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V. P. JOURNAL

VOL. I.] MAY, 1884. [NO. 8.

WITH this number we close Volume I. The eight issues that we promised have been completed; and we are about to commence our second volume. In reviewing the year, we have great cause for congratulation: our circulation has exceeded our calculations; our list of contributors has been steadily growing; and, judging by the many kind remarks, our readers have not been dissatisfied with our efforts to please, instruct and improve. The year's work has been one of profit and pleasure to us, and we hope that the coming year will, in this respect, surpass it. We made few promises, and we hope we have fulfilled the expectations of all. We prefer to leave the decision as to our past work in the hands of our readers; if you are satisfied, we will say that the coming year will see no retrogression. Our prospects are bright indeed. We have determined to issue our numbers early in each month, and will place Vol. II., No. 1, in your hands in the early part of July. From that date forward we have decided to issue the JOURNAL every month, twelve numbers to the year. We have not yet completed our list of promised contributors, but can say that the prospects are that the coming numbers will be in advance of the past. The new departure in publishing during the summer months, is owing to the hearty reception we have been accorded. There are many other improvements still desired; but we are anxious to keep our subscription price at its present low rate. Whether these shall be added or not depends upon our readers; as we are justified in doing so, we shall endeavor to

improve. With feelings of thanks, pleasure, and some satisfaction, we close our volume, and gladly turn to the bright, clean pages of the new, saying in the words of another: "If you are satisfied we are gratified, and if you are gratified we are satisfied."

NOTES.

It affords us much pleasure to be able to give our readers such an intellectual and scientific treat as the full copy of the lecture delivered in Faraday Hall, May 6th, by Dr. E. Haanel, F.R.S.C., before the Science Association under whose auspices this journal is conducted. We are sorry that we are not able now to reproduce the illustrations. We are compelled, on account of the length of the address, to suppress other columns, and hold over much matter; but we are well pleased so to do, for "The Physical Basis of Certain Mental Operations" is presented with such charming simplicity and clearness, and such sound scientific teaching, that we regret its shortness. Our readers may expect something further during the year from the same source.

Gilchrist Scholarship.—This scholarship, of the value of $500, tenable for three years, will be granted this year for the last time in Canada. We are very sorry that the directors have so decided for though the competition has been limited to a few, the men who have been successful have been men who have worthily upheld the reputation of Canadian students. Death has removed several, but we can to-day point to Dr MacGregor, of Dalhousie Univ., Dr. Goodwin, of Queen's Univ., and Dr. Alexander, now in Germany; while those of later years bid fair to rival them.

Hamline University.—Dr. G. H. Bridgman, a graduate in Arts of Victoria University, and lately of Lima Seminary, N.Y. State, has been advanced to the Presidency of Hamline University, Minn., U.S. This University has lately received some

very handsome endowments, and with new buildings and an auspicious start, bids fair to become an important seat of learning in the West. We congratulate Dr. Bridgman as a Canadian, and wish him a most successful career in Hamline.

We note with much pleasure the appointment of a young Canadian to the chair of English Literature in Dalhousie College, Halifax. Dr. Alexander is a native of Hamilton, Ont. On entering the University of Toronto he won a scholarship in English literature, thus early showing a taste for the subject which he has since made his own. In 1874 he won the Gilchrist scholarship, and from 1874 to 1877 he studied at University College, London. In 1876 he graduated B.A. in the University of London, with first-class honors in English literature. From 1877 to 1879 he taught English and French with marked success in the Prince of Wales College, Charlottetown. In 1879 he won a scholarship in English literature in the John Hopkins University, Baltimore, and from 1880 to 1883 was a Fellow in Greek of that University, where in 1883 he graduated as Ph.D. His graduation thesis has since been published. He is at present in Berlin, where he has spent the last year in the study of literature. Prof. Alexander is therefore a man of wide literary culture, who has won the highest honors in the study of the subject he professes, and has proved himself to be a successful and stimulating teacher. Who will be the next Canadian to win the esteem and respect of his fellow-countrymen by endowing another chair in some other university? We have men who can endow it; we have universities who can appreciate it; we have Canadians who can fill it. A chair endowed early is a chair doubly endowed.

It is possible to give the etymology of the name of the first man. According to a learned theologian, cited by Labruni, the name Adam signifies *red earth,* and includes in its composition the four initials A. D. A. M., names which in Greek represent the four cardinal points (Anatolia, Dysis, Arctos, Mesembia). Would this signify that God formed

Adam out of dust taken from the north, south, east and west? The English word "news" can and may have a similar etymology. It is the collection of events from the four cardinal points, *N*orth, *E*ast, *W*est, *S*outh. Such derivations are, however, more fanciful than accurate. If you wish to thoroughly understand the full meaning of the word devil, decapitate it letter by letter—Devil, evil, vil(e), il, 'l.

FAVORITE NAMES.—"What's in a name?" The names of women gracing the pages of the poets are certainly beautiful. We observe a few. Longfellow: Elsie, Beatrice, Annie and Evangeline. Tennyson: Agnes, Isabel, Claribel, Clara, Dora, Mariana, Godiva, Lilian, Vivien, Adeline, Madeline, Elaine, Guinevere, Oenone, Eleanore, Enid, Maud, Rosalind, Kate, Margaret, Lynette. Shakespeare: Helen, Regan, Imogen, Juliet, Margaret, Rosalind, Ariel, Isabel, Goneril, Katherine, Diana, Helena, Mariana, Cleopatra, Viola, Octavia, Miranda, Cassandra, Cressida, Volumnia, Valeria, Virgilia, Portia, Ophelia, Cordelia, Olivia.

THE universities throughout the land are now passing through the festivities and honors of Graduations or Commencements. Dalhousie (Halifax) conferred eight B.A.'s and one B.Sc. Queen's conferred twenty-one B.A's., one B.D. and seventeen M.D.'s—thirty-nine in all. Trinity conferred about forty-five M.D.'s. Victoria conferred thirteen B.A.'s, two B.Sc.'s, one B.D., one LL.B., five M.A's., fifty-five M.D.'s and C.M.'s, one D.D. (hon.) and one LL.D. (hon.)—seventy-nine in all. Mt. Alison, N.B., in 1875 admitted the first lady to the degree in Science (B.Sc.), and in 1882 the first lady to a degree in Arts (B.A.) In 1883 Victoria admitted the first lady to a degree in Medicine. This year Queen's has conferred the degree of B.A. upon two young ladies who have pursued brilliant and successful courses. Victoria has this year, for the first time in her history, admitted to the degree of B.Sc. a young lady, Miss Nellie C. Greenwood, who, coming to her halls an American, has by her perseverance, ability and modesty won a reputation

and respect unequalled by other graduates. Mrs. Haanel, wife of Dr. E. Haanel, was granted the same degree *ad eundem* (Albion, Mich.)

WE closed our columns to the further discussion of the question on Ministerial Education. We will not take any unfair advantage of our opponents by here replying to arguments advanced against our article, nor do we here intend to retract any statements made by us. The discussion has been taken up in another place, and there must be conducted. The remarks made by us have, however, been stretched by some beyond the limit intended, and meanings have been read into them that we fail to find and never intended. Simply to justify ourselves—not to take advantage of any opponent—we here state that we did not say or intend to convey the impression, nor could we wish to believe, that the Methodist Conference is as a whole or in much part guilty of such acts as have been alluded to. The discussion of the question is beyond our columns, and the actions of individuals will not here be dealt with.

MEN AS TREES, WALKING.

IN the last JOURNAL, we referred to Weber's experiments on the human body in determining the delicacy of the sense of touch for various localities. We there concluded that the tactile nerves are developed most highly, most minutely, in those parts where most used, and that our ideas of distance, extension or size, received through the sense of touch, will depend entirely upon the locality touching the object whose size we are determining. Dr. J. Clark Murray, in an article before the Royal Society of Canada, read May 23, 1883, has referred to two recorded cases of persons born blind having their sight restored by surgery. In both cases, the peculiar characteristic was that objects at first appeared very large to the newly opened organs, that they "saw everything much

larger than they had supposed from the idea obtained by the sense of touch." The sense of touch and the sense of sight, however, gradually became reconciled, and a new idea of the size of the objects was impressed upon the mind. At first the blind man of Bethsaida saw men as trees, walking; but afterwards he saw every man clearly. Dr. Murray says, after referring to the deceptions of our sense of touch: "Have we not in this the reason of the illusion which makes objects seem unexpectedly large to a congenitally blind man, when first restored to sight? Our ideas of magnitude depend on the extent of sensitive surface which seems to be affected by an object. Now, that extent is to be measured, not by its real dimension, but by the acuteness of the sensibility with which it is endowed. But this acuteness itself is proportional to the minute subdivision of the ultimate elements which form the essential organ of sensibility. For this reason, to touch itself a body seems to cover a larger expanse at a part of the organism where the papillæ and the corpuscula tactus and the tactile nerves are distributed in more refined minuteness and in greater multiplicity. Now, it is not necessary to institute an exact commensuration of the ultimate elements of organic sensibility in the hand and the eye respectively; it is sufficient to dwell upon the obvious fact, that the retina exhibits a structure adapted for a much more minute delicacy of sensation than the acutest part of the skin. Accordingly when a person who has been accustomed to form his ideas of magnitude from the impression of objects on the skin, is suddenly made to feel them affecting a much more acute organ, it is not surprising that he should see everything much larger than he had supposed from the idea obtained by the sense of touch." Our ideas of size come to us through the senses, and are therefore subordinate to our senses; so that one sense alone will not give us a correct sensation; nor will two; not even all our senses combined. Our ideas may be improved by the co-operation of all, but we are nevertheless still far from obtaining a correct idea of the size of objects about us.

MAN is a complex being, and may be looked upon as representing in himself a kingdom. Viewed in such a light the muscles would represent the soldiers, rendering perfect obedience to the commands given them. The intellect would be the Grand Vizier, who has direct access to the person of the monarch, of whose communication with the rest of the world he is largely the medium. The entity of self, the ego, would represent the ruler of the realm, the Sultan who sits enthroned in state and wields the sceptre of absolute sway over all his domain. As an absolute monarch he issues his imperial fiats to the mind, and exacts unquestioning obedience to the utmost of its strength. The body is but his slave.

> "And what a splendid serf is this, mine own!
> Strong hand, swift foot—not these alone;
> But he is leagued with all of earth
> By subtle kinship from his birth.
> He reads me stars; he reads me seas;
> The forest's gladsome mysteries,
> From cedar tree to hyssop vine,
> If I but will, he maketh mine;
> Of ecstasies no word can tell
> He knows the secret master spell."

The king of this realm may bring influence to bear upon his neighbor in three different ways. He may employ force through his soldiers, the muscles; or reason, through the diplomacy of the mind; or hold direct communication with the neighboring king. He accomplishes this through the agency of that mysterious something by which we are inspired and enthused, that something that is the essence of eloquence, of which we try to hide our ignorance under misnomers, such as mesmerism and animal magnetism.

It is fully recognized that an army is formidable because of discipline rather than because of numbers; that a nation's strength consists not so much in the extent of her territory and the millions of her population as in the education of her people and the development of her resources. As fully is it

recognized that individual greatness is measured not so much by natural abilities as by the extent to which those abilities are trained and developed. Ample means are accordingly provided for the training of nearly all the faculties in the possession of man. For the muscles there are lectures, text-books, and professors; there is also an elect society of experts, professionals and champions. For mental education what vast preparations have been made—schools, high and low, public and private, with lectures, text-books, teachers and professors in endless numbers, involving an annual outlay of millions of dollars. For the training and development of this magnetic or inspiring power there is no preparation whatever. There are no schools, high or low, public or private; no professor, no teacher, no lectures, no text-books, not even a name. This potent but unknown servant of ours has not received sufficient attention to have been christened; and yet a moment's consideration convinces us that this unknown servant—this soul-power—is the mightiest agency in our possession, is a loftier servant than either muscle or mind. It is the highest manifestation of the soul. Muscle acts only on muscle. Mind moves only in the domain of mind. They can influence the soul only indirectly. This mesmeric or magnetic influence is the action of soul directly on soul, without any intervention whatever. Mind is greater than muscle, soul than mind. Inspiration is, therefore, more than knowledge, soul-power than science. The one adds to the intellect, which is but the servant; the other to the self, the master. The soul looks to churches and ministers for education; abundant facilities are afforded for the understanding of the laws that govern muscle and mind; but with regard to our noblest and most efficient servant, we are left in densest darkness. We are quite conscious that such a servant is in our possession, but the methods of training him and the laws by which he is governed are wrapped in impenetrable gloom. Surely he will be a benefactor of his race who will give us a name for our unknown servant, and teach us how to bring out his abilities and avail ourselves of the splendid services he is so well able

to render. Immortality awaits the intellectual Stanley who will explore this unknown region of self, and discover to the world the laws by which it is governed. Bulwer Lytton's "Coming Race," rejoicing in the magnificent services of the potent "Vsil," look with pitying contempt on our benighted nineteenth century even as we look on the shadows of the midnight ages. J. W. A.

THE TRUTH-SEEKER.

THE truth-seeker is a character far too uncommon in these days of intellectual frivolity and unrest. In him there has been born a quenchless enthusiasm which counts all things but loss that he may know the truth. Intellectual dishonesty and carelessness are put far from him. His consecration is as devout as that of the martyr, and by all the dignity of a holy earnestness he is superior to the mere student or philosopher. Many are seeking information—true or false, it matters not to them, if it be but useful; culture, that flatters their vanity; knowledge, that pays; varnish, *finesse*, etc.; but Truth, "whose home is the bosom of God, and whose voice is the harmony of the world," has few worshippers. In the common depreciation of wisdom and idolatry of mere information, doubly blessed are they who bow at this unfrequented shrine. How truly pitiable is the condition of that student of theology who pursues his studies that he may master the literature of the subject, and so be able to defend a certain imposed theological system, and who does not set before himself this object —to know the truth, the whole truth, and to preach it, lead wheresoever it may! Without this object he has not the first qualification, after the possession of brains, for the grand study he has chosen. He who was called to be a child of universal truth in its highest forms, has become the bond-slave of a system and a creed. Equally pitiable is the condition of the young scientist, whose sole object is to master the facts of his department, that he may glorify his speciality, make men

wonder at his learning, and put money into his own pocket, and who does not seek to bring to light the secrets locked in the hearts of the grains of sand, and hidden in the very brightness of the sunbeams, that so, step by step, he may come to the larger truth which enfolds the facts, and to the barely-hidden thought of God which makes all science glorious.

The truth-seeker is humble. Matched with an all-absorbing eagerness and an impatience of half-truths, is a humility which makes the man of giant intellect a child. The man of dull heart and narrow outlook may be proud, but every sensitive mind that walks the shores of God's oceans, or wakes to the thought that

> "'Tis but the outer hem
> Of His great mantle our poor stars do gem,"

will be lifted into childlikeness. He will be too conscious of his liability to err, too covetous of certainty, too painfully apprized of the limits of his knowledge, to be arrogant and self-willed in the presence of the Great Unknown.

He must be brave. The coward stands a poor chance of ever knowing the truth. The man who is not ready to make sacrifices, to stand alone to be a martyr for Truth, in some great or small way, is not worthy of her. There comes a time in almost every student's life when he begins to think for himself. Authority is no longer sufficient. He finds that many things in religion and science, which he thought were as firm as the hills, are untrustworthy or mere temporary hypotheses, in which, as in tents, men have rested for a night, but which must be stricken as soon as Truth puts the bugle to her lips to sound the march to loftier camping grounds. An awful moment it is for him, for any man, when the seeming solid ground rocks beneath his feet, the radiant heavens grow black with an unspeakable darkness, the singing of the stars dies away, and from all the depths there comes a stifled moan of unutterable anguish, for to him the universe is orphaned and all creation has become a hollow, meaningless, echoing

dome, from which the Infinite One himself has departed. He fulfils the dream of the eccentric German dreamer: "When I looked up to the immeasurable universe for the Divine Eye, there glared down upon me an empty, black, bottomless eye-socket, and eternity lay upon chaos and ruminating it."

This is no fancy sketch to one who has passed through this hour of ruin. Then begins the work. The beautiful house of his childhood has crumbled to the ground. He must now build his own home. Happy is he if in his desperation he does not throw away those great principles by which all good houses are built Happy is he if in his soul still lives a love for simple truth, and a courage to face the bitterest that can come. His personal relations, scientific or religious, his ease or reputation, must not stand in his way. He must not let unverified theories, which charm by their beauty, lead him astray. He must not shrink from any conclusion demanded by the spirit of truth. Let him seek certainty, for one square inch of rock is of more value to him now than a whole continent of mist. A few grains of certainties are of more promise than many bushels of half-truths and probabilities. Slowly and painfully he must erect the fortress of truth where he may abide the fiercest assailment of doubt in the years to come. He who builds such a home knows what it is to partake of the hospitality of God.

He will be fully surrendered to the spirit of truth, and will welcome light from every quarter. He will gather up the fragments, that nothing be lost. Nothing will be despised by him, however small or mean, for God's greatest revealings are often spoken in shortest syllables, and many of His mightiest thoughts are written in His microscopic foot notes. He will be clear and exact in his definitions, for this is the half of logic, and the lines of truth are sharply drawn. Let such a one not be weary, for the angels still wrestle with mortals, and victory comes with the breaking of the day.

He must be unflinchingly honest. All transparently honest thinking is sacred, and we may believe that Heaven would rather see a young man doubt his Bible than be untrue to his

convictions. Grand revealments await every patient childlike thinker. No science is so purely physical that no spiritual truth lies hidden beneath its facts, eager to be questioned and to speak, for

> "Earth is crammed with heaven,
> And every common bush afire with God."

The truth-seeker is ever a pilgrim. Here he has no continuing city; he seeks one to come. He leaves the knowledge of to-day and passes on to the larger view of to-morrow. How many students have there been who, holding to the grand certainty that God in his works cannot lie, have passed away in the brightening twilight, having died in this faith, not having received the promises of the coming day, "but having seen them afar off, and were persuaded of them, and embraced them, and confessed that they were strangers and pilgrims on the earth." The fuller light did not come to them, but they came to the fuller light. And while they lived their souls were fed by the truth they had, and were cheered by the thoughts of that which was coming. The reward of certitude will not fail any true searcher. It will not extend to everything, but some things there will be whose certainty will burn itself into the very soul. Eye and ear proof, head proof and heart proof, will be given, if the heart is kept out of the swirls of passion, and the intellect free from the entanglements of time serving. Let there be a passionateness of honest search, and the soul will be held in the grip of certainty with a force it cannot resist.

He will be practical. If he looks at all truth he will not miss the earth by soarings among the clouds. Being a truth-seeker he will be a truth-speaker, and the hearts of others will kindle at his words. His search for truth will be no sentimental vaporizing or cloudy mysticism, for the facts of human life will call him, and he will be found working for the good of men in the search itself. And while others are inspired and blest, he himself will be waiting for the days of revelation (there may be more than one) which, according to

his measure, will come, when, as the scales drop from his eyes, he sees his chaos arrange itself into a marvellous order, his ears catch the sound of sweet anthems, for harmony has risen out of the screeching discords, and he stands enrapt, as one to whom the Infinite has spoken; and with a heart all athrob, he takes one exultant step nearer the throne of God, and gazes on a land perhaps heretofore undiscovered and unknown.

Brothers of religion, brothers of science, if it be ours to be truth-seekers of the right stamp, we shall know many racking doubts, painful misgivings and hours of anxiety, which we shall be spared if we can content ourselves with information alone. Information is cheap but truth is dear. These troubles are the growing pains of the truth-seeker. The cross and sacrifice are his birthright, as well as the blessedness of a holy consecration, and the honor of a divine mission. Let us rest in the faith that if with unfaltering hearts we follow the light we have, we too shall be guided as those other truth-seekers, who in darker days followed the light which "came and stood over where the young child was."

"Great truths are dearly bought. The common truth,
Such as men give and take from day to day,
Comes in the careless walk of easy life,
Blown by the careless wind across our way.

Great truths are greatly won, not found by chance,
Nor wafted on the breath of summer dream,
But grasped in the great struggle of the soul,
Hard buffeted with adverse wind and stream.

Wrung from the spirit in hard hours
Of weakness, solitude, perchance of pain,
Truth springs, like harvest from the well-ploughed field,
And the soul feels it has not wept in vain."

PHAN.

Men have no faith in fine spun sentiment
Who put their trust in bullocks and in beeves.—*Longfellow.*

THE MYSTERY OF LIFE.

"MATTER and Force" seems the watchword of modern science; and not without reason, for by these magic words she has exorcised the host of potent spirits which during past ages ruled in the heavens, the earth and the sea, and even tyrannized over man himself. But while science has driven the gnomes from their subterranean realms, and swept the dæmons from their rule over the planets, installing force in their place, there is danger lest she claim for force too wide a kingdom, giving us one despot for many. While we cannot help seeing the beauty of fitness, of law and order, in the inanimate things around us, while we cannot but admire the mathematical precision of the forms which matter under the guidance of force assumes in a crystal, yet we feel that this endless rule of force has become tyranny; we have no sympathy with lifeless matter in its passive obedience to inexorable law; we long for something lawless.

Life is the only rebel against the stern slavery of nature's laws throughout the wide universe; and, accordingly, not one of us, as a free man, can help having a feeling of sympathetic interest in anything which lives. We may admire the regular form and flashing brilliance of a crystal, but how different the feeling with which we look upon a living creature, be it plant or animal, not passively influenced from without, but utilizing every advantageous circumstance and struggling against every hostile one. Hostile circumstances may be too strong for it but while life lasts it struggles on.

Life force is to us the most important of all forces, yet the one of which we know the least. One by one we are solving the mysteries of inanimate nature; we even catch the errant influences, light, heat and electricity, and force them to tell us what they are, and what tidings they bring from the infinity beyond; but life—that presence which dwells in us and around us, which is the very essence of ourselves, though the best minds of all ages have pondered over it, though the best

methods of science have been used in its investigation—is still a great and hopeless mystery.

The very word life is practically indefinable. We can only say, at most, that it is a something whose properties are never found apart from a compound of oxygen, hydrogen, nitrogen and carbon, called protoplasm; on the other hand, this compound often exists unaccompanied by the properties of life.

In order to study with effect any difficult subject, we should look at it in its least complex form, so as not to lose the essentials in the surrounding circumstances. Perhaps the simplest form of life is presented in the amœba, a creature almost exactly like a drop of the white of an egg in appearance and composition. By perseverance or good fortune it may be found in water containing a little organic matter, and then may be studied sufficiently well with a microscope magnifying two or three hundred diameters. At first it may seem lifeless, like other matters within the field of view, but frequently we see that the drop has changed its shape. A part bulges out on one side, the projection grows, and, while we watch it, the rest of the drop has slid into it, and the amœba has moved a length. This is often done so rapidly by a young amœba that the glass slide must be moved every few moments to keep it in the field of view. This almost indescribable motion may be up or down in the water as well as from side to side. It is as though a man should thrust out his arm and presently all the rest of him should have flown into it, and then he should proceed to send out another arm in another direction.

The amœba possesses something like a will; he pleases to go in one direction or another, and straightway goes, as though to will was to do. We think we can understand motion where there is organization, machinery, to produce it, but here the highest powers of the microscope show no trace of organization.

An astronomer can calculate with unerring certainty the position of any planet of our system for any given future time—no man can calculate for a moment before where that drop of living jelly will have taken itself. How much higher

in the scale of creation is the amœba than the planet! The planet moves, as it is obliged to do, a bound and helpless slave to gravity; the amœba in his little domain laughs at gravity, and flows where he pleases.

Let us be impolite enough to watch an amœba eat. In some unknown way he becomes aware that there is a particle of food near; he thrusts out a feeler to inquire as to its quality. If it is unpleasing, the feeler draws in; if pleasing, the whole body flows round the particle, which henceforth forms part of the amœba. Certainly this is the handiest creature in the world, for at a moment's notice any part of its body will serve as a feeler, a mouth or a stomach, as the case may require. The results of this primitive mode of digestion are quite as satisfactory, so far as the amœba is concerned, as those of the complicated digestive apparatus which men possess; though the amœba, like its superiors, sometimes suffers from over indulgence of appetite. It is not uncommon to see one picking his way through the water with the silica skeleton of a diatom as long as himself poking out at one side.

Sometimes two parts of an amœba disagree, one end being resolved to go in one direction and the other in another; the result of the altercation being that each end has its own way, and henceforth there are two amœbas instead of one. This is their mode of propagation.

We have spoken in a somewhat jesting way of this drop of protoplasm; but, in sober earnest, when we watch those strange causeless motions through the microscope, we feel like baring our head in reverence before the mystery of life. We behold a miracle wrought before our eyes. A particle of dead matter is taken into that living drop and becomes part of it—the dead becomes alive.

Some advanced modern thinkers make life a resultant of the chemical properties of the components of protoplasm. Perhaps the best reply to this is that chemistry, with all its boasted advances, with its well-fitted laboratories and elegantly made instruments, cannot show the slightest chemical difference between living protoplasm, with its wonderful

powers, and the same when dead and inert, like ordinary matter. It is easy to kill an amœba: what has been taken from it? Chemistry cannot tell; but, once dead, no power of man can make that drop of jelly live again.

Haeckel, one of the latest and ablest of the German apostles of Evolution, says: "The soul's activity in the Protista," among which he includes the amœba, "manifests itself in their irritability, that is, in the movements and other changes which take place in consequence of mechanical, electrical and chemical irritation of their contractile protoplasm. In the Protista, as in all other organisms, the activities of the soul are traceable to molecular motions in the protoplasm."

Let us see if he has really given an explanation of "the soul's activities," by which we understand him to mean the manifestations of life. In the first sentence quoted, he simply describes living protoplasm as irritable and contractile. The terms irritability, irritation, convey to us no new idea, since they are only names for the unknown cause of some of the known phenomena of life. Contractility, as applied to muscular fibre, in reference to which the term is ordinarily used, means a regular shortening of the length of the fibre, with a corresponding increase in thickness. In this sense, in the opinion of Dr. Beale, perhaps the best microscopist in the world, the word does not apply, since the various diameters are constantly changing without the slightest regularity. This will be admitted by any one who has watched an amœba. In the second sentence he calmly reduces life force, and therefore life itself, to something "traceable to molecular motions." If the word molecular is employed in its usual sense in chemistry, he begs the question, for we know absolutely nothing of molecular motions either in simple elements or compounds, and how can we trace anything to them? To a less advanced person, this definition or explanation of life looks like the use of a cloud of learned words to conceal one's ignorance.

His account of the origin of protoplasm and of life is an excellent proof that even an eminent man of science is as

credulous as an ordinary mortal in the direction of his wishes. Modern chemistry has as yet been unable to produce even dead protoplasm; nay, more, hardly two chemists are agreed as to its formula; but Haeckel is ready and anxious to believe that this compound arose accidentally at some almost infinitely remote period of the earth's history. And what are the convincing facts which bring him to this conclusion? All the carbon now found, as coal, &c., was, when the earth became cool enough to allow water to remain on its surface, probably for the most part distributed as carbonic acid gas through the atmosphere; therefore, the composition of the atmosphere was different then from what it is now. Further, the density and electrical conditions of the atmosphere were quite different. In like manner the chemical and physical nature of the ocean, its temperature, density, amount of salt, &c., must have been very different from what they are now. "In any case, therefore, even if we do not know anything more about it," says he, "there remains to us the supposition, which can at least not be disputed, that at that time, under conditions quite different from those of to-day, a spontaneous generation, which now is perhaps no longer possible, may have taken place." He then leaves his readers to their choice between creation and spontaneous generation, adding, in effect, that since the latter hypothesis *has lost its former* difficulty, a believing mind, as well as a scientific intellect, should accept it.

Having accounted for the life of his most primitive speck of protoplasm, he goes on to evolve from this the whole of the animal and vegetable kingdoms. A portion of the protoplasm hardens on the outside, thus forming a cell wall; another portion, having been walled off on the inside, forms a nucleus; and we have a complete cell, which he employs as a structural unit. This may divide into two; these two may divide and subdivide *ad infinitum*. As all animals and vegetables are but aggregations of cells, if sufficient time be allowed, all may be descended from this primeval particle of protoplasm. Are you not curious to look through the microscope and behold the type of your earliest ancestor?

The idea that we and all living organisms are nothing but aggregations of amœbas is not, however, so baseless as one might suppose. The first germ of all life is the single cell, the germ of a plant, of an oyster or an ox being essentials undistinguishable by the microscope or chemical tests; yet what an immeasurable difference there must be in reality between them. Never does a germ forget its parentage and fail to grow up into the likeness of its predecessors. The materialist confidently says there are chemical differences, though so minute as to be undemonstrable. This amounts to saying that there are myriads of chemical compounds each differing from all the rest, yet so identically the same that he cannot prove the slightest difference between any one and any other. Here again we meet one of the mysteries of life, for the vitalist holds that it is not in the physical basis that the difference consists, but in the something which abides in it.

This germ, by continual increase and division, in a way strongly marked by purpose, finally becomes the perfect adult. This process may be watched in some of the more transparent animals. In accordance with this development, we find that men and animals are but a congeries of living, moving cells with intervening formed material. Under a high magnifier our blood is found to consist of a limpid fluid, thickened with innumerable flattened amber-colored sacs, called red blood corpuscles, and a few white corpuscles. The latter have precisely the appearance and motions of amœbas, and are evidently alive. The red corpuscles appear to result from their death. Muscle, tendon, and all our tissues, even including bone, at least in the young, are found to have more or less interspersed through them tiny masses of living protoplasm, the surrounding tissues being simply their formed and dead material. Thus myriads of living corpuscles are at work throughout our system, each building up its own portion. We may compare a man to a well organized state, where each individual lives for himself but still is busy on some work useful to the state in general. If the mere mechanism of man's frame is wonderful, what shall we say of the mechanics

who have the power to manufacture such products from so unpromising a material as blood. By far the greater part of us is dead; the living part is no homogeneous whole, but is made up of an innumerable number of units, each possessing by virtue of its life, to some extent the power of choice, something resembling will. What then constitutes the single self which every man feels that he is? Are we to conclude that the soul of man is but a resultant of the vital forces of his components, as the materialist holds that the life of the amœba is the resultant of the chemical properties of the hydrogen, oxygen, nitrogen and carbon? Again, we find that the man, the self, may die, while all the components remain as before. Each corpuscle pursues its work until, for want of a guiding spirit—it may not be for hours after life has left the physical man—the body falls into disorganization, and the corpuscles perish for lack of systematic nourishment.

And now we have endeavored, in a crude and imperfect manner it may be, yet conscientiously, to bring ourselves face to face with the mystery, or rather bundle of mysteries, of life. Could any eloquence close this paper more fittingly than the words, "We are fearfully and wonderfully made."

THE PHYSICAL BASIS OF CERTAIN MENTAL OPERATIONS.

AN ADDRESS BY E. HAANEL, PH.D., F.R.S.C.

KENELM CHILLINGLY was a precocious child. At the age of eight he startles his mother and Sir Peter, his father, with the question, "Mamma, are you not sometimes overpowered by a sense of your identity?"

This question expresses a feeling too uncommon in a child, but common enough with maturer minds, trained to reflective habits of thought. Such a feeling takes possession of the mind at most unexpected moments. It may come in the night-time or in broad daylight, in company or in solitude; and when it comes it illumines the horizon of consciousness as with a flash, revealing on the outskirts of it what had never

before been noticed, or had only been vaguely felt. "Have I been dreaming?" "How do I know?" "How can I prove to myself I am not now dreaming?" are the queries of an inner voice. The mystery of being seems to be overpowering. For the moment the mind is awakened, exalted, revealing in fitful gleams a new relation between it and the universe—a state of mind that can be experienced but not easily described. All this takes place in a moment. As mysteriously and quickly as this mood—shall I say inspiration—took possession of us, so quickly and mysteriously it leaves us. But it leaves us in a state of uncertainty. It leaves the mind in a questioning mood, sounding for a foundation, asking, "How do I know anything?" "How do I retain what I know as part of my intellectual self?" "Does my knowledge correspond with external fact?"

I purpose in this lecture to furnish something toward an explanation of the physics underlying the problems involved in these questions—to sketch for you in rapid strokes a theory which, as far as it goes, seems probable, and appears in harmony with the present state of science. The theory has grown in my mind from shadowy fragments presented during states of mind described in the introduction, and into which I have often been thrown while lecturing to my classes. The theme of many of these lectures, "The resolution of phenomena into modes of motion," was favorable alike to induce the state of mind referred to, and assist in the formation of the theory I venture to present to you. I have read so very little in the direction of the thought developed in this lecture that I do not know how much, or whether any part is original. Possibly it may prove to some to be something quite old in a new dress—a theory better developed elsewhere, but here presented from a new standpoint. Since I feel that I have been obliged to work it out for myself, I am conscious of many gaps, requiring to be filled at some future time, when I shall have more leisure for thought and study. All that I can be expected to do now will be, as indicated, to present you a short sketch. And although I fear that some parts

may not be as popular as you perhaps expect, we must remember that it is a lecture to be delivered before a Science Association, from the members of which we have the right to expect comprehension of detail somewhat minute.

Our knowledge of things external to us depends upon four powers possessed by us: 1. The power to perceive external objects; 2. The power to reproduce representations of them; 3. The power to vary them; 4. The power to judge them. In other words, we possess Perception, Memory, Imagination, Reason.

Let me illustrate this. On yonder plain is a pine tree. I direct my eyes toward it. I see it. My becoming aware of the existence of this tree depends upon my power of perception. I perceive the tree. I now close my eyes, but I can still see the tree, shadowy, not so brilliantly colored, ghost-like. I have a mental image of it. This mental image I can recall as often as I like. I can reproduce, in other words, the representation I have formed of the tree. In short, I remember it. This same process I may repeat in a number of instances with different trees, and thus become possessed of images of oaks, magnolias or willows, as the case may be.

Suppose now that I reproduce the mental image of the pine tree first seen, and change it to suit my fancy; for instance, I lop off a few branches, and bend and twist others, and finally replace the leaves of the pine tree with those of the oak. I can evidently do this with the mental image, and thus, as it were, create an image which, though composed of parts which separately may have their counterpart in nature, may not as a whole correspond to any external reality. The process of varying a mental image is termed imagination.

If now I compare this so formed image with other images, such as the magnolia, for instance, I note a want of correspondence between the two. I pronounce judgment of unlikeness between them. If, on the other hand, I compare the image I have imagined with that of the oak, I observe that my two images correspond as to leaves, and I pronounce judgment of similarity between them. This I can do with

any number of mental images, comparing them one with another, and judging them as to likeness or unlikeness. In other words, I can reason upon them.

This is a mere statement of fact easily verified. But *how* do I perceive, remember, imagine, reason? What is the mechanism underlying perception, memory, imagination, if there be any? What is the physical basis of these mental operations? In order to get at this problem, let us examine the physics of the phenomenon exterior to ourselves, which, when we perceive it, we denote "pine tree."

Physically considered, the tree resolves itself into aggregations of multitudes of very small groups of still smaller particles. These particles do not touch each other, but are separated from each other by spaces which differ in extent. These groups of particles, which we will term molecules, and which, when compared with each other, may be of different configurations, and contain a greater or less number of smaller particles, are not poised in empty space, but in a medium called "ether," which pervades all substances, and which may be conceived as filling all space. So that we may think of all substances—hence, also, of our tree—as being "ether-soaked," a very expressive phrase, invented by Tyndall. It is evident from this conception that whatever motion is performed by the constituents of the ether, may in part be communicated to the molecules of the tree, just as particles of sawdust partake more or less completely of the motion of the fluid in which they may be suspended.

If now we conceive the ether all about the tree to be in that state of vibratory agitation into which it is thrown when conveying light, it is evident that the molecules of the tree will partake of that motion. From the vibrations of the ether the molecules of the tree will select and absorb those which they themselves could impart to the ether if in a state of vibration. The remaining unabsorbed vibrations are thrown back into space—reflected.

Let us suppose that we have before us a solid wooden frame work, from the upper cross bar of which hang suspended

two pendula of exactly the same length and weight. I give to one of these a tip, and it commences to vibrate. Soon the other will commence to swing in harmony with the former; the motion will gradually be transferred from the first to the second; the first pendulum will come to rest, and the other will have increased its arc of vibration until its motion shall equal that of the former. Soon, however, in like manner as before, the motion of the second will cease, and the first will again, little by little, swing back and forth until it shall have taken up from the second the motion formerly lost. Thus we will have motion and rest succeeding each other—a transference of motion between two bodies which are not directly in contact. Such transference of course requires that the two bodies shall have exactly the same vibratory periods.

In the same way, if we have two tuning forks of the same pitch placed apart, the vibrations of one will be taken up by the other, and the two will sound forth the same note alternately, the vibrations of the forks being sent back and forth across the intervening space. It is necessary, however, that the two tuning forks shall vibrate exactly in the same manner. A small piece of wax attached to either will destroy the experiment.

Let all the tones of a piano be sounded at once, and let the mass of vibrations contain those corresponding to the sound of a particular tuning fork. This fork will cut them out of the complex and vibrate itself. Behind it we shall then have all the vibrations, minus those cut out by the tuning fork. To apply this to our tree, we may regard the molecules of which it is composed as so many tuning forks of different pitch, which select from the heterogeneous mass of vibration of the ether those with which each separately can sympathize, while all other vibrations, either too rapid or too slow, are rejected—reflected. About the tree then we have a state of most complex agitation. It may be likened to a perfect crash of music bursting from two orchestras playing different melodies This music is sifted, analyzed, by the tree; chords upon chords are eliminated from the tangled

web, one melody being retained by the tree, the other sent back into space. This song of the tree, consisting of the reflected vibrations, is sent along the highway of the ether radially outward. A representative group of these motions strike our eyes. They enter the front lens, are bent inwards, plunge through the dark chamber of this wonderful *camera obscura*, and upon the small screen, the retina, at the back of it, leave a faithful copy in miniature of the vibrations *rejected* by the tree—the picture of the *alter ego* of the tree. From this retina the motion is taken up by numberless fine white threads, collectively termed the optic nerve, and conveyed inwards into the bony cavity of the skull, to be landed at the door of the brain represented by certain ganglia. But even then we may not perceive the tree; not because of any physical disability, but because we do not pay attention. Hence, in order to perceive, we require to make an exertion, that is, pay attention. Let us see how we can account for the necessity of making an exertion before we can perceive, when the motion has, so to say, arrived at the very door of the brain.

Now, I maintain that the chain of motion, beginning at the object to be perceived, does not end in the ganglionic masses (the optic tubercles, or *tubercles quadrigemini*) when the object is perceived. Before I can perceive the object, the motion representative of the object must be transferred from the ganglia mentioned to the general structure of the cerebrum. This requires that certain parts of the brain shall be capable of vibrating in sympathy with the vibrations which have arrived at the ganglia, and that there shall be communication between these parts of the cerebrum and the ganglia along which the motion may be conveyed.

Let us now see what provision exists in the cerebrum for either the rearrangement of its molecular structure into groups having the same vibrating period as those which have just arrived at the ganglia, or of providing them in case they do not exist; and also what provision is made for connecting these groups with the general lines of communication.

The cerebrum when examined is found to consist of a somewhat pulpy, more or less elastic substance of very unstable constitution; that is, its molecules very readily, and on slight provocation, assume different positions with reference to each other, capable of forming different groupings. Hence on death it is the first to succumb to the ravages of decay, which, in chemical language, is equivalent to rearrangement—recombination. Throughout this substance of the cerebrum great numbers of fine white threads are found to ramify. These threads are collected at the base of the brain into bands which unite the two hemispheres of the cerebrum, and form lines of communication between the ganglia and the various parts of the brain substance. In addition to these threads, we have distributed through the substance of the brain vast numbers of bioplasts, which are especially numerous along the ends of the threads and in the substance surrounding these threads. It is the function of these bioplasts to convert the food supplied by the blood vessels, which anastomose throughout the brain substance, into tissue, formed material—into nerve fibre, or brain substance.

Suppose now that a certain motion, representative of an external object, has arrived at the ganglia, and I pay attention. What takes place before I perceive? Immediately a stimulus is sent along some nerve track already existing, directing the bioplasts in some part of the brain either to build a group of brain molecules or to differentiate what already exists into groups capable of taking up—copying—the motion which has arrived from the exterior. More than this; in building these groups, the bioplasts at the same time construct a nerve track joining the group of molecules with the main track. The stimulus I send along, directing the function of the bioplasts to perform the work indicated, is due to an exertion of the will, and to pay attention in the sense here indicated simply means to exert the will, by which the bioplasts are directed in their function. When this has been done, when the motion has been transferred to the brain along the highway already existing, and that part of it which has

been built for the occasion, then I perceive. Not to pay attention to a sensual impression means non-exertion of the will—non-direction of the bioplasts—consequently, no building of groups or differentiation of brain structure; in other words, no perception.

These bioplasts are present in such great numbers, and work in such harmony—each lending, as it were, to the other a hand—and the nerve track to be built is so small, that the time occupied for the performance of this work is, in general, very short.

It is easily seen now why it is that my perception of an object becomes clearer and more vivid the closer I pay attention, the greater the exertion of my will. For, evidently, the more minutely I scrutinize—the greater time I occupy in the mental operation—the greater will be the time allowed the bioplasts to perform their work. As a consequence, the more perfect and permanent will be the nerve track, and the more perfectly differentiated the brain structure at the end of it. On the other hand, the more rapid and casual the observation, or the feebler the attention, the more evanescent, filmy and thin the nerve track—the less perfect the differentiation.

This I conceive to be the mechanism underlying perception.

Suppose now again that I perceive an object—say our pine tree—and close my eyes so as to shut out the external stimulus. Still I see the tree, now however shadowy, ghost-like. I remember the tree. To call up this shadowy image, I require to make an exertion of my will—to send a stimulus along the nerve track, partly built by the bioplasts, to the groups of brain molecules which were differentiated, and had stored up, during the act of perception, the capability of vibrating in periods corresponding to those sent out by the tree. This stimulus is the force expended in setting the group into vibration. The mental image now excited is more feeble than the perception of the real object. Naturally so, for the vividness of the image depends upon the intensity of the vibration, and this upon the force expended. In the case of memory the motion is inaugurated and maintained by the

exertion of the will, unaided by the energy of motion from without. This very feebleness of the mental image, when compared with the vividness of the actual perception, enables us to make the necessary distinction between actual existence external to ourselves, and mere reproduction of a representation. By very close and absorbing attention to any one single object, and by long practice in calling up the mental image of that object, we may succeed in causing the group of brain molecules, representing in its vibratory period the object, to swing in amplitudes comparable in intensity with those excited from without in the act of perception. When this occurs, we are unable to distinguish the mental image formed from what would be perceived were the object bodily present. In this case we would confuse the product of our will with the impression made from without. We would actually see what has no existence outside of us. We would be in a state of hallucination.

To remember an object, then, is to set into vibration, by exertion of the will, the group of brain molecules representing the object in its vibratory period. Gradually as our perceptions multiply, the brain becomes more and more differentiated into molecular groups, the representatives of the objects seen and dwelt upon. From these groups nerve tracks ramify throughout the substance of the brain, to be finally collected at the base of the brain into that broad band of fibres which unites the two hemispheres of the cerebrum.

If now I have seen a pine tree and an oak, and can readily call up the mental image of each, it is easy to see how I may strip the image of the pine of its leaves by simply quenching the vibrations of the groups of brain molecules representing them. I further substitute the leaves of an oak by exciting to vibration the molecular groups corresponding to them. This requires an exertion of the will which is spent in causing the vibrations. The most complicated mental image may thus be built up like mosaic from the parts furnished by the memory.

That such impulse can be sent along a nerve track and produce motion at the end should not surprise us any more

than the fact, of everyday experience, that we can by will set into operation a most complicated series of muscles far removed from the brain. Certain movements termed involuntary, such as, for instance, the ciliary movement in the bronchial tubes, do not require an effort on our part, and I have no doubt that many movements occur in the brain which never rise to the horizon of consciousness, and which are independent of our will. But in every case of an intellectual process an exertion is required to be made, and this as an impulse is carried to its destination just as surely and as rapidly, though just as mysteriously, and in detail unconsciously, as the impulse of the will is sent to the fingers of a piano player executing a piece of music *prestissimo.*

The richer the resources of the memory, the more intense the vibrations corresponding to the several parts of the image formed, and the greater the skill and facility required of combining the several parts into a whole, the more brilliant will be the imagination. We may form some estimate of the marvellous capabilities of the imagination when we remember that all the words of all the languages may be built out of some twenty-four letters, that the songs and melodies of all nations consist of combinations of tones comprised in less than eight octaves, and that the multiplicity of the compounds of the chemical laboratory—indeed, as far as we know, of the universe—result from the combinations of some seventy elements.

It is this marvellous power of disintegrating the compounds offered by perception, and stored in memory into its constituent parts, and of recombining them in any manner to a new compound, which renders imagination so valuable. "Chastened by correct observation, it is the keenest detective of truth." This power of the imagination enables the scientist to rise from the visible to the invisible, by transferring the images of the visible into the realm of the invisible—from the fact of what has been observed to the problem of what might be observed. It is this power of the imagination which lays the line of construction through the mathematical figure,

and thus solves the problem as by magic. It is the power which peoples earth and sky with fairy forms in the fancy of the poet.

But to continue. I have no mechanism to offer in explanation of the operation of reason. This inner eye which compares the mental images, produced in obedience to the will, and pronounces judgment upon them in one state and in another, contemplates, and enjoys or is pained by the object of the contemplation. This power, which extracts the spiritual from the material and translates the motion of brain molecules into sensations, is not physical but *meta*physical. No material explanation has ever yet been attempted which even remotely touched the mystery involved in the word reason. Undoubtedly there is a mechanism underlying perception, memory and imagination, but the builder of the mechanism and the operator of it are out of sight, incorporeal, spiritual. But when I say that perception, memory, imagination require a physical basis, I do not mean that the motions underlying perception, memory and imagination are anything more than motions. It is the mind which perceives, remembers, imagines. Without the mind there would be no perception, no memory, no imagination, although the motions of the brain molecules corresponding to each were present. The motions might be interpretable, but the interpreter would be wanting.

We have so far confined our attention to visual perception memory and imagination, but the eye is not the only avenue by which modes of motion have access to the brain, which may give rise to perception, which may be stored as capabilities in memory and varied by imagination. We have in addition the perception, memory and imagination of sound, of taste, of odor, of general sensibility.

The physical basis underlying these is a mechanism similar to the one dwelt on in the case of visual perception, memory and imagination. The mechanism for each is distinct as to location in the cerebrum, but all are bound together by nerve tracks which pass from one to the other. This may explain to us why it is that an odor, a melody, a taste, or a feeling

is capable of calling up, as if by magic, an experience of the past. I hear a melody, and again I am on board ship. I see the harbor with its multitude of plying steamers, its forest of masts. I see the surging throng on the dock, bags, trunks, tinware, mattresses, a stream of persons passing the gang-plank, embraces, tears! I recollect my own emotion, and become aware that the melody I have just heard, and which has called up in my mind this picture, is the same that was being played by the band on board the steamer which, some years ago, left the dock at Hoboken with myself on board.

How natural the explanation. The vivid perception of the melody, represented by molecular vibrations of brain molecules, by sympathy excites those of the visual memory, stored on the occasion when the melody was first heard.

The intricate maze of nerve tracks, crossing and recrossing, connecting visual and auditory memory, the memory of taste, odor and general sensibility, binding into a whole all of man's conscious existence, all but baffle our imagination. If the analogy were not altogether too coarse, we might liken the brain to a forest, in which the trunks and branches represent the nerve tracks, the trembling leaves the differentiated brain molecules, the kind of tree, whether oak, pine or magnolia, the mechanism corresponding to the perception and memory of the sensations conveyed to the brain by the different senses; finally, the ground on which these trees grow might represent to us the link of intercommunication between them, and corresponding to the band of fibres which lies at the base of the brain. Sever, lop off any of these branches, and the memory, and hence the imagination corresponding to them, disappears. Let a hurricane of emotion sweep through this forest, twisting, prostrating trees and branches, tangling inextricably the net of nerve tracks, and we have insanity. But let a gentle breeze strike any one tree or branch, and we see its glistening leaves tremble, more vigorously perhaps on one branch of one limb than on any other branch of the same limb. The gentle breeze so carefully directed may symbolize for us the stream of energy directed

along the channels of a special organ, the resultant motion the physical basis of perception. The breeze ceases; the leaves become quiescent; I send a tremor along the trunk, the limb, the branch, to the group of leaves; again they tremble, but now feebler—I remember. I quench the motion of a group of leaves, and along the ground and up another trunk, limb, branch, send another tremor—I imagine. I compare the images represented by the motions of the different groups of leaves—I reason.

While then in a wakeful state we are constantly plied by external impressions—breezes—our brain is in a constant state of vibration. Image after image flits before us; thought chases thought, idea displaces idea—we are conscious. We know how utterly false the answer is to the question, "What were you thinking of?" "I was not thinking of anything." How exact and correct the answer to the same question may be, "I was not thinking of anything *in particular*." Absence of vibratory motion in the cerebrum is loss of consciousness. If blood transudes upon the brain, loading the brain, producing pressure, and thus preventing the free motion of the brain molecules, we become unconscious.

Allow me once more to return to the analogy of the forest. In sound dreamless sleep the forest is swept by no wind. Darkness, quiet, envelopes the scene. The cool night air, bringing with it the refreshing dew, descends upon soil, trunk, branch and leaf. So in sleep the brain is at rest. We are unconscious while the refreshing dew trickles from the capillaries, to nourish the bioplasts which store material and potential energy to be transformed into kinetic by the work of to-morrow's wakeful hours. But when the night comes on with a freshening breeze, when the murmuring song of the forest changes to the louder rustle of the leaves, there is no refreshing dew, no recuperation; we have the state "insomnia."

Again my forest is wind-swept. Image chases image. I exert my will to the utmost, and bring into quiescence all leaves but one group. I attentively observe. Still again my forest is at rest. I think. I call up an image. Yonder,

branches and leaves sway in obedience to my will, but by sympathy other leaves, other branches, become animated by motion. I quench the latter, pay attention to the former, and gradually from the complex of motion cut out all motions except that of one particular group of leaves. I perform the process of abstraction. I finally quench the motions of all the leaves save that of one leaf. I am now thinking of a point. The exertion I have to make to keep down the motion of all other leaves is known from experience to be very great. I cannot long sustain such an effort. One of two things will happen. Either the leaf upon which I had concentrated my attention will cease to move, neither my will nor the potential energy at the disposal of the will being sufficient to keep up the motion—I drop asleep—or other images will crowd upon the horizon of consciousness, and my abstraction is ended. From this it will be evident why, in the case of insomnia, it is recommended that we think of a point or line, or slowly count, for by this process we quench all other motions except those necessary for the limited image, and this process, as seen above, may possibly result in quiescence—sleep.

The phenomenon "hypnotism"—in popular language, magnetic sleep—admits of a similar explanation. Concentration of attention upon a single, not greatly extended, object, such as a silver piece, confines the vibrations of the brain molecules to a limited area. Weariness and exhaustion follow upon the effort, resulting in partial sleep.

The sum total of our experiences, co-ordinated by conscious effort, constitutes the basis of our identity. Let the meshes of our brain substance, woven under our direction, be plaited into other patterns, and our identity would be lost.

The contents of our consciousness are immense. To control and render them serviceable for communication between man and man, and for complex mental operations, man has co-ordinated these contents, grouped them, and for these groups has invented labels, which we call *words*. The different groups of brain molecules are classified and marshalled into companies, a single group being associated with them as their

captain. This single group, which stands for the individuals of the company, is a word. Companies of groups are organized into regiments, with a colonel at their head, which is again a word. Regiments are grouped into brigades with their general, and these into armies, with a word as the commander-in-chief. It is thus that we are able to operate with perfect mountains of knowledge, and perform the operation in a moment. Touch a general-in-chief, an abstract word, such as "vegetable kingdom," and generals, colonels, majors, captains, lieutenants, sergeants, down to each individual private, are reached and made serviceable. The most complex evolutions may be carried out, and in a moment group after group is marshalled before consciousness, and the roll in each company may be called. This truly wonderful process of co-ordination is entirely a mental operation. The symbols, the words representing the various classes and groups, are of man's invention. Each symbol is a group of oscillating brain molecules. I will, and send a tremor along nerve tracks from my brain to certain muscles of chest, throat and face. A few movements, and I have spoken a word, impressed the symbol on the air, and sent it along that highway to the ears of thousands of persons. In each it awakens a perception; a corresponding group of brain molecules oscillates; this general, colonel, captain, or sergeant, as the case may be, orders the oscillation of his respective command; a faint, shadowy picture rises above the horizon of consciousness in each individual. Thus I pronounce the word "tree." It is carried from me to you. It strikes your ear, a group of brain molecules oscillates, and now you see a tree, shadowy, nebulous. You require to pay attention—make an exertion. You thus amplify the oscillations of certain molecules and quench those of others, and thus it becomes in one mind a pine tree, in another a beech, in still another an oak, but yet in each a tree.

Again I produce by will power oscillation in the group corresponding to the word "tree." Again I send a stimulus along certain nerve tracks to the muscles of my arm, hand and fingers; a few movements, and I have written it upon the

blackboard, and there it stands ever ready to impress itself upon the universal elastic ether, and flow as a perennial stream outward, capable, as long as the word remains written, of affecting the chance eye directed to the blackboard. Through the eye and into the brain, and there a group of molecules vibrate corresponding to the word "tree;" and now the process sketched for you in the case of hearing the word is repeated, and the picture of a tree rises before the scrutinizing inner eye. Words have hence two avenues of access to the brain, the eye and the ear, and consequently require for each word a visual and an auditory memory.

It is thus, then, that we may conceive each brain molecule in the cerebrum of an intellectual person to be part of a mechanism essential to the formation of pictures with which the mind operates in the act of thinking. "Thought without representations is a philosophic fiction." The interdependence of the various parts of the cerebrum makes, moreover, the conversion of one kind of sensation, as of color-groupings, into another kind, as of sound, possible. We may thus, in part at least, understand why a beautiful landscape may awaken in a Mozart a melody, why a harmony in nature seen may become to him a harmony heard; or why a melody heard may in the case of a painter become a picture seen.

But to one thing I would now especially direct your attention, namely, to the fact that the motions of our brain, representing special objects or groupings of objects, evoke emotions, feelings, and that these—a state of the mind incapable of resolution into motion—can be conveyed, bound up in words along the ether, or the air, to the souls of others, capable there to awaken along with the motions the corresponding emotions. I describe misery, being myself moved by the picture of misery vividly brought before me by my imagination, and I may touch you to tears. Now this something which travels along the air or ether, in the communication between man and man, though measureless and immaterial, is full of power—a power which physics cannot analyze, with which science cannot deal; a power incapable of being meas-

ured by pounds, pressure or weight; a power which moves men. It vivifies the sluggard, and makes him instinct with life and ambition. It changes the loathsome sensualist into the idealist. It is the word or words spoken, weightless things though they be, that send him across oceans and amid foreign nations to work, to suffer, to die. These words, how tremendous their power! How they rankle, embittering a whole life! How they bless, sweetening another life! War, misery, anguish, death, all from a few words.

But whence this power? It is not in the words considered as a collection of sounds. Words uttered without feeling are powerless; they are but air, and carry no burden. He who would influence others for weal or woe must feel, must possess emotional memory and imagination. An imagination fired by feeling is the moving force which gives words their power. There is no power in logic. Two opposing minds will not convince each other by argument. But let the vivifying influence—feeling, emotion—be the burden borne along by words, and where argument failed, feeling and emotion succeed.

It is a trite saying of physics that the sunbeam clothes the flower of the field with its beauty, and tints the autumn leaf; but it is the imagination built on feeling which becomes the evidence of things not seen, and reads out of the ether waves, composing the picture of the flower, the burden of a Heavenly Father's love, and finds an interpretation of the physical phenomenon clothed with spiritual beauty in the words "Consider the lilies of the field," etc., and again, "If God so clothe the grass of the field," etc.

It may be a scientific fact that the wondrous beauty of sunsets of recent times is due to volcanic dust, but it is the imagination built on feeling which sifts out the finer vibrations from the gorgeous beauty, and reads out of them a message of power—a revelation of an immortality.

"Hear instruction, and be wise, and refuse it not."

WE of the present cosmopolitan era partake with equal relish of Irish stew and Bologna sausage, of the "chow-chow" of the Orient and the "pudding" of Yorkshire. As "the heirs of all the ages," we have adopted foreign viands, unknown to our homespun ancestry, as indispensable to the completeness of our daily repasts; and if all the exotics were excluded from an ordinary dinner little would be left. But in primitive times a national dish was in its way as characteristic and distinctive as a language. And even yet in some quarters of the world some very queer food is eaten.

It is an ancient custom in many regions to turn worn-out beasts of burden into food. The nomads of the Orient eat the flesh of the camel, and consider it equal to veal; the Laplanders drink the blood of the reindeer; when the Kalmucks tire of riding their horses they roast them; and the Esquimaux cook and eat their old dogs (an act that is said to be occasionally reciprocated when the dogs catch a stray old Esquimaux).

The inhabitants of "the realms of the boreal pole" consume immense quantities of fat to produce the necessary animal warmth. Even fastidious European and American travellers, when in the frigid regions, eat with relish huge slices of lard and drink train oil. Whale's tail, saturated with oil, and seal's flesh in a state of putrification, are esteemed desirable food by the natives of Greenland. Dr. Hayes tells us of a charming little maiden of the Esquimaux race, who became a prime favorite with his sailors, while they were in winter quarters, hopelessly imprisoned by the rigors of an Arctic night. Entering the cabin one evening, she expressed such artless admiration of all she saw that the good-natured captain offered to present to her any article she might select. After a moment's hesitation she chose an ornamental cake of Castile soap. When the doctor handed it to her she capered in an ecstasy of delight, then—*swallowed it!*

Among the dainties that figure on the tables of wealthy Chinese are birds' nests, salted earthworms, boiled Japan leather, maggots, pigeons' eggs, sharks' fins, and pounded

shrimps. The famine-stricken millions of the southerly provinces of the Celestial Empire have been forced to subsist on food detestable to civilized appetites—cats, dogs, rats, and frogs. Many nations, however, have relished the flesh of the dog. The common people of Greece and Rome ate it, and Hippocrates is quoted as commending it as light and wholesome. Hedgehogs and foxes and the odious polypi of the seashore were accounted good diet in classic times. Martial, in describing the various dishes of a Roman banquet, refers to almost every fruit and vegetable and meat that we now use, besides many dishes which to us seem grotesque and disgusting. The chief ingredient in seasoning the food of the ancient Egyptians was asafœtida. The Siamese are fond of a preparation of putrid fish; and the nobility of Russia highly prize the raw roe of the sturgeon. Many of the tribes in Southern Africa feast on insects and reptiles—snakes, grasshoppers, ants, caterpillars, and spiders. The Hottentots eat the elephant. Lions, tigers, and all the wild beasts of the jungle, are eaten in Central Africa; kangaroos, opossums, and the eggs of snakes, in Australia. The Arabs still partake largely of the old prophetic food—locusts and wild honey. Burckhardt tells us how the locusts are prepared: first dried in the sun, their heads, wings, and legs are torn off, and then they are boiled in oil. Some of our American Indians regale themselves on stewed rattlesnakes. The Brazilian tribes of the Amazon eat flesh of alligators, armadillos, lizards, sloths, and tapirs. And large numbers of our Mexican neighbors vary their luscious fruit diet of bananas and plantains by frog fricassee and monkey steak. *Apropos* to the last is an anecdote of a venturesome German *savant*, who, without other companion than a savage-looking Moorish guide, struck southward through Tunis to the wild lands that border the Sahara. After many hardships, and a scant supply of food for several days, they were at last threatened with utter destitution. The guide proposed as their only recourse a forced march to a neighboring forest, where possibly they might find monkeys. "How does monkey flesh taste?" asked the squeamish Teuton.

"Something like man," responded the Moor, "not quite so tough, and a little more spicy." The horrified explorer exerted his small remaining strength in making straight tracks homeward, insisting that his guide should keep to the front, within easy range of his own rifle.

Sunken to nearly the lowest level of humanity are those wretched tribes that seek to derive nourishment from mud and clay. In Java, on the banks of the Orinoco, and in some other unfrequented corners of the earth, they huddle together. It is a sort of pipe-clay that they use, baking it slightly in loaves. More degraded still are the cannibals. No quarter of the globe but has been polluted by their horrid practices, but they have especially prevailed among the tawny tribes that inhabit the islands of the Pacific. In Fiji the wretches doomed to death were compelled to dig a hole in the earth to serve as an oven, to cut fire-wood to roast their own bodies, and were actually invited to partake of the flesh of their fellows. No doubt this crime is traceable to the natural viciousness of the savage; but in its origin it was impelled by the scarcity of food, which makes life one long and almost hopeless struggle for existence.—*Demorest's Magazine.*

CLIPPINGS.

LAKE ERIE and the Niagara have thirty-seven different marketable kinds of fish.

PROFESSOR LANGLEY, London, has shown that the normal color of light is not white, but bluish.

SCIENTIFIC men rarely die so rich as the late Sir William Siemens—two million dollars personalty, and realty as well.

"NATURE" contains a letter stating that in the prairies of the Canadian North-West, as well as in Kansas, Indian Territory, Idaho and Washington Territory, there are no earth worms.

PROFESSOR THOMPSON, in a recent lecture, stated that the magnetic pole is now near Boothia Felix, more than 1,000 miles west of the geographical pole. In 1657 the magnetic pole was due north, it having been eastward before that. Then it began to move westward until 1816, when the maximum was reached. This is being steadily diminished, and in 1976 it will again point due north.

GENERAL WALKER says that, while it must be conceded that force of expression and faculty in the communication of thought are best to be acquired through the philosophical, dialectical, rhetorical studies and exercises which in the main compose the curriculum of older institutions of our country, he believes it to be equally true that the faculties of clear perception, of careful discrimination, and of just generalization are developed by the study of natural history, of chemistry, of physics, as they can be through no other educational means.

AT the temple of Kroto, Japan, is the great bell cast in 1633. It is eighteen feet high, nine feet in diameter, and nine and one-half inches thick. Its weight is nearly 74 tons. About 1,500 pounds of gold are said to have been incorporated in the composition. Its tone is magnificent. When struck with the open hand its sound can be heard at a distance of a hundred yards.

WHILE Preece has found that there is no difference in the conducting power of lightning rods of various forms, Holtz has concluded that solid steel bars do not form so good permanent magnets as tubes, because the core acts as an armature joining the two poles. In experimenting to test his hypothesis, he magnetized rods and tubes to saturation, and found that the magnetism of the tube showed an excess of more than 50 per cent. After waiting six months he subjected the same magnets to new tests, in order to find which retained the magnetism best. He found that the magnetism of the solid was to that of the hollow magnets, in one case as 1 : 2.5, in another as 1 : 2.9.

A FRENCH investigator, M. Delauny, finds from experiments upon himself that the character of his dreaming may be controlled by stimulating various portions of the brain by means of heat. By covering his forehead with a layer of wadding he gets sane, intelligent dreams. He also experimented on modes of lying, which favor the flow of blood to particular parts, increasing their nutrition and functional activity. He has observed that the dreams he has while lying on his back are sensorial, variegated, luxurious. Those experienced when on the right side are mobile, full of exaggeration, absurd, and refer to old matters; but those produced when on the left side are intelligent and reasonable, and relate to recent matters; in these dreams one often speaks.

A NEW method of electrically locating and following veins of metal in the earth has been applied in Massachusetts. In searching for metal veins, the inventor drives two metallic stakes into the ground at the termini of the field to be tested. The stakes are connected to an electric battery and to an alarm. If the stakes have not contacted with a metallic substance, the circuit is through earth only between the posts, and of too great resistance to allow the alarm to act. If, however, they have contacted with metallic matter, the circuit is closed and the alarm acts. After testing one point the stakes may be withdrawn and driven in at another point. It is claimed that by these means a large extent of territory may be rapidly and cheaply tested for metallic veins, and that if veins are found they may be easily traced.

ELECTRIC FISHES.—There are at least a dozen species of fishes which are alone among animals in the possession of electric organs—truly the most remarkable weapons in the entire animal armory. The application of electricity to the arts is one of the proudest achievements of nineteenth-century men; yet those fishes, there is little reason to doubt, applied their electric batteries to the art of capturing their prey long before man had come into existence. That those natural bat-

teries exhibit true electric phenomena is shown by their currents behaving in exactly the same way as those produced artificially; thus, says Gunther, "they render the needle magnetic, decompose chemical compounds, and emit the spark." To receive a shock, it is necessary in the one apparatus, as in the other, that contact should be made at two points in order to complete the circuit. The various species of electrically-armed fishes are not, as might have been expected from the common possession of so unique a weapon, by any means all closely related. They belong to three widely different groups —namely, rays, eels and sheathfishes—which would seem to indicate that electric organs have originated independently in each group. The electric eel of South American waters is the most powerful of these creatures, growing to a length of six feet, and provided with a pair of batteries containing some hundreds of minute cells copiously supplied with nerves.

SOME USES OF LICHENS.—

"The living stains, which Nature's hand alone,
Profuse of life, pours forth upon the stone;
For ever growing, where the common eye
Can but the bare and rocky bed descry,
There science loves to trace her tribes minute,
The juiceless foliage and the tasteless fruit,
There she perceives them round the surface creep,
And while they meet their due distinctions keep,
Mixed, but not blended, each its name retains,
And these are Nature's ever-during stains."—*Crabbe.*

The first plant to secure a hold on the smooth surface of a rocky cliff or mountain side is the lichen. Its fine, powdery spores are wafted by the wind and adhere to the surface of the most polished flint. On this the growing plant paints its thin crustaceous thallus firmly, and the spreading stain chemically etches its adamantine foundation, making a rough surface which catches the dust specks floating in air. Thus a small patch of soil is formed which can support a larger lichen or a moss, which in like manner accumulates more material until a plot of ground takes its place, supporting

wee[illegible], grasses, bushes, and finally the giant of the forest itself. Everywhere the lowly lichen is at work endeavoring to clothe the barren spots of the earth, and preparing in the wilds of the rocky wilderness some place where man may find a place to dwell. So promptly do these dutiful vegetative creatures attend to this work that scarcely does the white hot lava of Vesuvius cool before they begin to take possession of it. So beautiful a description of this cryptogamic conquest is given by one of Nature's truest poets (Crabbe), that we must quote him again:

> "Seeds, to our eyes invisible, will find
> On the rude rock the bed that fits their kind.
> There, in the rugged soil, they safely dwell
> Till showers and snows the subtile atoms swell
> And spread the enduring foliage; there we trace
> The freckled flower upon the flinty base.
> These all increase, till, in united years,
> The stony tower as grey with age appears
> With coats of vegetation thinly spread,
> Coat above coat, the living on the dead;
> These then dissolve to dust and make a way
> For bolder foliage, nursed by their decay;
> The long-enduring ferns in time will all
> Die and dispose their dust upon the wall,
> Where the winged seed may rest till many flower
> Shows Flora's triumph o'er the falling tower."
>
> —*Prof. Mackay.*

MR. GEORGE J. ROMANES recently delivered a lecture in London on "The Darwinian Theory of Instinct," and gave an account of the most recent investigations which he has made. Instinctive actions he defined as actions of "a consciously adaptive character prior to individual experience, performed without necessary knowledge of the relation between means employed and ends attained, and similarly performed under similar appropriate circumstances by all individuals of the same species." Instinct, however, whenever fully formed, is not invariably fixed, as generally supposed, but, on the contrary, is highly plastic under the guiding hand of intelligence.

As an experiment, after a hen had sat on dummy eggs, Mr. Romanes introduced four young ferrets to her nest. The growl of the ferrets instead of the chirp to which she had been accustomed apparently puzzled the old hen; but she clung to them, and after the manner of her kind sought to make them follow her—unsuccessfully, of course.

A TRAIN on a Western railroad several years ago met with a terrible accident miles from any station. Among the passengers was a young telegrapher. His ready mind took in the situation, and climbing the nearest pole it was an easy task to cut the wire, and using the two ends as a key send a message for help. To receive the reply was a more difficult task. Here again the young man's invention stood in good stead, and spurred him on to an exhibition of nerve that is rarely met with. Admonishing the distant operator to send slowly, he placed the cut ends of the wire upon his tongue, and by the strength of each shock to that delicate member made out the letters until the message was complete. That young man's sense of taste was destroyed, and returned only in a weakened degree after two or three years.

THE excavation of the St. Gothard Tunnel cost many lives. On coming out of the tunnel the men described the sensation as being like a sudden plunge into icy cold water. The hot, humid air affected the digestive organs very much, and produced intestinal worms, which caused the deaths of a great number of workmen. Horses were similarly affected, and died rapidly. Several eminent doctors who studied these peculiarities pronounced them as being due to the want of aeration and the poisonous gases evolved from the blasting operations. And they reported that during the working hours the men were always in a high state of fever, which was succeeded, when the work was done for the day, by cold shivers and collapse. With these experiences to guide them, the engineers of the Simplon have necessarily made the question of ventilation one of serious and anxious study.

THE United States government, in several of its light-houses, has the lanterns arranged so as to emit long and short flashes of light, which form certain letters of the telegraphic code. This is a method of distinguishing the beacon which is easily understood by a little practice. There happened to be an operator on board of a small coasting schooner which was cast on a Florida reef in such a position that escape from the ship and aid from the shore were both out of the question during the night of the wreck. Throughout the long hours of suspense he kept up communication with another operator on shore by means of a lantern, and words of hope, of sympathy and encouragement passed back and forth until day dawned and made rescue possible.

WHEN we were as yet small children, long before the time when those two grown ladies offer us the choice of Hercules, there comes up to us a youthful angel, holding in his right hand cubes like dice, and in his left, spheres like marbles. The cubes are of stainless marble, and on each is written in letters of gold—TRUTH. The spheres are veined and streaked and spotted beneath, with a dark crimson flush above, where the light falls on them, and in a certain aspect you can make out on every one of them the three letters L, I, E. The child to whom they are offered very probably clutches at both. The spheres are the most convenient things in the world; they roll with the least possible impulse just where the child would have them. The cubes will not roll at all; they have a great talent for standing still, and always keep right side up. But very soon the young philosopher finds that things which roll so easily are very apt to roll into the wrong corner, and to get out of the way when he most wants them, while he always knows where to find the others, which stay where they are left. Thus he learns—thus we learn—to drop the streaked and speckled globes of falsehood, and to hold fast the white angular blocks of truth. But then comes Timidity, and after her Good Nature, and last of all Polite Behavior, all insisting that truth must *roll*, or nobody can do anything with

it; and so the first with her coarse rasp, and the second with her broad file, and the third with her silken sleeve, do so round off and smooth and polish the snow-white cubes of truth that, when they have got a little dingy by use, it becomes hard to tell them from the strolling spheres of falsehood.—*Emerson.* Society.

J. R. GREEN.—The most striking thing in the book of J. R. Green is the first thing in it, a portrait on steel of the lamented author whose death was one of last year's greatest losses in literature. The portrait is an engraving by Stodart from a chalk drawing by Sandys, and is a remarkable portrait, distressingly remarkable. We do not remember ever to have seen the expression of physical suffering in a human countenance so powerfully depicted. The drawing was apparently made as the dying historian, dying by inches, but holding to his work with indomitable will, sat propped up in his chair or lay weakly on his bed. The loose folds of some sick man's garment hang lightly about his shoulders. The head is a noble head, with a lofty dome-like forehead, the hair scarcely advancing beyond the crown. The eyes are clear, vivid and penetrating. The cheeks are not particularly wasted. It is about the mouth that the expression of intense suffering is concentrated. The lips are open, showing the upper teeth; and no imagination merely could have sketched the deep lines that hollow the face and draw the skin back toward the jaws. A living sufferer *must* have guided the artist's hand, and the artist's hand have followed his subject with wonderful—painful fidelity. A fine type of manly intellectual beauty lies behind this death-mask; but the death-mask itself—this dying visage of one of the truest scholars and ablest writers and purest spirits known to modern England's history—is enough to haunt one's dreams.

There's beauty all around our paths, if but our watchful eyes
Can trace it mid familiar things, and through their lowly guise.
—*Mrs. Hemans.*