in the early part of the present year. He was a man deeply respected wherever he was known, and in him we have lost a warm friend, and the cause of education an earnest and energetic worker.

GOOD works of Nature—beautiful, symmetrical, harmonious, and withal perfectly adapted to their uses—are strewn around our daily paths, and are as accessible to the poorest country child as to the millionaire.—*Dawson.*

No life can be pure in its purpose and strong in its strife, and all life not be purer and stronger thereby.—*Owen Meredith.*

NOVELS AND SCIENCE.

NOVEL writers are becoming prolific, and in their eager anxiety to catch the eye and ear of the reading public are seeking subjects in new and interesting fields. Heretofore the field of scientific discovery and fancy has been the sport of that imaginative and curious writer, Jules Verne. Herbert E. Chase, however, has lately entered the field as a rival, and we can venture to predict that there will be more to follow. Fiction is interesting, but fact is more so; and the queer, quaint and curious characters that stand out isolated and apart afford histories, some sad and sorrowful, others interesting and delightful, and all true but apparently incredible. There are some writers, however, who take delight in trying to improve upon nature, and thereby mar their pictures. Chase has written a romance entitled, "A Double Life; or, Star Cross. An Hypnotic Romance." The *Literary World*, in a criticism, thus refers to one of the characters:—

"We have left little room to narrate how this young prodigy of magnetic power and vivisective tastes is discovered and recovered by his father, a Professor Barlow, or to describe Professor Barlow himself, with his still more wonderful magnetic and clairvoyant gifts, his command of electricity, his chamber of marvels if not of horrors, and the magical if not almost supernatural gifts of which he is the consummate master. In this Professor Barlow centres all possible occult applications of the scientific knowledge of the hour. He enslaves the wills of whom he chooses; he turns his servants into clairvoyants at pleasure; he adorns his reception-room with petrified human bodies in place of statues, as natural as life; the pictures on his walls come and go like slides in the stereoscopic camera; flowering shrubs grow right up through his carpeted floor; he draws his light from an unseen source; he entertains his visitors with inexplicable music; he enters to greet them like an apparition; he lifts a fifty-pound weight as if it were a feather, thus annihilating gravitation; and he is on the point of effecting the resuscitation of human life when an unhappy accident makes an end of him.

"Such are the general features of this 'hypnotic romance,' which is as fanciful as a fable, as extravagant as Jules Verne, as rational as the phonograph, as philosophical as Piazzi Smith, as coherent as a dream, and as credible as electricity. As a story its merit is small, but as a fantastic presentation of theories in practical science it is a sign of the times."

FOSSILS.

THERE certainly is a science of human character and nature; there must be if the principle of continuity holds true. We study the stars and group them; we study plants and classify them; we study rocks and arrange them; we study men, but do not classify them. The subject is a difficult and somewhat mysterious one; but that is not a satisfactory answer. There are men and men. We classify men as to color, as to size, but not yet clearly as to nature. The science of character development and mental diagnosis is one truly, as Fham has well proven, worthy of serious thought and study. The subject must, we believe, be approached as other subjects have been approached, by classification, from general to particulars. Here, then, is the first point for consideration—What is the basis of classification in human nature? Into what comprehensive and naturally distinctive classes may man be divided *mentally!* Then will come the consideration of the differences, their causes, how one class may be developed from another, how the ideal may be evolved out of the most undeveloped. But one step at a time. Our first question is, How are men's natures to be classed naturally? We hope that our thoughtful readers (which includes all) will give this matter attention and give us the benefit of their conclusions.

The terms so far made use of in the distinctions necessarily arising and frequently heard are generally taken from the other sciences—the natural sciences. Some of them are expressive, more so than intended, and convey meanings which, though true, are yet somewhat concealed. There are so many places suitable for the study of this interesting subject, either in individual cases or in collected groups, on the street, in the house, on the railway, in the assembly. In the gathering of the young and mirthful, the gay, giddy and reckless, the jovial and jolly, there is sometimes found a character whose appearance and nature relegate him to another class, another formation, another age. Shrivelled and distorted, sober and sedate, the feelings dried up apparently, the life quenched, the usefulness doubted, the intruder is termed a "fossil." Fossils do not form a natural class, merely a useful distinction; for to the geologist there are fossils and fossils. So with men—fossil men and fossil men. Some common and uninteresting, serving, as is the case with many limestone fossils, to *fill up*, having no written history. To the uneducated fossils are rocks, nothing more; to the geologist they are petrified histories; they are beautiful, interesting; they are still alive. To the human-geologist, the homologist perhaps, there are beauties in these living fossils. They have histories rivalling fiction's most ingenious stories; they have interest outweighing far the senseless, silly actions of the flitting butterflies of the day's existence.

Fossils are the recognized remains of former life. We can recognize the shape, the appearance, trace the motions, find out the modes of life, and gain a more accurate history, than of many of the animals still living. But we can learn more; for the twisting, wrenching, scratching and pressing tell us of torture and death, so terrible as still to send a shiver through the beholder's frame. Human fossils still live; but the bent form, the distorted countenance, the wrinkled scratches, the lifelessness, tell a story that, if we study it aright and learn considerately, will arouse our sympathy and interest, not our ridicule and scorn. Some fossils are despicable, but some are interesting. Ere our smaller nature is aroused our curiosity should be satisfied. The man may be a fossil from laziness, or he may be a fossil from oppression. Fossils are either human beings deteriorated or human natures oppressed.

In the classification of character and in the completed work we hope and expect to find a chapter on human fossils, their origin and nature.

The study of human nature is one of universal importance, and each can pursue it for himself, no further tools or books being necessary. You can begin with the study of your own nature if you wish. Should you prefer a particular discussion of the subject to a general, you could first consider these questions: Are you a fossil already? If not, are you fossilizing? Are you twisting, torturing, grinding any others into fossils?

These settled satisfactorily, choose your fossils, those whom, perhaps, you have been accustomed to treat with ridicule; trace their history and learn a lesson in human geology. Fossils, merely as fossils, are objects of interest more than of usefulness; but by change and reformation they may become useful.

MYSTERY OF CREATION.

II.

(Continued from page 87.)

THE Nebular Hypothesis has exceeded the expectations of its first champions; but still there are some phenomena which it seems to fail to explain directly and finally as yet. Time, however, may clear away these objections and harmonize all, as man's knowledge of the workings and laws of the celestial world becomes enlarged; and so we should not altogether condemn it because it does not seem to explain all, but retain it until we have found something superior to it, or until it is proven to be opposed to the laws of nature. It is contended that in the Nebular Hypothesis we not only have no reason for the origin of comets and meteors, but that everything is directly opposed to them. Comets are supposed to be under the same influences and to move in the same manner as meteors which revolve in large systems around some central sun. Around our own sun there are many of these revolving systems whose orbits must interlace and approach each other. Thus at times these systems of meteors come into contact and collide, motion is lessened, and they are drawn into the sun by the powerful grasp of gravity, thus helping to feed its continual fires. Some scientists ascribe to this the *continued* supply of the sun's heat, and, reasoning backward, have to this cause ascribed the source of all the sun's heat and that of the whole universe. This idea Proctor has taken in regard to the formation of the entire solar system. *Motion* is in this hypothesis, as in that of LaPlace, *presupposed.* "Countless millions of meteoric systems travelling in orbits of every degree of eccentricity and inclination; travelling also in all conceivable directions around the centre of gravity of the whole, would go to the making up of each individual planet. A marked tendency to aggregate around one definite plane, and to move in directions which referred to that plane corresponding to the present direction of planetary motion, would suffice to account for the present state of things. The effect of multiplied collisions would necessarily be to eliminate orbits of exaggerated eccentricity, and to form systems travelling nearly in the mean plane of the aggregate motions, and with a direct motion. Further, where collisions were most numerous there would be found not only the most circular resulting orbits; not only the greatest approach to exact coincidence of such orbits with the mean plane of the whole system, but the bodies formed out of the resulting systems would there exhibit rotations coinciding most nearly with the mean plane of the entire system." This, it is maintained, will explain the strange varieties in the size of the planets, the retrograde and almost perpendicular motion of the satellites of Uranus, and the systems of meteors which do not find full explanation in the Nebular Hypothesis. By this Meteoric Hypothesis many of the seeming irregularities of the solar system are explained as possible, since in it *chance* plays a greater part, and the sequence of phenomena cannot be calculated as mathematically as in the Nebular Hypothesis. But while it can perhaps account for the few irregularities better than the Nebular Hypothesis, it cannot account for the many regularities as well, unless we concede about as much regularity and order to the meteoric systems as in our present solar system. The Nebular Hypothesis takes us back farther in the order of time and origin, and starts more from first principles and the primordial condition of matter. If we accept the Meteoric Hypothesis we must bring forward another hypothesis to explain the origin of the meteoric systems; and that we contend would be more difficult and complicated than the explanation of the origin of our present solar system, since the motions would be much more complex, and thus we would be going into greater difficulties and more abstruse explanations. For simplicity's sake we prefer the Nebular Hypothesis to the Meteoric; but still we do not feel satisfied as yet to endorse it in its full extent, and so do not come to any definite and decided opinion in this paper. Nor would it be wise in any of us to rashly and hastily concur in any hypothesis until it has fully and satisfactorily explained all of the seeming defects. Though we may not be able to form decided opinions, still our thought will be aroused and quickened, and our mind directed back to the investigation of first causes; and herein consists our chief reason for bringing this subject before our readers. However, we cannot help a decided leaning in favor of the Nebular Hypothesis; for if that is not the true hypothesis concerning the formation of the universe, one somewhat similar, and involving its leading principles, must have been the true one; for modern science, from the observation of present phenomena and the records of the past, has made it evident that by following back the cooling processes now observed in progress in nature, we must arrive at a time when the planets were enveloped in the sun's fiery atmosphere, and were themselves in a molten, vaporous state. The reverse problem, however, is much more difficult, and we cannot say that we have as yet an altogether satisfactory explanation of the process by which, from a nebulous mass, there could be formed by condensation a system of such wonderful symmetry as our own. Still we must conclude, as we said before, that either the Nebular Hypothesis is true or something founded on similar principles and nearly allied to it is true. There are many difficulties connected with it, of which the principal one is to show mathematically how a ring of vapor could be detached from the sun and form into a single planet. One of the modern scientists has summed up his conclusions as follows:—"At the present time we can only say that the Nebular Hypothesis is indicated by the general tendencies of the laws of nature; that it has not been proved to be inconsistent with any fact; that it is almost a necessary consequence of the only theory by which we can account for the origin and conservation of the sun's heat; but that it rests upon the assumption that this conservation is to be explained by the laws of nature, as we now see them in operation."

There are some who reject the hypotheses thus put forward which indicate the workings of the Creator through processes or by means of second causes, thinking that they not only are in opposition to the teachings of the Bible, but also that they take away from the wisdom, grandeur of working, and power of God. But to such we would quote the words of a modern astronomer, that "It gives an altogether higher idea of that wisdom, which must in any case be far above our conceptions, to regard the laws of God as so perfect that they operate always to work out His will without the necessity of special interference on His part, than to see His hand directly operative in all the phenomena of the universe."

MR. E. R. L. GOULD, B.A. (Victoria University), a Fellow of Johns Hopkins University, has been appointed to a Professor's chair in Washington. He will take the degree of Doctor of Philosophy in 1885. We offer him our congratulations on his success as a Canadian student.

SUNBEAMS.

II.

(*Continued from page 96.*)

IN a total eclipse the black body of the moon is surrounded by a kind of glory consisting of long, red, flame-like protuberance. which, according to Lockyer, are sometimes eighty or ninety thousand miles long. These have been observed to change their shape at the rate of a thousand miles a minute, and altogether are very singular objects. Every scientific man was curious to know what the spectroscope would find in these flames. At the next total eclipse expeditions were sent to different parts of the world to observe them with the spectroscope. In the few minutes of totality the observers did not generally make very accurate measurements, partly, no doubt, from nervous excitement, for had not the supreme five minutes arrived for which they had spent months of preparation? But enough was made certain to assure us that these flames were hydrogen.

Soon after, Lockyer in England, and Janssen, a French physicist, in Guntoor, India, at about the same time found that these flames might be observed whenever the sun shone, as well as during an eclipse. The portion of sunlight entering the slit of a spectroscope is spread over the whole length of the spectrum, and thereby greatly diluted; while the hydrogen lines are not widened but only spread farther apart, since their light is homogeneous. By using a large number of prisms of high dispersive power the intense light of the sun was so spread out and weakened that the comparatively feeble light of the hydrogen lines could be observed at any time, as though the continuous spectrum were not present. It has been found that the greater the pressure upon a gas the broader its lines are until, as a certain point of condensation, the spectrum becomes continuous. The hydrogen lines of the sun were found to vary astonishingly in width, showing great and sudden changes of pressure. In this way the spectroscope gives us some idea of the state of the barometer on the sun. Sometimes, again, the lines were bent all out of shape. This is readily explained. Once more using the analogy of sound, if a railway locomotive whistles while approaching at full speed, the sound is considerably shriller than when receding. The height or depth of a note depends on the number of sound waves reaching the ear in a second. If the sounding body approaches, evidently the waves will be as much shorter as the distance passed between two waves, and the note to that extent higher. In the same way, if the hydrogen flame is darting toward the earth at an enormous speed, it will have the effect of shortening the waves of light; and, as the shortest waves are at the violet end, the line will shift its position toward the violet. Thus by the spectroscope we may follow quite as accurately the progress of a solar cyclone large enough to engulf half-a-dozen puny worlds like ours as the weather department in Washington can follow the motions of a storm a few hundred miles wide on this earth.

Huggins, who has done so much in stellar spectroscope analysis, tells us that we need no longer teach our children—

> "Twinkle, twinkle, little star,
> How I wonder what you are,"

since we already know what they are. Philosophers, young and old, had wondered what the stars were ever since men could think, and had wondered in vain so far as any definite answer was concerned; for before Huggins pointed his spectroscope toward the stars, everything which was said of their composition was mere speculation; but he soon gave a definite answer. The fixed stars were suns like ours, and contained, for the most part, a number of our own familiar terrestrial elements. Red stars, however, had more lines in the green and blue than in the red, and blue stars had most lines in the red end of the spectrum. He proved, by the shifting of the lines of hydrogen in Sirius, that twenty-one years ago that sun was receding from us at the rate of twenty-nine miles a second. I say twenty-one years ago, for it takes that long for Sirius' light to reach us with news of his condition.

In the year 1866 an almost unnoticed little star in the Northern Crown suddenly blazed out so as almost to equal in brightness the largest stars in the heavens. The spectrum of this star showed not only the ordinary black lines, but also bright lines of hydrogen. Its brilliance soon began to diminish, and as it diminished the hydrogen lines faded till, when the star once more descended to the eighth magnitude, the bright hydrogen lines became invisible. The only conclusion we can come to is, that there was a sudden conflagration of hydrogen—the star was on fire The intensity of its light was increased nearly eight hundred fold. If the intensity of the sun's rays were increased eight hundred fold our earth would soon be dissipated into vapor. Can we help thinking of that day mentioned by Peter, "wherein the heavens being on fire shall be dissolved, and the elements shall melt with fervent heat."

The difficulties encountered by Mr. Huggins in his investigations were not small. The moon, as is well known, is a bad sitter for a photograph, since the motion of the earth on its axis has to be exactly counterbalanced by clockwork, and the impression in the photograph is often blurred. The difficulty is increased when a fixed star, a mathematical point, is to be kept within the width of a slit the one-three-hundredth of an inch wide by clockwork. Again, if a point is lengthened out it forms only a line, not a band; so that the already feeble light of a star must be further reduced by a cylindrical prism, which changes the point into a line which, when expanded, forms a band. Of course, dark cross lines could not be noticed in a mathematical line which has no thickness. Another difficulty was the fickle English weather. The slightest haze would put a complete stop to his work. Taking all things into account his success was really wonderful.

Several nebulæ have been examined, and their spectrum consists generally of one bright line in the green or three lines. Of the three lines one corresponds to a hydrogen line, another to a nitrogen line, and a third between these two does not correspond to any known line. The bright line spectrum indicates that the nebula is in a gaseous state. Other nebulæ, however, give very faint continuous spectra, showing them not to be merely gaseous. As only one line each of hydrogen and nitrogen appeared in the spectrum, observers were at first in doubt whether this was conclusive; but it has been found that if the intensity of the light from glowing nitrogen and hydrogen be reduced, only one line remains visible in each, and that corresponds with the line in nebula.

According to the celebrated Nebular Hypothesis, these cloudy bodies are the raw material of which suns are made; so that all the other elements must be made from hydrogen, nitrogen, and some unknown element, if we are to accept the results of spectroscope analysis as conclusive. It is possible, however, that other elements may exist in the nebulæ, but so feebly luminous as not to show their lines in the spectrum.

The spectroscope tells us something about comets, too; those moths of the solar system that dash in from the darkness toward the light, flutter a moment dangerously near the flame, singe their wings and fall into it, or escape and flit once more out into the darkness. Those vagrant bodies—sometimes wandering years in the blank outer regions of space far beyond the beaten paths of the steady-going planets, always ready to change their course under the influence of any attracting body, sometimes getting fairly entangled among the satellites of one of the larger planets—have always interested the scientific man, while they have been objects of terror to the ignorant. Their strange and portentous shapes have been thought to foretell war, famine and pestilence. In the spectroscope they show three bands of color in the greenish blue, green, and greenish yellow. These agree quite exactly with three bands in the centre of the carbon spectrum; so that these strange visitors are composed of our familiar friend carbon, but in such a state of tenuity that, though sometimes a million miles in diameter, the smallest asteroid or satellite sails past without noticing them, while they are drawn all out of their course. Ten thousand miles thickness of cometary matter does not dim the light of the smallest star.

But meantime some inveterate utilitarian is asking in his mind: "What good is there in all this? Why do these visionary men of science squander thousands of dollars on a few three-cornered bits of dense glass with a telescope attached, and go into ecstasies over a streak of red or blue light that they see through them?" It is true spectrum analysis is but beginning to be of practical importance. Shall it therefore be neglected? Never! When it was discovered that a magnetized needle floating on straws in a basin of water pointed always toward the north, who would have predicted that ships as populous and as complete as a town should traverse with confidence the trackless ocean by the aid of this trembling guide; that, relying on its direction, men should sail boldly out to discover new continents; and that through it civilization should advance with giant strides in unthought-of directions: that broad seas should henceforth be bonds of union between nations instead of impassable barriers? The man who prophesied it would have been thought insane. But no real discovery in science is wasted. Every year seemingly valueless discoveries are found to have immense practical importance. No doubt it will be so in the case of spectrum analysis; but even if not, should it be put aside as unworthy of attention? Who can think so?

All nature speaks to us in a strange and unknown language, telling us of the wonders of its creation and continuance. Every wind moans some weird history; every wavering leaf or hanging flower has a tale to tell: every rugged and storm-battered rock mutely asks attention to the story of its origin; every rippling brook murmurs in silvery accents strange passages in the history of the world; and the waves on our coasts thunder forth with thick and stuttering utterance a record of the past: but, more wonderful than all, every sunbeam, every quivering pencil of rays from the most distant star is a swift-winged messenger from far countries hastening to write in letters of light the great events there transpiring, and the mysterious story of creation. Not one but steadfastly bears testimony to the majesty and glory of the Creator and Sustainer of all things.

It is true that many of the messages we receive we cannot comprehend, very many of the mystic characters are still undeciphered, many that are deciphered are meaningless to us as yet; but the scattered passages which scientists have so far been able to translate for us have such an amazing fulness of meaning, are of such transcendent interest, that we can no longer wonder when men of genius, who have partly learned the alphabet of this language, sacrifice all that others deem pleasure, and devote their lives to bringing to view the previously hidden meaning of pages in the vast book of nature.

Of all the attractive modes of interrogating nature none is more attractive than this latest one of spectrum analysis. It tells us through the microscope that a red speck on the knife of a suspected murderer is blood, and no accidental stain; and tells us just as confidently through the telescope that vaporized iron floats in the atmosphere of that twinkling star so distant that even light takes years to reach us; or that a tornado of incandescent hydrogen is sweeping at the rate of five thousand miles a minute over the surface of our sun.

Philosophers have described man's condition, as regards his knowledge of things around, as that of one standing in a dimly-lighted circle, while but a short distance from him all things are lost in the unknown night which settles down around his horizon; and even in the brightest part of his circle the long, dark shadows lurk about his feet. Who would not rejoice at any discovery which sent out a stream of light, driving back the horrible shadows farther into the void of space? The spectroscope enables us to feel the pulsings, the throbbings of the surrounding ocean of ether, that life-blood of the universe whose trembling, quivering motions are light and heat and energy, without which, so far as we can know from science, the blankness and blackness of universal darkness and death would close us in forever. Can we say more for this newest and most fascinating of the sciences than that it tells us more of the final composition of things near and distant than any other since man first studied nature.

EDUCATION IN JAPAN.

THERE is perhaps no country in the world that has within the last twenty years awakened a deeper interest in Europe and America than Japan has done. One reason is, that on account of its long isolation from the rest of the world it has developed a civilization of its own, and another, that it has exhibited from a very remote period a profound interest in the subject of education. Perhaps we may not go back further than the 4th or 5th century of the Christian era to reach the limits of trustworthy history in Japan. But it is claimed that before the beginning of our Christian era written characters were brought into Japan from Corea, and there is reason for believing that about A.D. 284 scholars from Corea and China were brought over to teach the son of the Mikado and government officials the Chinese language and literature. Early in the 6th century the Emperor Ketai selected his public officers for their learning as well as for their integrity, and Corean scholars seem at that time to have been in great demand. About A.D. 540 a fresh stimulus was given to this study by the introduction of the Buddhist religion. A university, with a Corean scholar at the head, was founded by the Emperor Tenji A.D. 668; to which were added departments of music and medicine by the Emperor Moumu, who established schools in several provinces. By the 11th century of our era Buddhism had effected the conquest of the nation, Chinese literature having been dominant in the land already for nearly three centuries. But from this time forward, on account of the civil wars consequent upon the development of feudalism, learning was less cultivated than arms; the university was neglected, and ultimately discontinued. Still, while ambitious soldiers wielded the powers of governme t, confined the Emperor in his palace, and left him only an empty title, scholars never ceased to exercise a powerful influence over public affairs. Meanwhile strife and disorder continued till the beginning of the 17th century, when Iyeyasu, the founder of the Tokugawa dynasty, attained the rank of *shogun*, made the office hereditary, and wielded absolute power in the land. Iyeyasu was a liberal friend of learning. So also his successors. Tsunayoshi (A.D. 1681-1709) founded at Seido, Yedo, a Confucian university; and Iyenori (A.D. 1787-1838) threw it open to the public. Xavier says that in his day there were four academies near Kiyoto, each with 3,000 or 4,000 pupils. In the high-class schools, which made up the university of Yedo, sons of nobles met with young people of the middle class. Others of the line of Tokugawa founded many famous schools in various parts of the empire, where the nobles were taught in Chinese literature and philosophy, and a popular career of the liberal professions was opened to the *samurai* or gentry class. Once more arms and letters were united in education. Private schools for children of farmers, merchants and mechanics abounded in all the cities, and it is said every village except the smallest had at least one. In hamlets too small for the ordinary school the principal inhabitants secured a young man as teacher, one giving him clothes, another board and lodging, the poorer giving monthly fees, while the poorest got their children educated gratuitously. In these elementary schools the pupils learned something of Japanese history, a little geography, and the exploits and amours of their ancient heroes, and were taught to read and write their simplest characters, and to perform easy calculations upon the *abacus*. But despite the fact that the valuable literature of their country was as far beyond their reach as the knowledge of the Rig Veda or the Iliad is beyond the common school pupil in Canada, not 10 per cent. of the male population was utterly illiterate. Most could read and write well enough for business purposes. As for the educated higher orders, years of childhood and youth were spent in mastering some thousands of Chinese characters. In the classical schools the works of Confucius and other Chinese sages were read; books of ceremonies were learned; Chinese proverbs and poems were committed to memory; and facility acquired in writing *impromptu* short poems in Chinese characters. Education embraced morals and manners, the minutest laws of etiquette, and knowledge of how to perform *hara-kiri*, or abdomen-ripping, by which method gentlemen were often compelled to put an end to their lives. Education, such as it was, was little calculated to expand the mind. It consisted rather of cramming than teaching, and learning by heart than sound mental culture.

Such was the state of education till the country was thrown open to foreigners in 1859. The Dutch enjoy the credit of having sown at an earlier date the seeds of reformation in education. As soon as treaties were concluded with foreign countries, the Japanese sent abroad for able teachers, and committed large numbers of gifted young men to the care and training of Western colleges and universities. In 1871 the work of national education was placed in the hands of the Mombusho, the Department of Education, and the old educational system disappeared. Vast changes were quickly made. In 1872 the new educational system was launched. The plan then proposed was to divide the empire south of the island of Yezo into 8 "great-learning districts," each to be sub-divided into 32 "middle-learning districts," and each of these into 210 "small-learning districts," so as to give one school for every 640 inhabitants, in which the teaching should be based on Western principles. Thus was organized a free system of compulsory education for all the children of the empire between 6 and 14 years of age, with a course of study covering 8 years. This plan has been modified. In place of 8 there are 7 "great-learning districts," in each of which it is proposed to establish a university. By the end of 1873 the number of pupils in government schools exceeded 400,000. By the year 1876, as seen in the report of the Minister of Education, published in 1879 the number of pupils was multiplied more than 5 times. The number of elementary schools was 25,459, and the number of pupils was 2,066,566, out of a school population of 5,271,807. The children learn their own syllabary and Chinese characters to the number of 3,000, geography, history, arithmetic with Western numerals and signs, etc. Often the school-house is the most noticeable and best-furnished building in town, with school apparatus, maps, blackboards, etc., and everywhere the people take great interest in their schools. Of middle schools there were in 1876 389, instructing over 20,000, mostly males. The course in them lasts from two and one-half to five years, and includes a good academic education, embracing writing, grammar, composition, book-keeping, mathematics, drawing, geography, geology, physics, chemistry, astronomy, physiology, natural history, moral philosophy, political economy, agriculture, commerce, law, the languages of the West, besides a course in Chinese and Japanese literature. These elementary and middle schools are supported from four sources—a government tax, a local tax on property, a small fee collected from the pupils, and private donations. The government of Japan acts as if it believed the saying of Edmond Burke, that "education is the chief defence of nations," for it spends twice as much upon elementary schools as upon the navy.

To provide teachers for common schools in place of foreign teachers, who were at first employed at great expense, a normal school was established in 1872 in Tokiyo; and by 1876 no less than 96 schools of that grade had been inaugurated, besides two normal colleges, the graduates of which were to be teachers of the middle schools. The normal school course is wide and thorough.

Besides, there are 52 schools for special studies, where are taught law, medicine, agriculture, commerce, navigation, chemistry, and mathematics. There are also foreign language schools and commercial colleges like those of Canada, a college for sons of noblemen, a naval college under English, and a military college under French officers. The old shrine-cure of the priesthood, the Chinese system of medicine, which was full of ignorance, superstitions, and absurdities, and the Dutch system of 200 years ago, which till recently commended itself to the most enlightened Japanese, are all becoming discarded as Western medical science is finding its way into Japan; and a German medical college in Tokiyo, under the most accomplished scientific men, is turning out yearly well-trained native physicians, who have opened medical schools and hospitals in every province.

In 1872 Mr. Arinori Mori, now Japanese minister to England, at that time Chargé d'Affaires of Japan to the United States, in a letter to Prof. Whitney, of Yale College, proposed the adoption of the English language by the entire population of the Japanese Empire. He stated that Japanese scholars found their vernacular inadequate for expression of Western ideas, so that either there must be the development of their own language by an increase of its vocabulary, or the adoption of a new medium for the expression of thought. Mr. Mori preferred the latter course. His letter awakened a hope in many that the Japanese would, before very long, possess themselves of our language, the key to largest intellectual treasures, and, above all, to the Word of God. But all hope of that in the near future has been abandoned, for it is the intention of the Department of Education to give up the foreign language schools as soon as it may seem safe to make the Japanese language the medium of instruction in the universities and special schools. Had Mr. Mori's scheme been carried out, it would have been an unspeakably great gain in many respects to the people of that empire. How great in one respect may be seen in the fact that a man who has any claim to scholarship must be able to read and write from ten to twelve thousand Chinese characters, while men of great learning must be perfectly familiar with from four to six tens of thousands.

The best-built institution in Japan is the Kobu-dai-gakko—the Imperial College of Engineering—and was a few years ago confessedly the most complete and best-equipped engineering college in the world. It is a very spacious institution, with museums, laboratories, and apparatus: and three years ago it had a very able staff of professors and instructors from Great Britain. Unhappily, after their too lavish expenditures upon the institution, in their attempts at economy they dismissed nearly all the foreign gentlemen connected with the college, and placed in their stead natives not sufficiently qualified. The general and scientific course, which is the foundation of their technical applications, includes English language and literature, geography, elementary mathematics, elementary mechanics, chemistry and drawing (geometrical and mechanical). They attempt to train students in the following branches of technical education: Civil engineering, mechanical engineering, naval architecture, telegraphy, architecture, practical chemistry, mining, and metallurgy. The examination papers presuppose students of large and varied learning, and indicate a great thoroughness in the teaching of the college. The course is six years long, and much practical instruction is given at the well-equipped works at Akabane.

Formerly, Japanese girls received but little instruction, and that little was seldom in schools. Since 1871 they have had all the advantages of the elementary and middle schools; and five normal schools for girls are sending out women well qualified for teaching in the elementary schools, in which, according to the last report, there are 1,558 female teachers. To crown this good work for the gentler sex, the Empress Haraku has established a normal college for ladies, who now enjoy educational advantages equal to those of most of the young men of the land.

The Tokiyo university includes departments of law, literature, and science, a medical college (the German medical college referred to above), the Yobimon (a preparatory college), and a botanical garden. The different *curricula* are very extensive, and the examination papers, Joseph Cooke says, "are as searching as those of Harvard, or Yale, or Oxford, or Cambridge, the classics only excepted."

A second university has been established at Osaka, and it is the intention of the authorities, as the needs of the country arise, to organize others in the remaining five "great-learning districts." Surely the poet is right:

> "Better fifty years of Europe than a cycle of Cathay."

So much for the national system of education.

To get a clear and comprehensive view of the situation we need to climb to an elevation. This paper is written on the bluffs which overlook the Bay of Quinte and the Glenora stone mills, while close by is "the Lake on the Mountain." To one standing at the foot of the hill, the bay is simply a fine sheet of water bounded irregularly by wooded lands. To us on the summit it is the loveliest spot in Canada. The ear takes in all the sounds—the roar of machinery below, the hoarse shouts of men in the distance, the varied songs of birds, the hum of insects, and the sweet voices of children—and all are blended into music. The eye embraces the beautiful panorama which stretches before us and on either side for many miles—the placid sheet of water reflecting the sapphire sky and the emerald foliage along the shores, dotted by steamers and sailing vessels: the coves and bays formed by the outjutting points and promontories: the bluffs in the Long Reach: magnificent forests, the growth of a hundred years: young plantations now under cultivation; fields of grain yellowing for the reaper; villages springing up here and there under the magic wand of labor: church spires shining in the sunbeams: the far-distant mainland, and the smoke of the railway train—all the irreconcilabilities melted into unity by the sunshine, which possesses the splendid power of harmonizing what is unharmonious in color and incongruous in form and of softening them while uniting. So it is only as we are lifted up to a lofty moral elevation—to fellowship in the heavenly places with the Lord Jesus—that we are able to survey the whole field and see its completeness or what it lacks. What do we see in Japan to-day? We see a nation stirred to its depths as if by some master passion, adopting best results of Western thought, reorganizing and equipping army and navy, rearing lighthouses along her rock-bound coasts, constructing railways and telegraphs, organizing a postal system, and an admirable system of education, from the common school up to the university. The Titan begins to feel his strength. He is turning to account the forces of nature. He is adding indefinitely to past acquisitions. He is pouring his spirit into nature around him and making it live. We see, too, a tremendous struggle going on between monarchical and democratic ideas; between a desire to stand in the front rank of nations and a desire not to appear to follow in the wake of any; between the press bent upon freedom, and the government, ever and anon putting its foot upon some too outspoken editor: in short, between the old era and its feudalism and the new era with its better spirit. And we see confidence in the old religions declining; and with the loss of faith, no exchange of the old faith for a better, but a loss of self-restraint, and a deeper plunge into the excesses of sensuality, to which already they had been, when faithful to their gods, too much addicted. This is the result of the quickening influence of Western thought. If we wish to understand why this is, we must regard the matter in the light from the eternal throne. It is said that a great master, Holbein, loved to paint with the light coming down from above upon his work. He used to say that a light from above put objects in their proper lights, and showed them in their just proportions, while a light from beneath reversed all their natural shadows. Undoubtedly the *status quo* in Japan is a stage in the development of the plan of Jehovah in regard to that interesting people. God is going to take Japan for Himself. This enormous intellectual growth is to the end that the more firmly the gospel of the grace of God may, while it quickens the moral nature, take hold of the entire individual and of the nation. Man is swayed by his animal propensities or by his moral and religious elements. Intellect by itself is not a motive power; it is only a light. Education *per se* is no antidote to vice. Voltaire was educated, but Strauss acknowledges that he could perjure himself upon occasion. It is not enough that Minerva is at hand to restrain Achilles from blindly following his impulses and appetites. The Parthenon, devoted for ages to the worship of Minerva, or rather of intellect, of which she was the embodiment, long ago became a disastrous wreck. And the hope of Greece to-day is not in the Parthenon, or Minerva, or the intellect, but in her mission schools and Christian Church. Intellect serves its purpose undoubtedly—and an admirable purpose it is—but it will be in the way indicated by Milman in his History of Christianity: "Christianity may exist," says he, "in a certain form in a nation of savages as well as in a nation of philosophers: yet its specific character will almost entirely depend upon the character of the people who are its votaries. It must be considered, therefore, in constant connection with that character; it will darken with the darkness and brighten with the light of each succeeding century: in an uncongenial time it will recede so far from its essential nature as scarcely to retain any sign of its divine original: it will advance with the advancement of human nature, and keep up the moral to the utmost height of the *intellectual culture* of man." And even the increased immorality of the people since they lost their faith in their old religions has served the purpose of causing the rulers and the more thoughtful of the people to see the insufficiency of intellectual culture to regulate the moral conduct, and the absolute necessity there is of some religion to save the nation from atrophy and ultimate ruin.

In the circumstances our duty is clear. A young missionary on reaching his field of labor was invited to visit the governor of the region, who said: "Your chances of success are small—the people are so debased and wretched." To whom he replied: "Yet we should not forget that God is able to lift up this degraded people as well as others." "Oh," said the governor, "of course: if you take the supernatural into account, that makes all the difference." Yes! this is our confidence that there is no nation so refined as not to need the gospel, and no nation is so degraded as to be beyond the reach of the gospel. For incarnated in it is almighty power, the power of the Lord Jesus Christ to save from the uttermost to the uttermost. As Jean Paul Richter says, "the Tree of Knowledge should be grafted on the Tree of Life." Go yonder without the supernatural, and some day the people, born to believe, to reverence and to adore, as well as to think, to feel and to act, bereft of their faith, which is their life, and stripped of all the joy and music and flower of life, will come to those who have despoiled them with the despairing cry—

"Give back our faith, ye mystery-solving lynxes,
Robe us once more in heaven-aspiring creeds;
Happier was dreaming Egypt with her sphynxes,
The stony convent with its cross and beads!"

But go with that gospel which invigorates every faculty of man and narcotizes none, and in the enjoyment of a personal and intimate affection for the living Jesus, and taking with you as much of science and philosophy and art as you can—the more the better—and you are embarked in a cause which is bound up with the happiness and destinies of the Japanese. The gifts of the orator and of the poet, the largesses of the philanthropist, were never enlisted in an enterprise more glorious, or which promised a larger success. But the time has come when we must make a forward movement. "The army," said Napoleon, "that stays in its entrenchments is already beaten." We cannot be too thankful to such men as Duff, who broke away from the traditions of the past and boldly established mission schools to educate the people for a nobler Christianity. We must have a first-class collegiate institute, under Christian teaching and influence, for instruction in secular learning, with the aim definitely and constantly kept before it of preparing students for matriculation in the university, of doing university work, and of developing ultimately into a university. We must have such an institution for the following reasons: (1) Our native ministers require the training such a college will impart; they cannot avail themselves of the university, for it is thoroughly infidel. (2) The young men of our Church who want a good and liberal education go to schools where the teaching of sceptics leads them astray. We must have such an institution to conserve the results of our labors. (3) We cannot expect to have the confidence of the masses of the Japanese public who do not believe in Christianity, but do believe in education, unless we engage in educational work. *The Churches that are doing educational work are growing* rapidly. Soon after they are opened, mission schools are filled with eager students. A much larger proportion of the students brought under the influence of Christianity in these mission schools in Japan becomes Christian than in similar schools in India or China.

We need now, at once, in addition to Prof. Whittington, three excellent men* who will use the English language as the medium of their instructions, equipped, each of them, for his post as a planet for her orbit, willing to perform, amid graver toils, the lowliest offices for the Lord's sake, like the angel, in certain "Illustrations of the Lord's Prayer," who, amid his lofty ministries, was not above filling little cups of honey for the exhausted bee. How grand a work such an institution can do, we can gather from the glorious results already secured by the Doshisha, the mission school of the American Board, the Sapporo *agricultural college, and the schools of the Presbyterians and* American Methodists. It is the well-instructed young men, brought under the constant care of Christian teachers, who are far more susceptible to the appeals which Christianity makes than those who see their teachers only once or twice a week, or not as often Coleridge has well said: "The water lily in the midst of water lifts up its broad leaves and expands its petals at the first pattering of the shower, and rejoices in the rain with a quicker sympathy than the parched shrub in a sandy desert." The Christian teacher in yon field goes to certain success. The religions of the land are already demoralized. They stand like the ancient barbarian pugilist, defending the place struck last, but utterly unable to guess where next the blow shall fall. The battle with the agnostic party is fairly begun, and already victory is perching on our banners. With the right kind of

* Canadian young men ambitious of doing good and of getting a place ought not to go to Japan in the hope of "something turning up." Nobody should go there who does not know what he is going to do, and how he is going to be supported.

men in our school—and may they soon be forthcoming!—we shall do our part toward the conquest of that land for Christ.

We call for largest consecration of greatest gifts and ripest scholarship, and yet, when victory is won, we shall ascribe all to God. "It is," said Plato, "neither the reins, nor the whip, nor the steeds that draw the chariot; the charioteer, who holds the reins and applies the whip or the brakes, it is he who draws it." Method and opportunity, apparatus and machinery, faithful and able men, these we need, but it is only as all are in the hands of Christ that they will prove a blessing. Nor shall we wait for the hour of victory. "Now unto Him that is able to do exceeding abundantly above all that we ask or think, according to the power that worketh in us, unto Him be glory in the Church by Christ Jesus throughout all ages, world without end."

G. M. MEACHAM.

HOUSE OF THE DIAMOND.—Diamonds, it follows logically from the recent discoveries of M. Chaper, the French geologist, may exist in all rocks formed from the degradation or erosion of pegmatite, in quartzites, with or without mica; clays, puddling-stones, etc. He found the diamond at Naixam, near Bellary, in Madras, India, in a matrix of rose pegmatite, associated with corundum. The region is bare and rocky, and nearly destitute of trees. The rock is traversed by veins of feldspar and epidotiferous quartz; and the rains wasting the rock deposit fresh diamonds in the soil year by year. The diamond crystals are perceptibly octahedral. This seems to dispose of the question regarding the mother rock of the most precious of all stones.

THE United States postal authorities must plead guilty either of teaching the youth of the great country south of us bad grammar or of spreading broadcast a palpable lie. Seeking to give unnecessary instructions to the corresponding public, they proclaim upon their postal cards, "Nothing but the address *can* be placed on this side." Canadian postal cards bear the more truthful remark, "The address to be written on this side."

THE SAND PLAINS AND CHANGES OF WATER LEVEL OF THE UPPER OTTAWA.

BY the Upper Ottawa, in this paper, is meant that portion of it which extends from the head of Coulonge Lake, a little below the lower end of Allumette Island, to the entrance of Deep River, about seven miles above the head of the same island. This takes in a stretch of nearly forty miles, following the coast line. Enough, indeed, for one attempt—too much to be very minutely handled.

By a word picture we shall hurriedly outline the position and nature of this portion of the Ottawa Valley.

(*a*) The town of Pembroke is situated on the south side of the Upper Allumette Lake, and about twenty miles from each end of this section. This town furnishes a good point of reference.

(*b*) The Allumette extends throughout a great part of the locality under examination.

(*c*) The Culbute flows on the north between Allumette Island and the Quebec shore.

(*d*) The Upper and Lower Allumette Lakes separate Allumette Island from Ontario on the south.

(*e*) At the head of the island, westward about eight miles from Pembroke, are the Narrows, where the water flows in a swift current.

(*f*) Eastward from Pembroke, about four miles, are three rapids almost parallel, and unnavigable. These are the Allumette, Lost Chenal, and Beckett's. The last is farthest south, the first farthest north, the Lost Chenal in the centre.

(*g*) Morrison's Island lies between the two first mentioned, and Beckett's Island between the two last.

(*h*) At the lower end of the Allumette are Paquette's Rapids, a series of swift but not very dangerous currents, extending about four miles from Westmeath Village to the head of Coulonge Lake. From the foot of these rapids the Ottawa—grand, placid, and majestic—glides along, joined by the Culbute, into which the Black River enters from Quebec, a couple of miles from its mouth.

The beautiful Coulonge Lake lies spread out eastward from this point, and is the eastern limit of our subject of study.

Turning our attention to the western limit, we may safely say that the scenery among the islands of the Paquette's, up the Culbute, around the Lost Chenal, through the Allumette Lakes, Allumette Bay with its many islands, the Sturgeon Lake and entrance to Deep River, is as fine and enchanting as any to be seen in Canada east of the Rocky Mountains. Dr. Perkins, of Boston, accompanied the writer last summer in circumnavigating the Allumette, and passed through a large part of the district mentioned. This gentleman pronounced it as "grand and beautiful" as anything he had seen in Europe, and he had at that time travelled over most of the continent. It has been the privilege of the writer to travel over and around our large lakes, through the prairies of the North-West, the Thousand Islands of the St. Lawrence, the Ten Thousand Islands of Lake Huron to the head waters of the Ottawa, through the States of Michigan, Minnesota, Dakota and New York, over every tributary on the north shore of the mighty St. Lawrence, from the head of Lake Superior to Montreal city: and in all these glory-containing regions the scenery of the Upper Ottawa is not surpassed, and seldom equalled.

To locate more accurately, we may notice that this district lies along latitude 45° 50′, longitude 76° 40′ to 77° 40′, Pembroke being 77° 10′. Height above the sea level of the Upper Allumette, 400 feet. The Meteorological Station of Pembroke, under the charge of Mr. A. Thompson, is 423 feet above the sea level.

For the most part the important sand plains lie on the south side of the Ottawa. The ancient Laurentians skirt the north side of the river, scarcely retreating over a mile at any place. We may contrast the coast lines of the two provinces as follows: Ontario lies comparatively low, undulating, and quite unpretentious, but is well supported by ranges of hills farther south: Quebec, on the north, presents a rugged, massive, broken and barren appearance.

(*a*) On the Ontario side, the Chalk River sand plain begins a little above Chalk River Station, twenty miles west of Pembroke, which town it almost reaches. There are a few broken range interruptions toward the lower end of this plain. These interruptions harmonize in position with the rapids, and are parts of natural barriers between a higher level westward and a lower level eastward. At places may be noticed sand ridges. These lie between ancient mouths of rivers, some of which remain to this day—as the Indian, Muskrat, and Petawawa—while others are quite extinct. Following these sand ridges mentioned, or in the direction of the diverging rivers, we invariably come gradually to higher ridges of native rock. The Chalk River Plain wants only the grass to give us a beautiful and extensive tract of prairie land; but as it is wretchedly barren sand, nothing will grow on it to any extent except ferns, small pines, and blue berries, the latter in great abundance.

(*b*) Eastward from Pembroke the sand stretches struggle with the rising and rocky base of distant hills which skirt the Ottawa from Westmeath in the direction of Renfrew town. At last the old hills, with their stores of marble, get the upper hand, and the sand tracts are terminated for a time.

(*c*) Back from the Ottawa, and between Pembroke and Renfrew, there is another factor to be taken into consideration. This stretch of nearly forty miles, extending beyond our present limits, is variegated with sand, clay, and irregular hills of rock. One low and very even clay bed contains over 1,000 acres of good and well cultivated land. Before passing to the Quebec side of the river, a few facts may be given which will afterwards form a groundwork of some explanatory remarks.

There are many small patches of sand, varying from, say, ten acres to a few square yards. Most of these are easily understood. The operations which are forming the smaller are going on in the presence of the observer. The larger accumulations are met with *suddenly* after passing ridges of rock in the direction of the running water, while they *gradually* disappear as we approach the next range. Wherever there is a small sand patch there is an old but weather-worn ridge of rock close at hand. Nearly always the order is this: Hard, massive rock; next large angular boulders of the same: then rolling stones, after which come pebbles; then coarse, followed by fine, sand. The first is always up stream, while the others range in regular order, ending with fine sand farthest down the current. Where there are clay beds mixed with sand the rock ridges are generally farther away, and show a variation in their composition. Speaking carefully, we may say that "clay is a soft earth which is plastic and may be moulded with the hands, consisting of alumina, to which it owes its plasticity, and also silica with water." Putting it chemically, we get alumina (O_3 Al_{iii}), silica ($Si\ O_2$) and water ($H_2\ O$).

It results from the slow disintegration of one of the constituents of granite rocks, and when chemically pure is called alumina. The farther from the source of formation the purer is the clay: the nearer to its source the more sand is mixed up with it.

Lime, magnesia, oxide of iron, and other ingredients are often present. The oxide of iron is a very common and abundant factor along the Ottawa Valley.

By careful examination, the basins of ancient rivers can be easily followed, with their rapids and stretches of calm water. Even the small bays of olden times may be noted. The kinds, qualities, and layers of sand must be our guide, always aided, of course, by the configuration of the immediate locality. Having referred to the qualities of sand and clay, we shall now specify.

So far as soils are concerned, they may be said to come from two kinds of rock, *granite* and *trap*. *Granites* consist of quartz, feldspar, and mica, the latter generally an insignificant factor. Quartz is flint, or the silica of the chemist. When the granite hills and ridges are washed down by water, the coarse quartz sand lies along the sides and at the immediate base of the hill, while the feldspar is ground to a fine tenacious clay and is carried forward into the valleys. Hence the soil in the flats of granite districts consists of a cold, stiff, wet and impervious clay, which needs much manure, draining, and labour to make it productive. The hillsides are almost useless, as they consist nearly altogether of quartz grit. Such are the Quebec slopes of the district we are now studying, but their valleys are too narrow, cramped, and water-hedged to give sufficient space for the sifting out of the feldspar from the quartz silt. Hence these narrow valleys are formed of ground-down feldspar and the finer quartz sand, the coarser being left along the mountain sides and close to their bases. It is on this account that the French *habitants* rejoice in their moderately fertile fields. In some places the writer has noticed solid bodies of feldspathic clay, but always at a distance from the rock ranges. This clay is known to many under the appellation of *pipeclay*, and is finer in texture and more coherent than marl.

Trap rocks, on the other hand, consist of feldspar and hornblende. From this we see that feldspar is common to both granite and trap. Out of 100 parts of feldspar there are 65 parts of silica, 18 of alumina, and 17 of potash and soda; while of 100 parts of hornblende there are 42 parts of silica, 14 of alumina, 12 of lime, 14 of magnesia, 14 of oxide of iron. A granite soil, in addition to the silicious sand, consists chiefly of silica, alumina, and potash, derived from the feldspar. A trap soil, in addition to the silica, alumina, and potash of the feldspar, contains also much lime, magnesia, and iron oxide, derived from its hornblende. Hence, as a hornblende soil—or, more comprehensively, a trap soil—contains more of the inorganic substances most important to plant composition, it is more valuable because more productive than granite soil.

There are a few fine stretches of the former, but many of the latter, along the Upper Ottawa. Using this method of comparison, we must conclude that the Upper Ottawa region will never be a first-class farming country; at the very best, it can only expect to be considered middling.

But we must return to our line of general observation. Large tracts, containing thousands of acres, like the Chalk River Plain, are difficult to explain. The student must travel to the mountains miles away, and take in the different ranges, their bearings, and the various streams and rivers which have operated during the long ages of the past. In fact, it is necessary to make out the differences of water level over vast areas, and the causes of the changes in the water line.

It is remarkable to see how the terraced work of Morrison's Island fits into the lower system of terraces at the mouth of Black River, where it enters the Culbute. These points are about ten miles apart. The broad Chalk River Plain corresponds in its two levels with the two definitely marked steppes standing out on the Laurentians near the head of Coulonge Lake. These two points are at least thirty miles apart. They appear to have been formed during the same water level.

At one time, and probably within a thousand years, there was a grand and mighty lake, in whose depths were hidden all the Chalk River Plain, the Pembroke district, Allumette Island, and thousands of the arable acres between Renfrew and Pembroke.

There were, in fact, two distinct periods, one of which represented a lake two hundred feet deeper than the Upper Allumette, and the other one hundred feet deeper. In passing down the Culbute, or emerging from among the islands of the Paquette's, the terraced ranges which remain as marks of old water levels show themselves quite prominently, and add much to the beauty, splendour, and majesty of the scenery.

In tracing the various systems of change in the water coast line, the interest becomes intense as it is discovered, without doubt, that at one time there was a vast body of fresh water lying over the present Ottawa River, and extending in length over a hundred miles and in width from ten to thirty.

In climbing many old weather-beaten and water-washed rock ranges one can see clearly the holes, cauldrons, and water-scored channels of bygone days. At the head of Allumette Bay, into which an ancient river emptied, there are many markings left as guides for the future generations.

To aid the sceptic, who is naturally hard to convince, in understanding that the writer is not simply drawing on his imagination concerning this ancient lake, with its far-reaching systems of rivers, most of which are now either wholly dried up or turned into other outlets than the Ottawa River, we shall ask him to add two hundred, or even three hundred, feet to the depth of water already indicated. In such case he will have before his vision a body of water as large or larger than Superior itself.

During the summer of 1876, A. P. Coleman, Ph.D., at present Professor of Geology and Natural History in Victoria University; B. E. McKenzie, B.A., M.D., of Riverside, Toronto: F. Munson, B.Sc., and the writer had the pleasure of exploring the whole valley from Ottawa City to the head waters of the Ottawa River.

At the head of Lake Temiscamingue we noticed a magnificent range of fossiliferous limestone. It appeared to be perched on the top of the granite rock, but part of it reached into the waters of the lake and was lost to view. We climbed to its top, two hundred feet or more from the water level, and examined it very carefully. In richest profusion and in every direction fossils of many kinds were lying. Of course this alone proves the presence of an inland sea, or a continental ocean. But the point of present interest is the fact that in every direction the operations of water may be noticed. Now, if there were grinding, wearing, and boring operations of water, we conclude that these took place under the action of rushing rivers.

To anyone who has a knowledge of the configuration of the Ottawa Valley the above-mentioned fact is enough to prove the presence of a vast inland sea, which has passed through all the necessary changes in the direction of diminution and contraction in order to leave us our present beautiful river, with its islands, lakes, rapids, narrows, and variegated coastings.

On the Quebec side of the river there are several interesting patches of sand, ranging from fifty to three hundred acres in extent, and many smaller. The most important are at Fort William, the Chapeau, and Lynch's Bay. With these may be included the lower half of Allumette Island. No observer need look long for the cause of these sand beds. Every step of the formation, which is still going on in some parts, may be seen at any time that the snow is off the ground. At one time there were small rivers at many of these places, which were among the ancient feeders of the great lake system of the Ottawa Valley. These are forever gone from the face of the earth.

The Chapeau district is important from the fact that there are two distinct and prominent water lines. One of these corresponds with the second steppe at the head of the Coulonge Lake, and also with the Chalk River Plain, which is the largest within the forty miles under consideration.

The average height of the lower of these two near Chapeau is about twenty feet, and of the upper about one hundred and twenty. Through the upper, and almost on a level with the lower, a large creek or small river meanders from among the Laurentians, and quietly loses itself in the gently-flowing Culbute.

The lower part of Allumette Island is a solid mass of sand, and is on the same general plain as the lower range at the Chapeau.

About four-fifths of the whole surface of the island, and fully three-fourths of its entire length, were formed by sand washed down from the mountains of Quebec, as were also many of the sand patches on the Ontario side.

Let us now look into the causes of these formations and changes. It may seem almost superfluous to make any special and minute references to the origin of these or any sand plains; but it will be of help to some if a few of the particulars are given.

Sand is finely-ground rock. Mountain ranges are constantly worn down by the action of heat, frost, wind, and rains of the ever-varying seasons.

It is instructive to watch closely all these agents as they do their work. Any day in the year, any hour in the day, the student may examine and learn much. To quote from notes of a trip through the mountains last July will aid us in this connection:—

"We left our camp near the Chapeau, walked along the sand, among the beautiful pines on the lower level a little way back from the Culbute, and ascended the first height of one hundred and twenty feet. The view thus gained was fine, and a very pleasing foretaste of what was to follow. Directing our steps towards the mountains, about three miles distant, we crossed a beautiful river with wonderful embankments of sand over one hundred feet high. Here we sat, observed, and wondered. During perfect calmness of the air the sand kept sliding down in ten thousand almost imperceptible streams, and was hurried along by the swift waters of the river. This sand is forming a bed near and beyond the mouth of the river.

"At one place in this plateau valley there is a washout close to the point of observation. By a rough but sufficiently careful method of calculation, we concluded that from two million to four million cubic feet of sand has been washed away from one small field. Rain begins to fall. The ascent is begun in earnest. The top of the highest peak must be reached. More than an hour is spent in climbing from crag to crag. At length we look down hundreds of feet below us on clouds and rainstorm.

"To stand on the Laurentians during a July rainstorm, and to take in all the strange, hazy, and mistified grandeur, is one of the richest treats of a lifetime. The heavens are cleared in patches, the sun shines through the rifts, the rain falls, and rainbow-tinted glory decorates the heavens. The sight is truly grand.

"In ascending these mountains we started from their resting places large and small stones, which rolled down hundreds of feet. Boulders, when displaced, bounded forth with tremendous force and crashed through the trees below with irresistible violence.

"Streams caused by the falling rain were hastening down the precipices and gorges, carrying with them myriads of shining sand grains. These, if examined under the microscope, would be found to be granules of mica, quartz, feldspar, and hornblende. On the very summit could be seen the simplest formation of these streams. Many almost invisible streams, each formed by a few drops of rain, were uniting and forming minute currents of water, following the inclines and slightest indentations of the rocks. On careful examination, fine grains of sand could be detected even in the spreading-out rain drops and on the bare head of the hardest and smoothest gneiss rock. In descending we reached the converging points of the smaller streams, and finally the home of the torrents, furiously leaping through the deep gorges, and issuing with terrific force to join 'the brimming river.' Here we noticed something more than sand. Pebbles and small-sized stones were violently borne along and deposited in the less rapid water. They are covered by the sand and soon lost to sight, but aid in filling up the valley.

"In sunshine and calm we ascended the same peaks the next day. Along the top, at the very summit, we looked carefully to see if any sand grains were left. To our great astonishment, in every direction we found it in quantities varying from a cubic foot to a single grain.

"Our curiosity being aroused, we examined not only the top of the bare peak, but the tops of loose boulders, and even the upper edges of small-sized stones. Strange, but true, this next day after a drenching rainstorm, which finished up not suddenly, but very gradually, and in the warm month of July, grains of sand were lying loose on every spot which was examined.

"Another similar rainstorm would wash these grains away, and their places in turn would be occupied at once by other sparkling points.

"On further observation we discovered a constant movement of exceedingly fine sand dust caused by the gentlest zephyrs.

While descending we noticed several places where the sand was actually trickling down the crevices. Streams of sand, varying and spasmodically fluctuating, were constantly lessening the mass above and filling the hollows below.

"So far we have said but little concerning the cause of sand formation, or rather rock-wearing, during summer weather. At any time during the warm summer months fine sand dust may be discerned even on clear-looking boulders by means of a small magnifier.

"The weather-beaten exterior of all rocks is more or less cracked and granulated. Numberless fine cracks ramify in all possible directions. Many of these are invisible to the naked eye. When the rain falls the water saturates the surface. After a little while the temperature rises. The expansion of the moisture in the cracks pries off many small grains of sand. In fact, we are safe in saying that during the months of warm weather the contraction of the rock surface in the night, and the expansion consequent upon the heat of the following day, without any reference to dampness, wears away the rocks constantly."

When we remember that this section of the valley under consideration belongs to the oldest of all geological periods, our interest must increase. Geologists have marked out over thirty geological divisions. Here, however, there is one, the oldest, the Archæan, of which Dana says: "There was first an age or division of time when there was no life on the globe; or, if any existed, this was only true in the later part of the age, and the life was probably of the very simplest kinds. The Archæan stands apart as preparatory to the age of invertebrates." Now, in saying that this district belongs to only one geological period, we do not mean that there has been no change during the many ages of the past. But we do mean that the rocks are Archæan, with a base surrounding of their own refuse and ruins. Some would prefer to say that the first and last geological periods meet in this valley. Here the Aozoic stands out in majestic sublimity, looking down upon the only child of its many years.

This could be called the Quaternary period, and, Minerva like, came from the head rather than the loins of its progenitor. Since the latter is nothing but the ground grit of the former, it is immaterial whether we say there is a blending of two periods or the full age and chronicled history of the Archæan alone. This history may be epitomized as follows:

(*a*) The earth's foundation rocks were formed during the first geological period.

(*b*) In many parts of the world the earth building went forward.

(*c*) Various courses of material, called stratifications, have been deposited upon these foundation stones.

(*d*) Many parts of the old formation rock were never utilized for building purposes, as the Laurentians of the Ottawa district.

(*e*) As they were not built upon, they were left unprotected.

(*f*) The warring elements during the many cycles of time have continued to grind these foundation stones to powder, which still lies at their base in the form of sand plains.

Passing forward to another part of this subject, we acknowledge frankly that there are serious difficulties staring us in the face. The changes of the water level are necessarily linked with the different sand plains. It is absolutely essential to have different kinds of measurements for our work, such as present water depths, mountain heights, and water levels as compared with the sea. The length and breadth of rivers, lakes, and plains are also needed.

Anyone knows that the acquisition of all these and many other measurements involve much labour, time, and expense. Few earnest students of nature are blessed with all the requisites for accurate observation concerning much of vast importance. Besides, the time marks of the Ottawa Valley are very indistinct. Their language is scarcely known as yet, and is hard to master. One kind of measurement alone is left us, and that may give us some help when acquired and used. This is *space* and lineal measurement. We venture to express an ardent wish that before many years have passed away a tabulated list of careful observations and measurements may be obtainable. In this connection we deem it quite in place to suggest that the Government establish a meteorological station at the Chapeau, and also at DesJoachims. We think, moreover, that the weather gaugers at these stations should be required to give extensive and accurate lists of actual measurements of heights and distances.

In this paper it has been already assumed that at one time there was an extensive inland lake, which has gradually lessened till a few small lakes and river stretches alone remain. The cause of the diminution is easily seen. The water has worn down the channels at what were formerly rapids. When vast quantities of water rush annually over rock surfaces, the river beds must be lowered. Observation will show that the rapids of the Upper Ottawa are natural barriers between an upper and a lower water level, and between the rapids there are even lakes or large river expansions. With a given quantity of water, a constant unit of time, and a homogenous hardness of rock, the rate of lowering of channel must be regular, unless the seasons, rains, and freshets vary greatly. Even if all these were constant and regular at present, we would be unable to locate the time in the past when the mountains were one hundred feet higher, or when any given river channel was twenty feet higher than now.

By an examination of the rocks we can easily perceive that the hardness varies. For example, the rock beds at the Narrows, a few miles west of Pembroke, are very hard,-say seven degrees out of a possible ten. But the channel rocks of the Allumette Rapids, at the opposite end of the lake from the Narrows, are only five degrees of hardness. These rocks are a fine sandstone compacted with a bluish or brown clay. The corroding action of the water tells readily upon the clay, and thus the sand grit is washed from the surface.

What do we learn from this simple fact? This: The space between the two rapids must be gradually drained of its water by the greater corrosion of the lower rapids. This means that the present Upper Allumette Lake is drying up, or draining off through the Allumette Rapids becoming lower.

This in turn means that the now navigable "Narrows" will in time become too steep and shallow for steamboats to pass; but the now unnavigable Allumette Rapids by that time will be navigable. These are changes going forward to-day, and will be facts of the future.

Again, let us compare four parallel rapids, the Allumette, the Lost Chenal, Becket's Chenal, and the "High Water Portage," an old channel of the river, but now completely dry even during high water. The rocks of these four channels are all of different degrees of hardness. The "High Water Portage" rocks are the hardest, Becket's Chenal next, then the Lost Chenal, and lastly the Allumette.

After examining these different channels, their positions, their volumes of water, and the whole basin, we find that the volumes of water vary in inverse order, beginning with the Allumette, the largest; which means that the oldest channel has least water (it has none now), while the youngest has most, flowing over the soft bed of which the bulk of the Ottawa rushes with a constantly-increasing effect.

My attention was attracted to the "High Water Portage" by the bare and dry water-eaten rocks. The channel is as easily traced as if carrying water. The rocks are extremely hard. Becket's Chenal shows a softening in its bed, but the Lost Chenal is more marked in this respect, clayey sandstone beginning to show itself. But when the Allumette bed is examined the conclusion must be that this channel is destined to carry all the water of the Ottawa alone. Then there will be three old and dry channels. This is an inevitable result unless the present soft Allumette channel bed is thinly built upon a hard and more enduring foundation. By this particular comparison and conclusion we are now prepared to rise to a higher plane of study. In such a system of scattering mountains as the Laurentians there are and have been many rivers. These rivers have had many mountain barriers to overcome. They have passed over the lower parts and cut their way through the softer ridges. At one time in the past a river has rushed wildly along through a rugged and adamantine channel. Now, in the later ages of the world, the same river lashes itself into fury as it passes through a channel one hundred feet below.

Some beautiful and clearly outlined old channels of the Ottawa are easily seen not far below Aylmer.

The Paquette's Rapids, at the head of the Coulonge Lake, are composed of harder rock than the bed of the Allumette. The result will be that the Upper and Lower Allumette Lakes will eventually form one navigable stretch, limited at the western extremity by the "Narrows," and at the eastern by the Paquette's.

At one time the ridges back from Westmeath *connected* with the ranges on the Quebec side of the river. Over these ridges the mighty Ottawa River Lake hurled itself into a vast abyss of seething waters at least two hundred feet below. From this fact, and also from many observations at scores of points westward along both shores and for hundreds of miles up the river, we have concluded that there was once a mighty and expansive inland lake of fresh water, as previously stated.

In the interests of science and natural history, this and other science associations should memorialize the Government to aid in accumulating vast stores of facts and observations. The present meteorological system is good, but needs extending and perfecting. More work needs to be performed. Not only should the general geology of Canada be studied on an extensive plan, but the ten thousand points of minutest details should be secured and placed within the reach of the earnest students of nature.

NOTE.—The above article, which was read for the author (Mr. E. Odlum, M.A., Pembroke), by Rev. James Allen, was followed by an interesting discussion, in which Mr. Odlum's views were accepted and endorsed by many members of the Ottawa Field Naturalist's Club.

SCIENCE—MATHEMATICS—LANGUAGES.

IN estimating the present position and prospects of experimental science, there is good ground for encouragement. The multiplication of laboratories gives to the younger generation opportunities such as have never existed before, and which excite the envy of those who have had to learn in middle life much that now forms part of an undergraduate course. As to the management of such institutions there is room for a healthy difference of opinion. For many kinds of original work, especially in connection with accurate measurement, there is need of expensive apparatus; and it is often difficult to persuade a student to do his best with imperfect appliances when he knows that by other means a better result could be attained with greater facility. Nevertheless it seems to me important to discourage too great reliance upon the instrument maker. Much of the best original work has been done with the homeliest appliances; and the endeavor to turn to the best account the means that may be at hand develops ingenuity and resource more than the most elaborate determinations with ready-made instruments. There is danger otherwise that the experimental education of a plodding student should be too mechanical and artificial, so that he is puzzled by small changes of apparatus much as many school-boys are puzzled by a transposition of the letters in a diagram of Euclid.

From the general spread of a more scientific education we are warranted in expecting important results. Just as there are some brilliant literary men with an inability, or at least a distaste practically amounting to inability, for scientific ideas, so there are a few with scientific tastes whose imaginations are never touched by merely literary studies. To save these from intellectual stagnation during several important years of their lives is something gained; but the thorough-going advocates of scientific education aim at much more. To them it appears strange, and almost monstrous, that the dead languages should hold the place they do in general education; and it can hardly be denied that their supremacy is the result of routine rather than of argument. I do not myself take up the extreme position. I doubt whether an exclusively scientific training would be satisfactory; and where there is plenty of time and a literary aptitude I can believe that Latin and Greek may make a good foundation. But it is useless to discuss the question upon the supposition that the majority of boys attain either to a knowledge of the languages, or to an appreciation of the writings of the ancient authors. The contrary is notoriously the truth: and the defenders of the existing system usually take their stand upon the excellence of its discipline. From this point of view there is something to be said. The laziest boy must exert himself a little in puzzling out a sentence with grammar and dictionary, while instruction and supervision are easy to organize, and not too costly. But when the case is stated plainly, few will agree that we can afford so entirely to disregard results. In after life the intellectual energies are usually engrossed with business, and no further opportunity is found for attacking the difficulties which block the gateways of knowledge. Mathematics, especially, if not learned young, are likely to remain unlearned. I will not further insist upon the educational importance of mathematics and science, because with respect to them I shall probably be supposed to be prejudiced. But of modern languages I am ignorant enough to give value to my advocacy. I believe that French and German, if properly taught—which I admit they rarely are at present—would go far to replace Latin and Greek from a disciplinary point of view; while the actual value of the acquisition would, in the majority of cases, be incomparably greater. In half the time usually devoted, without success, to the classical languages, most boys could acquire a really serviceable knowledge of French and German. History and the serious study of English literature, now shamefully neglected, would also find a place in such a scheme.

There is one objection often felt to a modernized education, as to which a word may not be without use. Many excellent people are afraid of science as tending towards materialization. That such apprehension should exist is not surprising, for unfortunately there are writers, speaking in the name of science, who have set themselves to foster it. It is true that among scientific men, as in other classes, crude views are to be met with as to the deeper things of nature; but that the life-long beliefs of Newton, of Faraday, and of Maxwell are inconsistent with the scientific habits of mind, is surely a proposition which I need not pause to refute. It would be easy, however, to lay too much stress upon the opinions of even such distinguished workers as these. Men who devote their lives to investigation cultivate a love of truth for its own sake, and endeavor instinctively to clear up, and not, as is too often the object in business and politics, to obscure a difficult question. So far the opinion of a scientific worker may have a special value; but I do not think that he has a claim, superior to that of other educated men, to assume the attitude of a prophet. In his heart he knows that underneath the theories that he constructs there lie contradictions which he cannot reconcile. The higher mysteries of being, if penetrable at all by human intellect, require other weapons than those of calculation and experiment.

Without encroaching upon grounds appertaining to the theologian and the philosopher, the domain of natural science is surely broad enough to satisfy the wildest ambition of its devotees. In other departments of human life and interest true progress is rather an article of faith than a rational belief; but in science a retrograde movement is, from the nature of the case, almost impossible. Increasing knowledge brings with it increasing power; and great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind. Encouraged by the thought that our labors cannot be thrown away, let us redouble our efforts in the noble struggle. In the Old World and in the New recruits must be enlisted to fill the place of those whose work is done. Happy should I be if, through this visit of the Association, or by any words of mine, a large measure of the youthful activity of the West could be drawn into this service. The work may be hard, and the discipline severe; but the interest never fails, and great is the privilege of achievement.—*Lord Rayleigh.*

CARBON.

CARBON is one of the most abundant materials in nature, forming nearly half of the vegetable kingdom, and entering largely into the composition of all animal matter. Then it exists locked up in combination in limestone, coral and other carbonates, vast beds of these substances occurring in numerous sections of the world. And again, we meet with this useful article stored away in immense layers in the interior of the earth as mineral coal, a material hidden away for the comfort of coming man, millions of years ago, during that geological period of our earliest history, classed as the carboniferous age. Carbon is found in two distinct crystallized forms or modifications, diamond, the clearest and most brilliant of all substances, and as graphite, this black and dirty material.

On account of its great brilliancy and remarkable hardness, the diamond has ever been valued as a precious stone. Up to the year 1777 this gem was supposed to be a kind of rock crystal; but, during that year, by means of the blow pipe, it was shown that it did not contain silica, and then it was looked upon as a fossil resin, something of the order of amber. That diamond was combustible seems to have been known at an early age, and, strange to say, there are some very remarkable statements just the reverse, *e. g.:* One authority states that his father, at the command of a prince, heated diamonds in a gold-melting furnace for about thirty weeks with no perceptible change. Newton, who seemed to hesitate at no problem, and at the same time solved whatever he undertook, first gave convincing arguments to prove the combustibility of this precious substance; his proof being based on the high refractive power of diamond, a property peculiar to the class of all assimilating bodies. This theoretical proof was afterwards experimentally proved by placing the diamond in the focus of a large burning lens, when it entirely disappeared.

Various observers experimented with it, until finally the product of the combustion was proven to be carbonic acid, the same as results from the burning of charcoal; hence the truth was finally reached that diamond is nothing but carbon in its purest form. This royal stone was brought to Europe from the East, but the mines that were once so famous are now entirely exhausted.

Owing to the crystalline forms of the pure article, it admits of being split into thin pieces, and these sheets are taken and used as a veneering on the facets of the glass body, giving an imitation that does not lose its lustre. Then imperfect stones are stuck together so as to produce large ones, and this work of patching up the diamond into the spurious article is done in such a skilful manner as often to defy the most acute experts.

So much time has been given to carbon in its purest form, it will only be possible to mention the other forms before taking up the compounds and a series of experiments. The other crystalline form is the substance graphite, or familiarly known as black lead, a name given to it on account of its producing a mark similar to lead on paper, and was supposed to contain lead. Graphite is the substance used in pencils, and is the basis of all stove polishes. In the arts this material is of great value, because it will stand the strong heat of metal furnaces, and is much used for crucibles where an intense heat is required, as in the casting of brass and in steel works. The amorphous forms of this wonderful element you are all familiar with under the names of gas carbon; the deposit on the iron retorts in which bituminous coal is heated to produce illuminating gas; anthracite and bituminous coal, coke, charcoal, and lampblack. Charcoal, besides the ordinary uses of everday life, is much used as a disinfectant, owing to its great absorptive power for gases, then it has the valuable quality of removing coloring matter from organic solutions, and in the form of animal charcoal is used in very large quantities by sugar refiners to remove coloring matter from brown sugar in order to produce the beautiful white sugar we now see on our tables. This peculiar property is thought to be due to the capillary spaces permeating charcoal, a cubic inch of it being so crowded with these minute pores that it is estimated to give 100 feet (square) surface.

Starting with this precious gem, the diamond, the hardest known substance, the type of all that is pure and beautiful, we see this wonderful substance passing downward in hardness and beauty, finally to sink to the level of this black soot which darkens our atmosphere and soils our persons and all we have that is beautiful. What an immense range of properties and usefulness it covers! As lampblack it sometimes burns spontaneous; as graphite it resists the action of the smelting furnace; in diamond it is a non-conductor of electricity; as gas carbon it forms one of the best conductors; in one form the person is adorned, in another our books and papers are printed with it; the electrician takes and uses it for the promotion of our comfort, while as charcoal crayon the artist handles it: as coal and coke it gives us light, transports great distances at a rapid speed, smelts our metals, cooks food, warms the body, and in numberless ways adds to the comfort of mankind. To man this is the most useful of all the elements, and adds more to his comfort in this temporary home than any substance that finite mind can conceive of.—*Electrical Review.*

LIMITED space compels us to hold over much interesting matter for another issue. We hope to give our readers something in *favor* of Confederation next month.

THE Parisians have a system of card telegrams. The cards are dropped in boxes and shot through air tubēs to different parts of the city. Fifty words or more can be written on a card that costs six cents to convey.