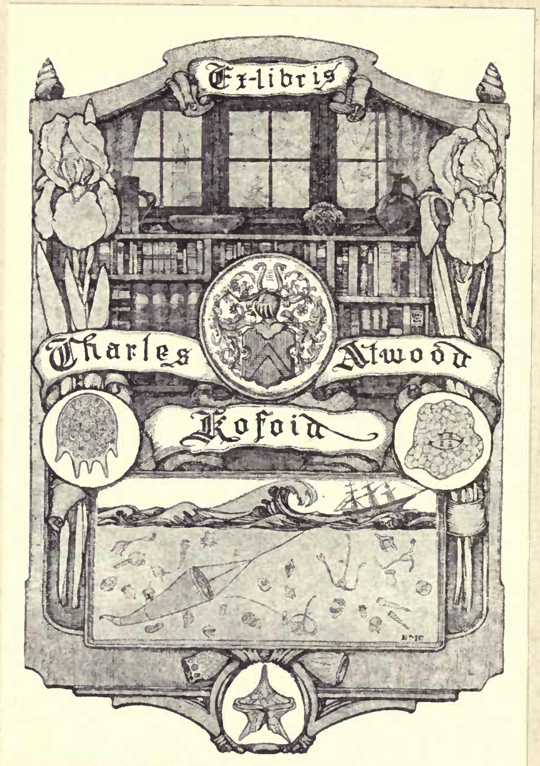
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MISCELLANEOUS PAPERS

BY

ANDREW JACKSON HOWE, M.D.

SELECTED AND ARRANGED

BY HIS WIFE,

GEORGIANA L. HOWE.

CINCINNATI:
ROBERT CLARKE & CO.
1894.

"Sleep after toyle, port after stormie seas,
Ease after warre, death after life, does greatly please."

—SPENSER'S "Faerie Queen." Book I, Canto IX.

PREFATORY NOTE.

The papers here gathered were written by Dr. Howe at intervals during the last fifteen years of his life, and as a recreation from surgical writing. Most of them were published in the Eclectic Medical Journal. I have no evidence that their author thought they would appear in a book. They were scattered about on the shelves of the library and in various magazines. I have taken pleasure in giving them a more permanent form and one in which they can be more conveniently looked over and read.

CINCINNATI, December, 1893.

"Thy greeting smile was pledge and prelude
Of generous deeds and kindly words;
In thy large heart were fair guest-chambers,
Open to sunrise and the birds."

—WHITTIER.

"Nature has no secret which she does not somewhere lay bare before the eyes of the attentive observer."

—GOETHE.

"They say knowledge is power, and so it is. But only the knowledge which you get by observation."

—KINGSLEY.

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SKETCH

OF THE

LIFE OF ANDREW JACKSON HOWE.

ANDREW JACKSON HOWE was born in Paxton, Worcester county, Massachusetts, on the 14th of April, 1825, and was the fourth of nine children. His father was Samuel H. Howe, and his mother Elizabeth Hubbard Moore. John Howe, mentioned in Savage's Biographical Dictionary as living in Watertown, and his son, one of the principal settlers of Sudbury, petitioner for the grant of Marlboro in 1657, afterward residing there, were the earliest of this branch of the Howe family in America. The grandson of John Howe of Marlboro went to Paxton in the first part of the eighteenth century, and bought a considerable tract of land, building the house upon it in 1743, where four generations of the family have lived, and which at the present time is in a good state of preservation.

This was the birthplace of Dr. Howe, and although his father removed to Leicester, three or four miles distant, when he was but a few years old, the picturesque scenes of hill, woodland and stream had already indelibly impressed his mind. He had a strong imaginative temperament, but it was not developed in a marked degree. In his writings the poetical impulse can often be discerned.

His mother's immediate ancestors lived in Worcester, and were people of standing and worth. She was a woman of remarkable energy and decision of character, and of an affectionate disposition. She naturally controlled her son's earliest education, and to her teachings and principles may be traced the influence which was one of the chief blessings of his life. He attended the district schools under several different teachers, and fitted for college at Leicester Academy. Among his teachers he placed high Mr. Josiah Clarke, then principal of the academy, as an instructor who stimulated the ambition of his pupils, and recognized qualities they possessed specially worthy of cultivation. He entered Harvard College in 1849, graduating in 1853. He met some obstacles to progress, such as small pecuniary means often create, but his happy temperament, combined with great determination, found in these difficulties incentives to new resolution.

He was a student of medicine before he went to college at Cambridge, having passed a few months in the office of Dr. Calvin Newton, Worcester, and attended one course of lectures in the medical college of that city. Subsequent to his graduation at Harvard he attended the "Jefferson Medical College," in Philadelphia, during the winter of 1853, and the next winter the "New York Medical College," Thirteenth street, and the "New York College of Physicians and Surgeons," frequenting the hospitals of the city for clinical instruction. He took his degree in medicine at the Worcester Medical Institution.

Standing, as it were, on the threshold of active life, he was an agreeable companion, refined in taste and sentiment, genuine, straightforward and affectionate in nature. Dr. Walter Burnham, Professor of Surgery in the Worcester School, at this time asked him to take charge of his practice in Lowell during his six months' absence as a member of the Massachusetts Senate. He was also appointed professor of anatomy in the school almost at once after his graduation. This favorable introduction to his professional life led to his opening an office for himself in Worcester, in the vicinity of his early home, and among congenial friends and relatives, with whom he was a great favorite.

The following autumn he was invited to lecture upon Anatomy in the Cincinnati College of Medicine, but returned at the close of the term with the expectation of remaining at Worcester. The next year, however, he was again invited to lecture in Cincinnati, and with inducements that led him to the decision to make it his permanent home. He did not take this step, so full of importance to him, without misgivings. He entered upon the duties of his profession in this new field with vigor and enthusiasm, aware of the effort required to be a successful surgeon. He was as diligent as when fully established in practice, occupying his time partly with preparing pathological specimens, making anatomical drawings, and obtaining an insight into mechanical arts, adding withal industrious reading and steady observation. Soon after coming to Cincinnati, Dr. Howe married Georgiana Lakin, eldest daughter of Mr. George S. Lakin of Paxton.

He lectured upon Anatomy in the College of Medicine, and afterward in the Eclectic Medical Institute, where in the course of a few years he was transferred to the chair of Surgery, which he continued to occupy during his life. He spared no pains to become a master in the subject he would teach, and possessed the power to strongly impress his thoughts upon others. He was active in the Natural History Society, and found there opportunity to study the anatomy of animals, a subject not unfamiliar to him from youth. The department of Comparative Anatomy steadily increased by his zeal and labor for some years. Through correspondence with curators of this branch in other countries he added to the collection a few specimens rare in America, and he contributed many essays to the meetings of the society. Generally his time was devoted directly to his profession. He felt the high degree of responsibility involved in its service, and any thing which engaged his attention collaterally was eventually made to subserve his chief aim. He advised students to select for their diversion what might prove useful as well as pleasant to them. His own recreation from the absorbing duties of his profession was found chiefly in natural science. Every thing living possessed to him an attraction. With his exuberant spirits in early life, there were few fields within miles of his home that had not contributed to his pleasure in sport, and being a keen observer, his education as a student of nature commenced unconsciously even then.

The inclination of his medical and surgical views may be judged by the following extracts from his editorials, taken from among many similar ones, and written after years of practice: "Having been an advocate of experimental knowledge, and often asserted that ideas empirically developed were the most valuable, I am pleased to see a confirmation of my views by persons of eminence. Dr. Sawyer, in his presidential address before the Birmingham Branch of the British Medical Association, made the following remarks: 'There is another condition of our work in the treatment of disease, about which there has been much misconception, but about which we can scarcely miss agreement, if we weigh the case carefully. It is this: whether we like it or not we must be mainly empirics in our practice. We must not be above being empirics. I do not mean empiricism in any bad sense of the word. I do not mean that there is any real opposition between true empiricism and scientific practice. The great bulk of our therapeutic knowledge is as yet empirical, and as empirics, though as rational and scientific ones, we must administer it. By this empiricism I mean, and mean only, a knowledge which grows from and with experience, and which is in this sense empiric, however scientifically it be applied. In much of our therapeutic work it is experience which prompts our action whilst experience alone can test our results. Much of what we do, we can not explain in the scientific meaning of the word explanation, so we lean upon experience, and trust with an empiric faith much that we know to be true, though we can not understand it.' . . . In empirical trials let us be reasonably bold; not be rash, yet not be cowardly. The distinguishing characteristic of a surgeon is courage,—willingness to assume a risk."

"Rational medicine alone is to prevail. In scientific matters school has no place. There will always be shades of belief in undeveloped science, but they necessarily fade under the blaze of demonstrated truth."

Dr. Howe wrote for publication early in his professional life. His first book was "Fractures and Dislocations." "The Art and Science of Surgery" came out in the sixties, "A Manual of Eye and Ear Surgery" a little later, and "Operative Gynæcology" in 1890. He designed a large proportion of the cuts in his books and papers. He wrote monthly a surgical article and some editorial miscellany for the Eclectic Medical Journal, and occasionally essays semi-scientific or literary. All this time he was an active practitioner, and for many years had had an extensive surgical practice. It was his nature to be busy—to do his work if possible before it was needed; this was his method of seeking relief rather than by putting work off. Much of his professional life can be read in his surgical writings and editorial sketches; and in the progress of the years they became the storehouse of his reports of operative surgery, of his registered observations and notes, and deductions carefully compared and reduced to laws of health and disease—the wisdom of these years of study and experience. His mind dwelt chiefly, in the maturity of his labors, on the improved methods of treating surgical diseases, and the mysteries of living things. He gave himself but little leisure, and his capacity for work was unusual. His physical constitution was of more than ordinary power of endurance. He had a generous spirit united with great strength of purpose. Nothing adverse disheartened him; no difficulties affrighted him.

In a sketch of Dr. Howe, published in the twentieth volume of the Transactions of the National Medical Association, Dr. Wilder, the secretary, says: "He also became a member of the various Eclectic organizations—the Ohio State and the National Eclectic Medical Associations, and later of the Eclectic Medical Society of Cincinnati. He had been a member of the former National Association in its later years of existence. With but one or two exceptions, he always attended meetings, taking a seat near the platform, seldom exchanging words with any one, but watchful of the proceedings. He took part eagerly in the discussions, especially when they related to surgical or gynæcological questions, but for routine medical subjects, therapeutics, or technical points involving principles of law or parliamentary usage, he had less aptitude. He was never ambitious for official honors. In 1882, however, despite his objections and protests, he was elected president of the National Association at its annual meeting in New Haven. He brought to the office his habitual diligence and energy. He was never remiss in a duty or in any way inefficient."

And in a sketch published in 1890 the same writer says: "Whether Professor Howe shall be called a leader of the Eclectic School of Medicine it is hardly in our province to discuss. . . . One, however, who has been so long a prominent teacher in the principal Eclectic College, who has been always in attendance at our meetings and participated in the conducting of them, who is regarded by a multitude of Eclectic practitioners with an admiration seldom exceeded, who is the most constant of the contributors to our literature, and whose every utterance is carefully pondered by a multitude of the most thoughtful and earnest Eclectics, has his rank and position beyond our power to establish it for him."

Constant in his attendance at medical meetings, he was seldom the presiding officer. He believed that he could be more useful to the societies in situations less restricted by rules. It is not too much to say that there was probably no member of these bodies whose voice was listened to with more interest or whose opinions were more valued.

The economy of time which Dr. Howe practiced afforded him opportunity for the enjoyment of social life and the pleasure of extending hospitality to friends, professional brethren and strangers. The hour before he resumed his work in the evenings he was generally at liberty to pass with his friends. Many of them will recall his open-hearted cheeriness of manner, and oftentimes the charm of his conversation, sparkling with wit and anecdote. He always had the same unaffected simplicity of character. His love and notice of children was marked, and it was a significant tribute of the regard which the children in turn bore to him that those of the neighborhood who but saw him in his daily walks to and from his residence, wept when he was gone.

Dr. Howe traveled extensively in the services of his profession, and often long distances, having answered surgical calls in twenty different states of the Union, and in some of these many times. Undoubtedly such frequent journeyings caused him to be disinclined to travel for pleasure. One visit to Europe and one to the Pacific Coast, with an occasional brief sojourn in his native state, almost comprise his vacations. The weeks passed in New England were a particular enjoyment to him, and driving over roads and hills with which he was familiar, he took delight in pointing out the trees he had planted, and the places made doubly charming to him through youthful reminiscences. He always seemed to live near Nature, and to hear her "singing a more wonderful song" and "telling a more wonderful tale." In his last years he had purchased the estate which was his birthplace, intending to present it to his native town, in the summer of 1892. His wishes in this respect were faithfully fulfilled.

He was a member of many societies for the promotion of science and art, and gave liberally of his means for the public welfare. But his special pleasure in benefactions was where the favors bestowed were known only to the recipient and himself. His kind words and genial smile involuntarily shed happiness about him. He extended the right hand of fellowship to many unknown and struggling young men. When with any real need of encouragement they sought him, they did not go away with a chill upon their mind. He gave his professional services freely and generously, rather as if it were a pleasure to give them.

From no individual in society are advice, sympathy and encouragement more sought by people of all classes than from the wise physician; and the influence thus exerted, who shall measure? Students who heard Dr. Howe lecture, felt his magnetism, his simplicity of manner, and the plainness of his instructions; and the admiration thus commenced was invariably continued. Often, in later years, came back to him expressions of gratitude from those he had helped, when assistance had meant giving direction to their hopes and fortunes for life. And when he had passed away, the voice of sorrow was unanimous from those he had taught, wherever they were situated over the land.

Dr. Howe was interested in religious movements, and frequently assisted, according to his means, different organizations. The church in which he felt the greater interest was the Protestant Episcopal. Honesty and honor were the guiding principles of his great heart, and the rule of his life was the golden one. He aimed to understand what was justice and to do it. The longevity of his ancestors, his hitherto excellent health, and his buoyant temperament, caused him to think old age might be meted out to him. The last months of his life he was less vigorous than formerly, but his hands and mind were full of active interest in the science that ever engaged his attention. He always worked with a will and a purpose. As a friend said, perhaps his life work was as fully rounded as though he had lived to old age.

He died January 16, 1892.

G. L. H.

The funeral of Dr. Howe was the 19th of January. A very large assemblage was present at St. Paul's Protestant Episcopal Church, to assist at the services.

The procession was met at the church porch by the Rev. Mr. Baker, rector of St. Paul's Church, Dr. Baker, the assistant rector, and vested members of the choir. Leading the way to the chancel, Rev. Mr. Baker recited the opening sentences of the burial service in the prayer-book, commencing, "I am the Resurrection and the Life, saith the Lord."

The anthem, "Lord, let me know my end and the number of my days," was chanted with deep impressiveness by a quartet of men's voices. Dr. Baker read the lesson, "Now is Christ risen from the dead," and Rev. Mr. Baker recited the concluding prayers, the responses being rendered by the congregation.

A part of the beautiful choral service was hymn 391, "Rock of ages, cleft for me," and Hymn 335, "Abide with me: fast falls the eventide." In the music of the organ, as the congregation passed from the church, among other airs, was that of "Home, Sweet Home."

The pall-bearers were the Faculty of the Medical College and representatives of the societies of which Dr. Howe was a member.

The interment was at Paxton, Massachusetts, in March.

ANTHROPOIDEA.

(Read before the Cincinnati Society of Natural History, Oct., 1877.)

The visitor to our Zoological Gardens can not avoid observing that the Monkey-House attracts more spectators than any other department in the exhibition. The dense throng in prolonged attendance indicates the interest men, women and children take in creatures which in so many ways resemble the human family. Great delight is expressed at the solemn countenances, comic grimaces, and roguish tricks displayed by members of the motley Simian tribe. A listener will often hear incontinent remarks like the following: "That old baboon looks as grave as a judge; and that lively little monkey loves to poke fun at him." The multitude seems to be fascinated with the human similitude apparent in each apish feature and action. Every look and attitude provokes a smile, and is suggestive of an attempt to ridicule human peculiarities.

No one in the crowd stops to make scientific comparisons, or attempts to analyze the affinities and differences in the great range of resemblances and diversities represented, but everybody appears satisfied to observe the humor in the travesties performed. It would naturally be supposed that persons of an inquisitive mind should endeavor to select the Simian representative that most closely resembled man, but no effort of the kind is manifested. And when we consider that no individual in the whole Simian family approaches man in many features, and that a few human characteristics are to be observed in every species of the monkey tribe, the reason for not trying to find the particular ape from which it has been alleged that man sprung, becomes apparent. It would seem as if some one of the great apes should embody and personate the highest attributes of the anthropoids, yet in many respects the smaller monkeys are the nearest to man in resemblances. The twinkling eyes and mobile features of the little Sapajou strangely remind us of a creature capable of caricaturing our very selves. We wonder how such creatures can be so near human, yet so far fall short of the mark!

The Darwinian assumption in regard to the Simian origin of the human race has taken such a deep hold upon the popular mind that many people believe a monkey is nearer a man than a careful analysis of the apish organization proves it to be. In the first place, it is a common mistake to suppose that an ape is *quadrumanous*, or four handed. The creature is generally arboreal in its habits, and, therefore, needs grasping feet to cling to the branches of trees. In some species of monkeys the tail is developed into a prehensile organ. Man may be properly denominated "bimanous," yet not in contrast with "quadrumanous" animals, for none such exist. The posterior limbs of all the Simian family terminate in *feet.* The toes and hallux may possess the grasping functions of a hand, yet *anatomically* considered, each pelvic extremity ends in a foot. It would be as erroneous to say that an opossum was four-handed as to aver that a monkey is quadrumanous. The great toe of an ape diverges from the lesser toes, as the hallux does in many of the marsupial animals; and in several instances there is a defect in the nail of the divergent toe, as in the opossum, but the aberrant digit is moved by muscles that belong to a leg and a foot.

What a monkey gains by having hand-like feet is lost to it when upon the ground. If an ape were compelled to live where no trees exist, its lack of good feet would be seriously felt. The grasping feet of an ape do not contribute a particle toward elevating the creature to the status of man; but they actually hinder that physical uprightness which is characteristic of the human race.

When we examine the anterior or pectoral extremities of the Simian family, we do not meet with so high an order of *manus* as is credited by the popular mind. Many species of monkeys and apes possess a thumb and four fingers on each anterior extremity, yet none of the race can boast of a thumb which is opposable to the ends of each of the adjacent fingers—the thumb is too short and the fingers are too long for such a maneuver. In fact, no monkey nor ape possesses a perfect thumb. The dressed up Sapajou can not button its clothing nor tie its cravat. Its thumb is ridiculously below the "second hand" of Sir Charles Bell.

It is a notable fact that monkeys with extended caudal appendages are apt to lose the pollex altogether. The *cebidæ*, or American monkeys, are, with one exception, long tailed, and all are thumbless or have stunted thumbs, except the short tailed variety alone. The Ateles or Spider-monkey, is remarkable for the prehensile character of its tail, the underside of the extremity being hairless to enhance the tactile sense; and its anterior extremities are destitute of thumbs. It seems as if a law of compensation operated upon the organization of these creatures, a prehensile tail being obtained at the expense of thumbs.

The brain constitutes such a distinctive feature of man's superiority over the inferior animals, that though other parts of lower organizations were equal to corresponding parts in man, and even excelled them, man as a psychological being would still stand unapproached. Some of the Gibbons and most of the *cebidæ* possess an arrangement of the encephalic mass which quite closely resembles the general contour of the human brain. If the "facial angle" of Camper signified what has been claimed for it as a measure of mental capacity, the tiny Marmoset of South America would rank higher as an intellectual being than man, for the angle is greater in its face and head, though its brain contains little gray matter and no convolutions. The Siamang has retracted jaws, incisor teeth which meet each other vertically, a prominent forehead that gives the face a human appearance, yet its cerebrum does not overlap the cerebellum as completely as does that of the Marmoset. The Ateles has a projecting muzzle, therefore its face is not so human in appearance as is that of the Siamang, but its forehead is more projecting, and the occipital lobes which possess cornua and lesser hippocampi, quite cover and conceal the cerebellum, as do corresponding parts in the larger apes and man. The spider-monkey also possesses folds of brain substance interposed between the parietal and occipital lobes, which in man are called "bridging convolutions." In this feature the Ateles surpasses the largest apes. But while so many cerebral characters of a high anthropoid nature are possessed by the spider-monkey, it must be borne in mind that the brain of the animal will not weigh more than six or eight ounces; and that the creature otherwise is less anthropoidal than the great apes.

Of the Simian family most resembling man in general features, size being a leading consideration, are the Gibbons, the Orang, the Chimpanzee, and the Gorilla. In cerebral features the Gibbons stand the highest. However, when weight of brain is considered alone, the Chimpanzee takes the lead; and the Gorilla falls below the Orang. But, mere mass, or preponderance of weight, does not alone constitute intellectual elevation,—there must be a proportionate amount of gray matter in convolutions to insure intellectual strength and activity. The elephant and the whale possess more brain-substance than man, yet not so much gray matter. It is said that a canary bird has comparatively more brain than man, but the comparison is not important in this connection.

Although the Chimpanzee possesses the heaviest brain among the great apes, its cerebral mass does not approach in weight the smallest human brain. A full grown Gorilla will weigh over two hundred pounds, and the average Esquimeau will not exceed half that weight, yet the brain of the latter will weigh twice as much as that of the former. The brain of the Chimpanzee will not weigh over twenty ounces; the smallest human brain reaches over forty ounces; and that of Cuvier weighed over sixty ounces. In comparing the cerebral matter of the highest apes it is found that in the development of the anterior lobes, and in the preponderance of outside, cortical, or gray substance, which is chiefly in convolutions, the Orang is superior to the Chimpanzee and the Gorilla. Psychologically considered the Orang is the highest ape; and those people who claim that man had a

Simian origin would do well to select the Orang as the progenitor of the human race.

M. Gratiolet, who has given much attention to the anatomical structure and mental character of apes, regards the brain of the Gorilla as the lowest of all the latisternal apes. In the disposition of the brain of the Gorilla, he says, "there is the culmination of that type of cerebral structure exhibited by the relatively brutal and degraded Baboons."

Professor Rolleston, after declaring the Orang as "king of the Simiadæ," expresses himself as follows: "In the world of science as in that of politics, France and England have occasionally differed as to their choice between rival candidates for royalty. If either hereditary claims or personal merits affect at all the rights of succession, beyond a question the Gorilla is but a pretender, and one or the other of the two candidates the true prince. There is a graceful as well as an ungraceful way of withdrawing from a false position, and the British public will adopt the graceful course by accepting forthwith and henceforth the French candidate, and by indorsing M. Gratiolet's proposal for speaking of the Gorilla as but a Baboon, of the Chimpanzee as a Macaque, and of the Orang as a Gibbon." A similar view is held by St. George Mivart, who in his late and interesting work entitled "*Man and Apes*," makes a very close analysis of the man-like features to be observed in the various varieties of the Simian family. He comes out strongly in favor of placing the Orang on the Simian throne.

Mr. Huxley, in his "*Evidence as to Man's Place in Nature*," labors to prove that man may have sprung from the Gorilla on the ground that this great ape differs less from the lower grade of mankind than it does from several species of the Simian family,—for instance, from Lemurs and Marmosets,—creatures which are nearer squirrels than monkeys. While this is apparently a strong argument, it is really an exceedingly weak one, as a comparison of members of another order of animals will show. The Ostrich is a bird, but it can not rise upon its wings and fly; and its wings are tipped with claws or nails, showing the creature is not fully removed from quadrupedal characteristics. The Kangaroo is at the head of a class of marsupial animals which reach down to monotremes, a sub-order, to the ornithorhynchus, a creature which is half bird.

The Kangaroo hops about on two legs like a bird; its trunk is poised on its femurs like that of a bird; its head is small like that of an Ostrich; its fore-paws are employed to help the animal along as the Struthio family use their defective wings, consequently the Ostrich must have sprung from the largest and most prominent of the marsupial family, for it is nearer the Kangaroo than the latter is to the lowest of the marsupials! or, to modify the application of the argument to suit the proposition, the Kangaroo is more widely separated from the platypus than it is from the Struthio family, consequently the Ostrich may have sprung from it.

It is not a little strange that no representative of the Simian tribe has attempted to talk, or to convey ideas by words. Some of the monkey family possess a vocal apparatus which enables them to howl fearfully, yet no visitor to a Monkey-House ever hears sounds that express much meaning. Dogs can bark, howl, whine, and otherwise by vocal sounds make known their feelings. Parrots speak quite plainly, and are thus more anthropoidal than any of the monkey family.

The male Orang has a well developed beard, which adds considerably to its man-like appearance. Several of the *Simiadæ* and of the *cebidæ* exhibit quite creditable whiskers. The Sakis sports a luxuriant beard; and the female takes pride in a handsome head of long hair which she parts in the middle.

There exists a prevailing notion that length of tail has much to do with grade of development in the Simian race, and that man must have sprung from the ape that possessed the shortest caudal appendage. Against this popular idea it may be stated that several of the short-tailed Baboons are exceedingly stupid and brutal, while the long-tailed monkeys are mostly active, intelligent and tractable. Kangaroos and other long-tailed marsupials are notably agile, cunning and quick of apprehension. On the other hand the Australian bear, the Koala, the Wombat and other short-tailed marsupials are remarkably dull and uninteresting. The number of caudal vertebræ in the Orang, the Chimpanzee, and the Gorilla is the same as in man, while the dull Barbary ape—the Inuus—has one less than the human family.

Those persons who presume there is little difference between the highest order of apes and the lowest grades of man, should consider that if a young Orang, Chimpanzee or Gorilla be raised by man and subjected to elevating influences, it would remain an ape all its life, yet the infant of the most degraded of the human family may be so managed and educated that it shall at least equal the average man so far as intelligence is concerned. A baby snatched from its New Zealand mother and raised under civilized influences, would at length exhibit an intellectual endowment characteristic of the human race, though it might retain the short legs and physical peculiarities of its parents. It might not rival the highest of mankind in mental scope, but it would be infinitely superior to the best trained ape.

Sometimes nature departs from the even tenor of her ways and produces a monster, or an individual strikingly at variance with original or ancestral stock; yet the *saltus* or leap is nearly always downward, an inferior organization being the result. It is a lapse and not a leap. If it could be shown that the *saltus* is ever forward or upward—a step having been taken from a lower to a higher grade—there might be some foundation for the supposition that the frisky little Sapajou took a jump forward and became an *homunculus*, if there could be such a being; and this strange creature at length raised itself to the status of savage man!

There is a tendency in the organic world to improve upon original stock by an inherent principle of variation, but the conditions must all be favorable or a corresponding lapse will occur. Changes for the worst may be rapid; but if they are for the better the movement is so gradual that cycles of time must have been consumed in attaining varieties, to say nothing of species. To reach a difference that could be regarded as sufficient to establish an advanced species, would demand a *saltus* or an extraordinary leap upward; but abrupt transitions have not been observed to occur in the organic world, though cataclysms of the physical world have stranded elephants in the ices of Siberia. From any thing that has thus far been observed to occur in the animal kingdom, there is nothing to warrant the assumption that the human family—

the *Hominidæ*—ever sprang from the *Simiadæ* or the *Cebidæ*. The gap is too wide to be cleared by any *saltus* ever before taken in the history of evolution. If man did spring from an ape the evidence leading to that conclusion is defective. The verdict in the case should be, "not proven."

Any one who has made many dissections of the human body must have been struck with the number of variations encountered in the organism; and if he has closely observed and considered every prominent variation he must have been surprised to find that each aberration, be it great or small, could be compared to a normal state existing in a lower grade of animal.

There is no part of the human body in which anatomical deviations so frequently exist as in the *brachial* region. In several instances I have met with a muscular band, spanning the lower part of the axilla, and uniting the latissimus dorsi and pectoralis major muscles; and in dissecting the felidæ I find this to be the normal state. Every work on surgical anatomy calls attention to this and other variations of muscles and deviations of vessels in order that the operator may not be disconcerted by meeting an abnormal arrangement of parts.

In one instance I found the "biceps" had a third head which covered and concealed the brachial artery and median nerve in the lower third of the arm—a variation which agrees with a normal state in *felidæ*.

It is well known to every comparative anatomist that most *marsupialia*, all *felidæ* and the lower *cebidæ*, are related by one feature in the osseous system, which is, that the internal condyloid ridge of the humerus is perforated for the passage of the brachial artery and median nerve. What may be the object of this arrangement I will not pretend to explain; nor do I believe an avowed evolutionist can give a satisfactory explanation of the uses of the arrangement. It has been alleged that protection to the nerve and vessel was secured by the peculiar disposition of parts; but I can not see why the dog and the rabbit should not need the favor as well as the cat and the lemur.

In the humerus of man there is occasionally met an abnormal state which approaches a normal condition in the lower animals that possess a perforation of the humeral condyles. At a point two inches above the internal condyle, a spur of bone springs from the shaft of the humerus just inside the condyloid ridge, and projects like a hook with its point directed downward. This spur of bone, which may be called the supra-condylar process, is a third of an inch in length, and its point is connected with the internal condyle by a ligament that leaves a foramen beneath it, or between it and the bone. The ligament corresponds to what is osseous in the adult cat. In the young of the *felidæ* the foramen is bounded in part by a segment of ligamentous tissue.

When the supra-condylar process exists in man the brachial artery and median nerve pass behind it, and through the foramen, thus imitating what is normal in marsupial, feline, and certain of the lower *Simiadæ* and *cebidæ*. Normally the Gibbons, the Orang, the Chimpanzee, the Gorilla, and the larger *cebidæ* do not possess a supra-condylar foramen, but exceptions occasionally exist in each of these, yet whether oftener than in man's organization remains to be discovered by extended observations. It would be a point in favor of the evolution theory if it could be shown that the supra-condylar foramen appeared oftener in the prehistoric skeleton of man than it does at present; and if it showed itself more frequently in the great apes than it does in the savage or civilized man. But knowledge is confessedly so limited on this subject at present that the results of future comparisons can not be predicted.

LATIN

AS A COMPULSORY QUALIFICATION IN THE MEDICAL STUDENT'S PREPARATORY EDUCATION.

At present English rule and custom require some knowledge of Latin as a preliminary qualification to registry as a medical student; and a half century or more ago, a similar prerequisite was demanded to enter American medical colleges.

In 1892 the general Medical Counsel of the United Kingdom of Great Britain will require for registration as a medical student the following *compulsory* subjects: English grammar and composition; Latin, to the extent of grammar and the reading of easy lessons; Mathematics, comprising arithmetic and the simple equations of algebra; Geometry, with easy deductions. *Optional* studies embrace one or more modern languages, logic and Greek. Graduates in Arts are exempt from preliminary examinations. Without a University training a candidate for registry must be acquainted with elementary physics, chemistry and biology.

In France the preliminary examinations embrace a somewhat advanced knowledge of Latin, and a thorough understanding of physics, chemistry, mathematics, and zoology. In Germany a considerable amount of Latin is required, with capacity not only to translate, but to compose sentence after sentence, and to read easy lessons in Greek. One modern language besides German must be spoken; and there must have been a thorough training in mathematics, physics and the natural sciences. In Russia a sound education is required, and a familiarity with Latin and Greek prose and verse. At least two modern languages are compulsory—French and German preferred. In Italy a young man desiring to commence the study of medicine must be thoroughly prepared in mathematics and physics; and pass a rigid examination in Latin and Greek. The requirements are equivalent to graduation in the Arts. In Switzerland a knowledge of several Latin authors is required—Livy, Cicero, Virgil, Plautus and Horace. Besides, in mathematics, chemistry and physics, the requisition is about on a par with that of a university graduate. In Spain and Portugal a thorough education is required, including advanced knowledge of Latin and Greek. In most European countries a medical student is examined in drawing, much weight being attached to the accomplishment.

From the citations made it will be seen that a classical training is required in all European countries for students who contemplate studying medicine; and that the natural sciences constitute prerequisites to registration. Such have been the requirements for centuries, and no laxity in learning is prospective. A greater and greater degree of erudition is demanded at every decade. Only in America has it been permitted that students from farms, trades and workshops enter the portals of medical colleges without a preliminary examination—without a question being asked as to character or clerical acquisitions. The rapid increase of population in the country created a pressing demand for more and more medical men. Pretenders in medicine from foreign lands settled in our cities and large towns without let or hindrance; and to cover their own educational defects they compared the meagerness of an American training with that demanded in the countries they emigrated from. In a majority of instances it was found that such sticklers for great erudition had never studied medicine at all, but were the sorriest of adventurers in medical practice.

To repeat—in America the call for physicians became so pressing, that school teachers and graduates of high schools were admitted to seats in medical colleges, till half the graduates had not a smattering of Latin and Greek; and it has been found that the non-classical among graduates in medicine have been as successful practitioners as bachelors in art and science.

The innovation was fought against by the wealthy and aristocratic, but it became plain that the scepter of authority had departed from the sway of dogmatic universities. Rivalry in medical colleges led to a cry for numbers, and not for well qualified matriculants. Thus matters drifted for a quarter of a century or more, when the cry arose that doctors were becoming too plentiful—that some kind of Malthusian scheme must be invented to check overproduction. Already the edict has gone forth that the period of medical study must be prolonged. The time and cost of a medical education must be increased as a restraint upon undue multiplication. The curriculum of medical study has been extended from two to four years; and a preliminary examination is demanded—there is a call for a teacher's certificate, or a knowledge of English grammar and composition, with some proficiency in mathematics and elementary physics. In other words a barrier is placed at the portals of medical colleges which requires some degree of learning to pass. And if this does not prove a sufficient restraint upon propagation, a classical qualification will be added, especially as the customs of Europe call for it.

If the medical course cover four years, I would reduce it to three, and require a preliminary year to be devoted to classics and natural sciences. It would amount to the same in the end, so far as cost and time are concerned, yet would be a wiser division of study. A man with a year's training in Latin will learn much faster than the student who has to turn to the medical lexicon at every step taken.

At the International Medical Congress, which recently convened at Berlin, were gathered representatives from twenty-five different nations; consequently, in the reading of papers and discussion of topics, there must have been a Babel of tongues. Few could understand what may have been said. In contrast with this confusion of speech is a council of Catholic dignitaries convened at Rome to discuss some measure of the Church. Though they come from the four quarters of the earth, and officiate in the language of the countries they represent, they are all educated in Latin, and transact business in a common tongue. I mention the circumstance to illustrate the need of a "dead language" as a medium of communication for delegates constituting international congresses, whether to discuss religion, medicine, law or commerce. The international importance of the matter may be overestimated, yet it is worthy of notice, especially as English is not likely to be the ruling tongue for a thousand years or more.

In a consideration of the subject, it must be borne in mind that the language of science is largely classical. Latin and Greek are derivatively utilized in almost every technical expression. Medical literature is burdened with technicals of classic origin. The nomenclature of every branch of science is classical. Medicine was born in Latin—its earliest words were lisped by Romans, imbibing Arabic and Greek enough to make it interesting. Before English or any other modern language was written or spoken all scientific matter was couched in the Latin tongue. Anglo Saxon was uttered in monosyllabic words in mediæval time, but not written in scholarly forms. Our scientific terms are derivatively Latin. An objection to modern methods is that they have been slavishly classical. When Dr. Wood described the great fissure near the base of the brain it was not called after the patronymic of the discoverer, but was denominated the fissure of *Sylvius*, the Latin for wood—a common and not a proper noun. So it was with the Brunonian theory, which originated with Brown—Bruno being the Latin translation of brown, a color! Nothing could be more absurd. *Glandula pituitosa* is the name given to what is ordinarily denominated the pituitary body, yet the pea-shaped mass is not phlegmy, nor is it a gland. Other namings in anatomy are as ridiculous. The haunch bone is easier spoken and written than *os innominatum*. No wonder the non-classical student of medicine asks why such dismal nomenclatures are not discarded, or supplanted by good English expressions—but he does not understand the difficulty of changing even the spelling of a word. We are irrevocably chained to the past. A translation into English is not always forcible. Let an example be presented—*iter a tertio ad quartum ventriculum*—a canal in the brain becomes "a way from the third to the fourth ventricle." Again, *levator labii superioris alæque nasi* becomes a "lifter of the upper lip and a wing of the nose." *Ductus communis choledochus* becomes common bile duct, which is as good as the scientific form. Yet a translation is sometimes flat or spiritless—take *corpus luteum* for instance. Its classical meaning is simply "yellow body," but there are so many yellow bodies in the world we need something more distinctive. I cite these examples to show how useful becomes a smattering of Latin to the student of anatomy. Without a classical training the novice in medicine is a slave to his dictionary. He wastes so much time in consulting lexicons that he would do as well to begin his studies anew, giving a year to Latin before entering upon a medical career.

At a recent meeting of the British Medical Association the president, Dr. Francis Wade, delivered an address on the "Prætechnical stages of a Medical Education," making some timely remarks on the amount of Latin a student of medicine should possess before registering as such. He said, "We need not trouble ourselves about the fortunate few who have the taste, the time and the money to pursue classical studies; and are able to pay their way in foreign seats of learning, including schools of science and unrivaled hospital advantages—they can and will take care of themselves—they are outside our solicitude; but we are to devise ways for the mentally capable, though pecuniarily restricted. I hold that a protracted study of the classics, such as is now demanded by the General Medical Council, is not within the reach of many otherwise qualified to enter upon the study of medicine. The problem now is to forward a practicable plan by which a less expensive career can be honorably passed in the attainment of a medical education. If a classical course be not necessary for the successful study and practice of our profession, and at the same time not lower the standard of sound scholarship, it is our duty to adopt measures looking to that end. In an elementary course must be embraced a knowledge of mechanics—of physics, mathematics, chemistry, botany, biology, and the elements of a sound, thorough education in general. There should be no lowering of the time-honored standard in educational matters; but possibly more science and less classics—more practical knowledge at the expense of that which is regarded more or less as ornamental. An argument in favor of less Latin is in the fact that the recent Pharmacopœia gives both the Latin and the English names of drugs. All directions to the compounder of medicines are to be written in English. With such changes there is less need of classical qualifications as a prerequisite to a medical career. Besides, it is a growing custom with those who have enjoyed a liberal education to employ less and less Latin in their prescriptions—to indulge less and less in the pedantry of classical exhibitions. The half-educated are most likely to make a display of slatternly Latin."

Mr. Gladstone once gave the following testimony before an educational committee: "In my opinion a classical education is the very best for those who can afford the time and the money for the acquisition of the luxury, and whose tastes lead to the accomplishment, but terrible errors have been committed in attempting to force Latin and Greek down the throats of every body of a certain rank, quite irrespective of capacity and conditions. The main purpose of education is to make the human mind supple, strong, and effective, whatever be the avocation of life entered upon, or in whatever career an individual may be called upon to act, whether of choice or accident. An education is something to help the intellectual citizen to perform his part in life to better advantage than could be done without it."

It is my opinion that Latin should be an *optional* and not a *compulsory* study in a medical education. The success of a physician depends more upon a certain tact than upon erudition. A knowledge of human nature—a ready understanding of its weak points—does more for a physician than a familiarity with the conjugation of a Latin verb. However, I would not be misunderstood in this matter. If two young men of equal ability start off together in the study of medicine, the one with a non-classical training and the other with a university degree, the chances are that the latter will outstrip the former in the professional race, especially in large towns and cities where culture is appreciated. The unlettered doctor is known as such, and intellectual brilliance will not hide the fact. He is something less than what he ought to be or might have been. He may have genius, but lacks the ability to display it to the best advantage. But, learning without talent is not as valuable as talent without education. A combination of the two is what makes the strongest man.

Professor Huxley, in a recent letter to the *London Times*, has expressed himself rather severely on the perfunctory Latin course, saying: "Medical students, like other cultured people, should have a sound literary training, and that they may attain a good degree of learning, especially in science, they should be through with elementary studies at the age of fifteen. That they may correctly estimate the worth of scientific pursuits, they must cease to worship the Latin fetish—they must put a just value upon practical talents, and not hold the classics in superstitious reverence. Fortunate is the man who possesses a jewel—a diamond—but not unfortunate is he who does not have the bauble."

President Eliot, of Harvard University, has thrown the weight of his great influence against a prolonged classical course, reaching as it has in times past through the four years curriculum. He would demand as much Latin and Greek for entrance, but would reduce the college career to three years, as in English universities, and he would have undergraduates give more attention to science and modern languages. This is not retrogressive nor revolutionary, but a concession to the demands of the age. At present the utilitarian idea is predominant—the world wants practical mechanics, engineers, architects, and inventors. A practical electrician commands a higher salary to-day than the professor of Latin and Greek in a renowned university. The demand of the times is for successful managers of great enterprises, and not for scholastic pundits who can discuss profoundly the Metamorphoses of Ovid, declaring why, or why not, *in* should be placed before *medio tutissimus ibis*. A classical decision in the case would be of little importance to the projector of a transcontinental railway, or a line of swift steamers to cross and recross the Pacific. People are not satisfied with old rates of speed—they want more efficient locomotives and faster running steamships, and he is the lauded hero who, through inventive talents, has lessened the time between two places. The editor who knows "a little Latin and less Greek" vigorously applies the lash to the fast-going world, and stimulates greed for fame and fortune. The preacher is superannuated unless he be sensational, the lawyer without a conscience is in demand, and a dudish doctor is sought by the senseless multitude. *Sic transit gloria mundi.*

But above and outside of this hustle and bustle there is, and ever will be, a place for modest merit. The educated and refined will constitute the basis of good society. The "three professions" will exert their swaying influence as long as they be filled with educated gentlemen. The minister, the lawyer, and the doctor will be revered as long as they represent learning and gentlemanly qualities.

At the International Medical Congress the section on anatomy considered the question of modifying anatomical nomenclature. There was evidently a difference of opinion as to the extent of proposed modifications. Sir William Turner made a very sensible speech. He said that before any thing could be done in this direction some general principle should be agreed upon. There must be a recognized basis on which the proposed committee could act while attempting to give scientific shape to technical modifications. Although many of the terms used were singularly inappropriate, they were *classical* and held a prominent place in the history of anatomy, commanding such reverence that British anatomists would never consent to give them up. . . . . .

. . . . Inasmuch as Mr. Turner and Professor Cunningham were put on the committee of *revision*, it need not be expected that radical changes will be entered upon.

In the physiological section some novel ideas were presented. In a discussion of nerve supply for the larynx it was contended that no word in any modern language could take the place of the Greek expression. "Organ of the voice" was not a substitute—not a translation. In the course of some remarks on phonation, Dubois-Reymond stated that in some animals, as the cat and the cow, vocal sounds were produced by inspiration, and not by expiration. Professor Exner remarked that such was also the case with the pig, and gave a realistic demonstration how the grunt was produced by an inspiratory effort.

I have cited the opinions of scholarly men who are opposed to a prolonged classical career as preparatory to the study of medicine; and to be fair I propose to quote from two or three who are in favor of a thorough training in Latin and Greek. M. Bourgeois, the Minister of Public Education in France, declares that only indifferent success can be attained in scientific studies if the classics be neglected. M. Jules Simon, whose authority on questions of education is beyond dispute, recently remarked: "I should certainly be disposed to advocate an increase in classical studies, for I hold that my friends Berthelot, Bertrand, Pasteur and Jaunsen, advocate a study of the classics for the good they know to be in them,—for the discipline obtained in the study of ancient literature, and for the educational virtue which is imparted to the classical scholar. Where is the liberally educated individual who regrets the cost and time spent in learning Latin and Greek? When such a person is found I should regard him as demented."

What the student of medicine needs is education enough to enable him to prosecute his studies in college with comparative ease; and such an amount embraces a good English training and some knowledge of Latin and Greek. If only the alphabet of the latter be known, the characters can be rendered in Latin—in English. A year's training in Latin ensures a sufficient acquaintance with the language to master anatomical terms. If a student be fitted to enter Harvard or Yale, he is creditably prepared to pursue the study of medicine. His scholarship is then above reproach. For the indigent among aspirants for medical degrees, the farm is a place where a young man can work enough to pay his way, and at the same time obtain a creditable knowledge of anatomy, physiology, botany and natural history. Let him buy a few text books (which have to be owned sooner or later), a work on anatomy, a physiological treatise, an elementary guide to botany, and a book on the elements of zoology. In every rural district there is a scholarly citizen who *con amore* would give a little time each week to hear a lesson in the Latin reader, give an explanation to the technicals of botany, and discuss the salient points in zoology.

The school teacher in a country village, who may be ambitious to study medicine, will find time to recite lessons in Latin to the preacher, who is glad to refresh his memory in classical lore. If the pedagogue complain that his duties are already onerous, I can assure him that the memorizing of a paradigm will prove recreative. We see that the teeth of animals are so placed in the two jaws that, through attrition, they become self sharpeners; so it is with human pursuits—the mind is not only rested by dropping one subject and taking up another, but it is sharpened and strengthened by the change.

Lawson Tait has said that he sends his medical students to the mills and manufactories to learn how to use their hands. At the pottery they may learn to mold plastic clay, that they may make a model of a deformity; they shall spend time in the limner's studio and the photographic gallery, that they may learn to express features in outline and shade. The physician who can not sketch a morbid expression is unfortunate. I would make drawing a compulsory qualification to matriculation. The best surgeons in the world have served time among the trades. It is a laudable accomplishment to be able to handle tools adroitly. There are more advantages in cultured manipulation than ever entered the head of a classical dullard. The surgeon's *tactus eruditus* is the cultivated sense of palpation; and it is not inherited, but acquired.

A dislocated shoulder or hip can not be reduced without an understanding of the application of force in the most direct and advantageous manner; and there is no better place to become expert in such knowledge than in the multiple and varied labors of a ruralist. In a logging camp are experiences which test a man's ingenuity and widen his mental capacities.

MATTER AND ENERGY.

(Read before the Cincinnati Natural History Society, Sept. 3, 1889.)

Inasmuch as it is illogical to assume that matter was made from nothing, we are forced to believe that it has always existed in some form; and as matter is never without attributes—without activities or energies—it is logical to conclude that forces have always been associated with matter. Knowing that such forces are antagonistic, the conclusion can not be avoided that they necessitate motion in matter. The idea that matter may continue at rest is hardly conceivable, for inherent energies would enforce activity.

Matter is capable of assuming a variety of forms; it may appear as gas, or as liquid, or solid; and force may be transferred from one activity to another, without waste of material or energy.

Gravitation is one of the inherent energies, and repulsion is another. In their manifestations they aggregate matter into masses, and also tend to dissipate substances, and by their opposing influences they cause transformations and transmutations which embrace a history of the universe.

While the postulate is that matter and power have been eternal, we can not, as finite beings, help looking upon our world as being in a somewhat mature state, with a formative story running backward, and a prospective one foreshadowing decline and ultimate desolation. A basis of the reasoning is that the moon and certain stellar bodies which are not what they were, furnish a foundation for such lucubrations. But, granting that a celestial body—a satellite, for instance—does grow old and exhibit decrepitude, that is not conclusive that its substance in other forms, may not again take part in cosmical affairs. A mass of matter may be resolved into its elements—into nebulous atoms—and have its particles aggregated again into a sidereal sphere, the processes of diffusion and concentration repeating themselves indefinitely and eternally.

THE NEBULAR THEORY.

Before proceeding at greater length I would call attention to a somewhat antiquated hypothesis, which is that in the beginning (?) matter was not in aggregated masses—in solar systems—but in an exceedingly tenuous form—in gasses and nebulous states; and that heat, a form of energy diffusive in character, kept the particles apart, until cooling and condensing processes broke in upon the status of things, and the gravitative force drew the particles together or into intimate relationship. The opposing or antagonistic energies—gravitation and repulsion—through a subsidence of heat, the repelling force, resulted in a subdivision of the nebulous stuff, and an aggregation of it into a multitude of sidereal bodies—into solar systems as we now understand them. The forces cited were sure to keep the more or less eccentric masses in revolving motions, some bodies moving rapidly, and others with restricted velocities, and with a liability to collide or come in contact.

Such is the merest outline of the workings of the nebular theory; and while it has had some serious objections raised against it, they are not insurmountable.

The impact of two ponderous bodies, moving at almost incomprehensible velocity, must be sufficient to pulverize the densest metals; and the evolved heat would dissipate the debris of the colliding bodies, returning the particles to space in a gaseous or nebulous state. In this way the aggregation of matter and its diffusion may have been going on eternally, and is thus to continue forever. Aberrating activities are always disturbing the alleged "harmonies of the universe," rendering collision possible, if not probable. The display of meteors through contact with our planet demonstrates the possibility of collisions; and the heat known to be evolved by such contacts is in accord with the nebular theory. It is not possible for so many spheres traveling at varying rates of speed, to escape collision; and when two heavy bodies come into direct contact the course of each would be arrested, yet new forces would come into play, governing the movements of the debris, for the concussion would pulverize the masses, evolving an immeasurable amount of heat. The minute fragments of matter, through the agency of the suddenly acquired heat, would fly apart, gravity not being strong enough to hold them together or in intimate relations. The larger fragments would attract and aggregate the smaller that happened to be near or proximate, and a new sphere of revolving matter would enter upon an orbital career. Many erratic pieces would fly hither and thither at random, and possibly find lodgment in contact with the earth.

METEORS.

Meteors are constituted of fragmentary stuff that has its origin in collisions. They sometimes travel in groups, and strike this planet on certain days, recurrences taking place with such regularity that there must be some system in the display. On the 10th of August and the 13th of November, "star showers" may be expected and looked for every year. On almost any clear night a "shooting star" may be seen, therefore the earth may be gradually gaining at the expense of meteoric substance. That showers of aerolites are encountered on certain days in the year would indicate that their concurrent course is in proximity with the earth's orbit; and that their velocities are related to the speed of the planet's movements. Meteorites are dark bodies and are not seen if they strike the earth in the day time. However, a meteor of considerable size might strike near an observer, and make its presence known by hissing sounds and a puff of smoke where it hit. A number of such bodies are to been seen in cabinets. When critically examined they present no elements not found in our planet, therefore, it is presumed that in "other world's than ours" there is nothing new. Meteors become incandescent through friction as they reach the denser portions of our atmosphere, though the luminosity is not pronounced enough to be seen in the light of day. The cause of the collision is not a fortuitous circumstance, but the impact is mostly produced by the attraction of the immensely greater body—by the gravitating power of the earth.

The subject of meteors is introduced to illustrate what may be said in regard to the nebular theory, so called, which supposes that matter in an exceedingly tenuous state once pervaded all space, and afterward became aggregated into prodigiously great masses that have been denominated solar systems, our own being one of the smallest of the entire lot. In the contemplation of the vast scheme much has to be presumed, yet in the sifting of the various theories ventured in regard to the evolution of Cosmos, grains of truth may be gathered. Besides, our mental capacities are widened by the endeavor to comprehend the profound and the mysterious.

COMETS.

In the consideration of stellar matter we have to contemplate comets—erratic bodies which occupy elliptic or swerving orbits, and whose range is immense. They may be strangers to the sun's range of authority, visiting the different solar empires as messengers from one grand luminary to another. Their velocity is very great, therefore they may come from the regions of the "fixed stars," trillions of miles away. Under such a supposition they must possess some propelling force not at present understood. Comets may have had an origin similar to that of meteorites, yet some unknown force projected them on eccentric courses. They possibly may have an office in the distribution of energies among sidereal bodies. The sudden liberation of heat attendant upon collision of non-luminous masses might project comets from one solar system to another. While a study of comets is intensely interesting and somewhat instructive, only a smattering of knowledge has been contributed to physics by a contemplation of their forces, of their erratic courses, and of their elementary constituents.

A speculative idea in the nebular theory is that matter was gaseous in the "beginning," and gradually condensed into molecules, masses, and stellar bodies; and when the transformed state existed, something like maturity had been attained, and an "end" was theoretically in view. Such is not my comprehension of the subject, but simply the fact that in the transposition of matter collisions render nebulous such a portion of the general whole as may be subjected to the immense shock—to the nebularizing process. The nebular theory is hardly mentionable unless associated with that of collision. There must be a cause for the nebularization of matter, as there is for the aggregation of it into stellar masses. If the nebular theory be correct, there need be no thought of a beginning or of an end, but in the transformation of matter from one state or condition to another, the ponderable medium of the universe is sometimes nebulous and as often as solid as a planet.

THE EARTH.

That the earth was once a diffused mass of gas is not improbable; that it cooled and contracted to a molten state is also plausible; and that it further cooled and condensed to something like its present state is demonstrable. At length a smooth envelope of crystalline character was attained by agencies already cited; and this case inclosed a molten mass within. Some part of the melted stuff still exhibits itself through the craters of volcanoes. Such vents for the fused mass within were once much more numerous than at present. Lastly, the crust was bent and warped by internal commotion, mountains and corresponding valleys being developed by the disturbing agencies. The globules of moisture which through excessive heat were suspended as vapor, were floated to mountain tops and there condensed into rain. Through the force of gravitation the water "ran down hill," forming rills and rivulets, and collected in pools. Thus the river system was commenced. The surface of the earth became more deeply corrugated, the hills becoming higher and the ravines deeper. The basins of lakes, seas and oceans were formed, and steadily were filled with water flowing from great mountain chains. The heat of the sun converted more or less of the stagnant water into vapor, which by winds was driven in clouds to the highlands to be condensed into rain, again to descend in streams to the sea. The flow of water in rills and rivers wore furrows in the rocks, and triturated the disintegrated masses into sand, the basis of soils. Frost helped in the denuding and pulverizing process, and a condition favorable to the introduction of organic life appeared here and there. The waves of the seas eroded the shores, and chemical activities lent their aid in decomposing the hard rock constituting the earth's crust.

Finally, near the poles of the earth, where the cooling processes had rendered it possible for plants and animals to live and thrive, *there* they first appeared. The coal beds of Disco bay reveal the fact that gigantic ferns once flourished in that high latitude, and the mammoths of Siberian ice indicate that the food of such creatures once grew as arctic flora. Although much thus far offered is the merest conjecture, there are facts enough to found rational conclusions upon. A history of the evolutions of the earth is the hypothetical story of kindred planets, and possibly of all celestial bodies. That the earth will remain much as it is for cycles of time there is no rational doubt, but a collision with some mysterious moving body unseen in sidereal space is also possible. In the unfathomable future, some unaccountable cataclysm may occur, converting this solid sphere into a "puff of smoke," or into a state either gaseous or nebulous.

LUMINOUS ETHER.

Light in its passage from the sun seems to be wafted on waves of a tenuous medium which has been denominated *ether* on account of its thinness or marvelous tenuity. Although ether is an essential substance, it is too subtle to be weighed or measured; in fact such a material as luminous ether has been doubted—has been denied an existence. But the presence of such a body has been demanded to account for certain phenomena in connection with the transmission of solar or luminiferous rays. It has been contended that all stellar interspaces and the interstices of molecules are occupied by a universal and circumambient ether. How, it is asked, could the light of fixed stars be conducted to the earth except through such a medium. The nebular theory furnishes tenuous media which have the qualities for transmitting light and possibly sound. All nebulous bodies reduced to extreme tenuity are easily made undulatory. When two meteors collide in space, the concussion is positively imparted to the nebulous environment, and conducted indefinitely through waves of tenuous matter. The impulse of sound would be transmitted as well as light and heat, and perhaps electricity. The photosphere about the sun is a luminous ether, but need not necessarily be distinct from tenuous matter in general. When it is considered that an atom of hydrogen is the basis of all matter, and that all molecules and masses are but multiple combinations of the subtle stuff, we may not be astonished to hear that luminous ether is a composition of hydrogen and *helium*, and that helium was only another form of hydrogen! Although the oxyhydrogen flame is very hot, it sends off a feeble light. The citation is to show that some combinations of hydrogen are not potent transmitters of light. It requires a powerful galvanic battery to decompose water or to resolve it into ultimate atoms or elements. Heat will rarefy water, converting it into globules of moisture or into vapor. By cold and hydrostatic pressure oxygen gas can be converted into snow, and hydrogen into hail, which rattles as it falls upon a floor. The illustration may aid in the conception of possibilities in matter. The time may come when, in the expansion of scientific demonstrations, ether may not only be made ponderable, but condensed into a solid and handled. If such an advance be made in the manipulation of subtleties, "luminous ether" may not prove to be a new element, but modified hydrogen. A writer of considerable acumen has said, "that since every thing is black in the dark," it follows that color is a property of light. Now light, which is itself invisible, is due to oscillations or vibrations set up in all directions by any luminous body—whether the sun or a rushlight—in the ethereal medium which prevades all space, and is composed of rays of different refrangibility—as from ether to air or any denser medium.

Another office ascribed to ether is that in the conservation of energies,—in the distributions and recombinations of potential and kinetic activities, there shall be no loss of power as there is no waste of matter. In a discussion of the nebular theory the points developed are such as render it possible to leave out the hypothetical or ethereal medium whose office is to fill space, and to become a receptacle for the interchange of energies. As gaseous matter condenses, its capacity for storing heat decreases, hence as a nebulous mass approximates, a solid heat is, as it were, squeezed out, or set free to become dissipated in space, and in going from one atom of matter to another there is no call for a medium of transmission other than what incidental molecules of matter may furnish. In other words there is no apparent necessity for an ethereal medium.

SOLAR HEAT.

The internal heat of the earth is no longer competent to warm its crust sufficiently for biogenic purposes. While in a nebulous state there was heat in abundance, but as the gaseous substance became condensed the heat in its molecules was driven out and radiated into space. To counterbalance the loss, an atmosphere was evolved from the environment of ethereal matter. Oxygen and nitrogen held such affinities for one another that air became an envelope for the new-born earth. This had so many intermixtures that it was not "pure" and respirable, but time acted as a clarifier. It was thin and tenuous at its outer boundaries, but denser near the earth. This atmospherical envelope renders organic life possible, and serves as a medium for floating clouds. Birds sustain themselves in flight through the density of the agent. Its pressure upon the earth is fifteen pounds to the square inch at the sea level, but much more rarefied at the altitude of the highest mountains. The air is an important agency in the evolution of mundane affairs. While the elastic and vibratile body transmits sound and light with seeming facility, yet it offers more or less resistance to the passage of solar rays. Fortunately this friction becomes a source of heat, as in a revolving axle or in any other familiar example of the kind. In elevated places where the atmosphere is diffuse, the resistance offered to the passage of solar rays is inconsiderable, but in valleys where the air is condensed through pressure of the mass above, the friction is great, and the resultant heat is intense.

The old theory of solar combustion as a source of heat is untenable for several reasons, the most prominent of which is that the great luminary would have burnt itself out long ago; and another is that as only its planetary bodies and their satellites are recipients of the benefit, stellar space would consume much the larger amount.

In the summer when the sun is overhead, the impact of solar rays is greater than in winter when the sun shines slantingly. A sun-glass converges solar rays into a focus, and thus multiplies the friction,—intensifies the heat at a given spot. The moon has no atmosphere, hence solar rays falling upon it meet with no resistance—evolve no heat.

The suggestion of Proctor that the sun's fires are fed by inflowing meteors as fuel, is also a gratuity. As meteorites become scarce, the heat would decrease—a lack of supplies would have been felt long ago. Besides, in the combustion of so much coarse material, what would become of the ashes or debris?

There seems to be but one rational account of the origin of solar heat, and that is through friction. If that be the source of the sun's beating energy, it is to last as long as our atmosphere does, hence may be regarded as abundant and eternal.

LIGHT.

Heat is the manifestation of an energy, and so is light. The glow-worm and the fire-fly flash phosphorescence on summer nights, and the "will o' the wisp," or swamp gas, is a torch lighted through the agency of decompositions. The farthing dip feebly illumines the humble cottage, and electric incandescence makes brilliant the halls of palaces. When brakes of a swiftly moving train are applied the friction evolves heat enough to kindle a flame, and a spark is elicited by a stroke of flint and steel. Light is emitted in rays from a center of illumination, as the flame of a burning lamp, a blazing meteor, from stars and from the sun. The "fixed stars," so called, issue luminous rays as the sun does, but they are so far away that we see only a stellar twinkle. Light from the moon is wholly reflected, solar rays glancing from the face of the lunar orb to the earth. Sunbeams differ somewhat from other luminous rays. A pencil of sunlight thrown upon a spectrum or glass prism will exhibit plainly the primitive colors, and rays from the electric arc display such hues, but not so prominently. Plants do not thrive as well under artificial heat and light as they do under the sun's energies. Solar rays decompose carbonic acid in the leaves of plants through the agency of chlorophyl, the carbon forming woody fiber, while the oxygen disengaged passes into air. All the colored rays of the sun will not decompose the carbonic acid of plants, but the *actinic* or chemically active blue and violet rays. Plants may develop in substance without the aid of sunbeams, but the stalks and leaves are colorless, and the acme of maturity can hardly be attained.

Light has been denominated an energy, and not an ethereal substance. It may be transformed into heat and electrical units,—it may assume two or three kinds of energy. The sun is the great source of light in its own system, but looked at from Sirius its twinkle becomes a star of the fourth or fifth magnitude. The vivifying powers of solar energy are all important to our planet. Without the influence of light and heat the earth would have no seasons, no plants, no animals, no rains, no atmosphere, no condition contributing to the support of life. In shaded places poisonous fungi may vegetate, and in the deeper parts of the sea where heat does not reach, nor solar rays penetrate, there may be encountered organic forms, both floral and faunal, but their support is borrowed from material that has been under the sun's influence. Near the poles the water swarms with marine life, but the water is rich in protoplasm that has been developed under the energies of a tropical sun. The energizing influences of solar rays are stored in trees, and eventually laid away in coal banks, hence their character should be considered in the economies of our planet.

POTENTIAL AND KINETIC ENERGIES.

In a discussion of matter, power, and motion, it became necessary to allude to the forces inherent in stellar bodies, and as displayed in the movements of atoms, molecules, and masses. It is perhaps unfortunate and to be regretted that scientists have not formulated better terms for the two activities which forever exert antagonistic qualities, as gravitation and repulsion; but we must become familiar with the language of science, if we would understand its teachings. A potential energy may abide or continue in a state of rest, as solar energy may be laid away in coal. The actinic rays of the sun, which are kinetic or active, elaborated carbon in plants, and this became coal, with an affinity, under kindling, for oxygen, constituting combustion and the liberation of a force that had long been potential, but now, in a restored kinetic or active state, may drive the wheels of a locomotive, or do other work under the guidance of man's skilled hand.

When a wound-up top is spun, the released activity is kinetic, though the swiftly revolving toy is seemingly still. But in this display of energies double kinesis is called into play—*that* imparted in the winding up process, and *that* spent in running down, gravity acting all the time, but not with sufficient force to overthrow the body acted upon.

The kinetic energy of the savage arm in bending a bow stores up a force which, when suddenly released, again becomes kinetic in speeding the arrow. The force is held potential by the string while the bow is bent. A clock wound up possesses potential energy, and parts with it kinetically when expending the energy in measuring time. Water stored in a pond embraces potential energy which may be liberated with devastating effect. Vapor in globules of moisture, wafted to the tops of the Alleghenies, is by the cold of the region condensed into rain, which runs in rills and brooks, expending energy in turning wheels, and at length is imprisoned by a barrier, by the Conemaugh dam. There it rests in a placid lake until the barrier yields, releasing kinetic force enough to overwhelm Johnstown. But a part of the story of transmutating energies remains to be told. The sun's heat unlocked the gravitative force of water by converting it into a passive or potential form in vapor, and cold condensed the globules of moisture into rain—into water—the precipitation displaying kinetic energy. The heat of the sun, then, is the great source of kinetic or active energy in the solar world, and is externally opposed to gravitation, though an interchange of energies is repeatedly displayed, as in the vaporizing of water at the ocean's level, and its return again to rain—rills at the mountain tops.

In a not uninteresting way the kinetic energies of the sun's rays may be traced through soils to plant growth—to the ripening of grain, or the storing of potential energy in kernels of wheat—in starch and albumen. The bread we eat embodies the energy, while digestion and assimilation impart a still higher order of potential energy, to be unloosed and spent kinetically in a wrestling match. It might be still more interesting to trace the energizing influence to the brain, and there by the unfolding of mental force —a form of energy—find expression in "thoughts that burn and words that move."

Foods rich in starch and albumen were not plentiful in earlier geological histories. Little heads and great bodies were first evolved. The ichthyosaurus is representative of the idea, as the ostrich is at present. But after phosphorus became plentiful and cereals were endowed with potential energies, brains became conspicuous; man, with a voluminous brain, entered upon the scene where conditions were favorable to his continuance. Higher forms succeeded the lower, though not in any very definite order, modifying qualities ever appearing in the order of evolution. In the peopling process there was not always a "survival of the fittest," but a continuance of the more fortunate.

In the cataclysm which swept over this continent, the horse had to go, though a re-introduction of the animal has been attended with satisfactory success. The mollusks whose cretaceous envelopes are imbedded in our hill-sides, did not perish through imperfections in their organization, but through a subsidence of the shallow seas in which they had thrived. There was no application of the survival of the fittest dogma. When a whale strands and dies, its death does not depend upon a deficit in its organization, but upon an accident. An increase of temperature amounting to a few degrees would end organic life on our planet; as would also excess of cold, or the withdrawal of a few degrees of heat. And it may be inferentially stated that a return of our accustomed temperature would be attended with a gradual peopling of the earth again. When the conditions are favorable to life, there will it be manifested. The attributes of matter under favorable influences are all vivifying and life-sustaining, but are restricted by incidental and accidental conditions.

"DE SENECTUTE."

> "Grow old along with me!
> The best is yet to be;—
> The last of life, for which the first was made."

Robert Browning, in *Rabbi Ben Ezra*, begins a philosophic poem as above. But the young will say that the writer is making virtue of necessity. The man at sixty, looking backward, sees what has gone, and never to be regained; and therefore tries to make the best of the situation, praising the remnant of existence, calling it *the best.* But, is not there a verity in the assertion that the first of life is necessary for the attainment of the last? If it were not for the fitful blaze of youthful corruscations, the embers of age would be the less enjoyable. While youth, in the acme of its ambition, is struggling to reach the zenith of blissful existence, age serenely views the contest, believing the attainment not worth the effort were it not for that which is to come!

Cicero's essay on "Old age"—*de senectute*—is the most philosophic and satisfactory of any of the great orator's productions. In an address to a friend he says: "this work is so delightful that it has not only obliterated the annoyance of age, but has rendered existence more charming than it is possible for life to be in youth." Further along he says: "to those who have no resources within themselves for living happily, every age is burdensome."

Johnson, in *Rambler*, writes: "He that would pass the latter part of his life with honor and decency, must, when he is young, consider that he shall one day be old; and remember, when he is old, that he has once been young. In youth he must lay up knowledge for his support, when his power of action shall forsake him; and in age forbear to animadvert with rigor on faults which experience only can correct." *Spectator*, contains the following words on the topic under consideration: "As to all the rational and worthy pleasures of our being, the conscience of a good fame, the contemplation of another life, the respect and commerce of honest men—our capacities for such enjoyments are enlarged by years. While health endures, the latter part of life, in the eye of reason, is certainly the more eligible. The memory of a well spent youth gives a peaceable, unmixed, and elegant pleasure to the mind; and those who are so unfortunate as not to be able to look back on youth with satisfaction, may give themselves no little consolation that they are under no temptation to repeat their follies, and that they at present despise them." The consciousness of a life well spent, and the recollection of charitable and noble deeds, render existence more than tolerable—they make it delightful! All men can not be Scipios nor Alexanders; and few such are long happy. A life passed in peace and comfort is more desirable than one inflamed by the storming of cities by land and sea, and in the ephemeral display of conducting triumphs. Plato, in his eighty-first year, died with pen in hand, while expressing the beauties of philosophy. Isocrates wrote brilliantly in his ninety-fourth year, declaring that he had no reason to whine over the infirmities of age.

It is not becoming to regret the departure of what may be supplanted by something better. Does the boy lament the loss of his infancy, or does the young man regret that he is no longer a youth? And it might be asked with equal propriety if the well settled adult longs for the uncertainties of early manhood? And, finally, is there need for repine on the part of the elderly who enjoy intellectual repasts, as well as a satiety of physical feasts?

> "Maturer life with smiling eye will view
> The imperfect scenes which youthful fancy drew."

Sophocles when asked if he yet enjoyed carnal pleasures, calmly replied: "The gods have given me something better; nay, I have run away from them with gladness, as from a wild and furious tyrant."

There is such a large proportion of suicides among adults, that the circumstance is taken as an argument favoring the idea that existence beyond youth is hardly worth continuance. But in this we are not to be misled. An ambitious man may become despondent as soon as his schemes fail, and his future appears dark and uncertain. He has not wisely estimated the world, but has entertained a more hopeful outcome to it than facts warrant. The husbandman who mortgages his crop in seed-time, is not sure of a harvest—he would be wiser to wait till the danger of frost and midge are over, and the golden grain is ready for the sickle. Impatience and unreasonable expectations are among the faults of youth, and lead to untimely unhappiness.

Age does not alone insure comfort and repose, nor is advanced life a surety; yet once attained, and the environment be fortunate, who would exchange its substantial worth for the uncertainties of youth? The young are chasing a phantom, the substance ever evading their clutch; the elderly, with the assurance of support, and the possession of mental wealth, are better off than the frivolous young, and infinitely happier. This the young can not appreciate till they pass the meridian of life, and begin to descend the gentle slope, going slow that there may be opportunity to admire the ever lengthening shadows—till the twilight tints the horizon—till it would be hard to tell when the day doth end and the night begins.

A mind schooled in cultured ways never has time hanging heavy, as if it were a burden; but the wit, wisdom and worth, of the great masters in art and literature, become enchanting studies, widening comprehension and enriching appreciation. To grow old under such influences is not a burden or yoke hard to bear, but to glide along an eddying pool after cascades have been shot, and turbulent waters are calming to mingle with the sea.

Let noisy youth enjoy its huzzas; and the adolescent dream of bliss, almost within reach; and the stalwart adult just entering the race of real life strive for prizes with an eagerness that challenges admiration, yet only the elderly live to enjoy the best of life's struggle. Then "grow old," the better is to come! The first enjoyed was only good, that the last might be the best!

Old age is a misnomer—there is no end of time. The babe that died to-day was comparatively old—its term of life expired; the lad is young in years, yet may be sporting on the brink of the grave. The smiling, winsome, waltzing maiden is shocked at the wrinkled image of age, yet may be nearer the tomb than her grandparents. The man of sturdy form and iron will may hurl defiance at any foe but death standing near; the aged alone are calm and not afraid—they have seen all except the unseen and cheerfully await the inevitable.

DARWINISM:

ITS WEAK AND STRONG POINTS.

(Read before the Cincinnati Society of Natural History, Oct., 1879.)

Darwinism, so called, is not a complete and steadfast doctrine, but a somewhat disjointed combination of theories and speculations invented to account for the origin, continuance, and variation of organic forms on the earth. Hypotheses of a kindred character were discussed by the ancient Egyptians, and afterward obtained support from Aristotle, as well as other classic philosophers. Views of a similar character have been entertained by liberal minds of every age. At a comparatively recent date, substantially the same ideas were collated and expanded by Jean Lamarck, a French physicist and contemporary of Cuvier.

The theory of the birth and development of the organic kingdom, to say nothing of the evolution of the sidereal and solar systems, did not spring full grown from a single brain, but proves to be the patchwork of many contributors, the most methodical and scientific of whom was Charles Darwin, an English naturalist of great experience, industry, and ability. The doctrine of Evolution, as applied to cosmic changes and organic development, was well along toward recognition a century ago, but it required the mind of a profound scientist to elaborate the many facts and fancies into the semblance of a system. Darwin could do no better than to adopt the theories and principles of Lamarck, and follow his general course of reasoning in regard to the evolution of our planet and the vital objects that are upon it. The doctrine of Evolution, so far as it pertains to the inorganic world, is more Lamarckian than Darwinian. The peculiar cosmic views entertained by the anonymous author of *The Vestiges of the Natural History of Creation*, are substantially the same as those advocated by Lamarck, and later by Darwin. The chief difference consists in the more methodical manner of treating vital problems that is characteristic of Darwin.

The doctrine of Evolution, as applied to biology, has been strengthened from time to time by Huxley, Hæckel, and other profound scientists, yet the name of Darwin will be forever associated with the famous theme that has so long engaged the attention of scientific men. And from the amount of discussion at present devoted to vital operations, past and present, the topic seems as captivating as ever.

Lamarck held that the inanimate matter of the universe embraces forces that have a reciprocal relation with the activities or functions of organic structures; he looked upon the attributes of the physical world as correlative with those that give life and form to plants and animals. In other words, he was an avowed materialist, declaring that the present state of the earth was evolved from nebular masses, and moved by impulses inherent in solar systems and sidereal bodies. He argued that the earth's surface was diversified through necessity, and that the earth's inhabitants were a sequence in the great chain of cosmic operations. Life was spontaneously generated, or the outcome of chemical, magnetic, and other forces inalienable from planetary activities. He claimed that if life were to come to an end by some catastrophe, it would soon appear again when original conditions were repeated, a single cell coming first, and more and more complex forms afterward, until the widest range of variation be reached. Now, all this is but Darwinism in a crude form. If an organism, however simple in structure, could be endowed with vital attributes, through an inherent law of variation a monad might be evolved into a mammal.

No power was needed beyond what is comprised in natural laws. A deviation in any creature established a variety, and from varieties come species, and from species genera, orders, kingdoms, and empires, in the development of animals from lower to higher forms.

Linnæus and Cuvier, who have given us our present classification of plants and animals, believed in special creations and undeviating types. These great zoologists looked upon fundamental differences as permanent, and upon variation as the result of accidental circumstances or chance surroundings. Species was defined as a combination of peculiarities in a group of creatures so closely resembling each other that they always filiated or formed fruitful unions; varieties were notable departures from original stock, yet individuals of any number of varieties would filiate with one another. Pugs and pointers among dogs would form prolific associations, while wolves, foxes, and dogs constituted so many species of the canine family, and would not therefore voluntarily filiate. This method of arranging animals into species founded upon sexual mating is not without its defects, yet it is tolerably definite. For instance, in the genus *equidæ*, the different species will cross, yet the progeny is sterile, thus showing difference or variance in a degree that interferes with reproduction. Even if the female mule is not always sterile, the exceptions are so rare that for all practical purposes the rule is distinctive. Besides, the different species of the equine family will not filiate in a feral state, but only when tampered with by man. This natural and definite method of designating species is easily understood, and generally adopted by scientists, yet Mr. Darwin would unsettle old classifications and introduce fanciful notions in the arrangement of species in order to prepare the way for the adoption of his transmutation views. By so doing he has introduced confusion into biological studies, and gained nothing of importance. When it suits Darwin's purpose he creates species out of mere varieties, basing the affinity upon resemblance or some fanciful feature having no fundamental principle in it. Although a fruitful union has been forced between sheep and goats, the difference between these races in a natural state is enough to keep them distinct. They never filiate voluntarily. It is important to insist upon a distinctive feature as characterizing species in order to possess a definite rule for gauging grades in the human family. If the different races of mankind would not filiate, or prove prolific in cross connections, then we should have true species among us. But as all kinds of intermarriages are fruitful there are only varieties in the *genus homo*. No species, nor mongrels, nor hybrids exist.

Among the more plastic of domestic animals variation is cultivated to the fullest possible extent, the limit of variability being reached only by refusal to be prolific. In an attempt to breed in a certain direction the departure from original type at length reaches a point where reproduction ceases, or is carried on with great difficulty. A diminutive variety of the black and tan terrier has been bred down to a degree that admits of restricted fruitfulness.

It is a strange fact in regard to ancestral peculiarities of a fractional nature, that the offspring of the jack and the mare takes after the sire in voice, and therefore brays; while the progeny of the stallion and the jenny follows the dam, and also brays. This circumstance tends to show that hybrids do not partake equally from either parent. It has been estimated that the equine hybrid is two-fifths horse and three-fifths asinine stock. These are not uncommon fractions among results of cross-breeding.

Darwinism is supported by the appreciable tendency in the organic world to deviate. It is a fact that no two blades of grass are alike; even "as near alike as two peas" is only a figurative comparison, for no two seeds in a pod are identical in every feature. Perfect resemblance between parent and child is never seen. Even twins among children fail to present the close resemblance generally accredited to them. Tendency to variation must be regarded as an attribute of organic bodies. Although the acknowledged variability is elastic enough to permit the evolution of varieties, it is a question whether it will admit the differences which constitute species.

Fossil bones from the Tertiary period of the earth's geological history show that "giants lived in those days;" not human beings of gigantic proportions, but ponderous saurians and marine monsters. These, according to Darwin, were naturally evolved from smaller varieties, served the purposes of their bulky organizations, and then became extinct. A cause for the temporary existence of huge forms is flippantly given by the illustrious scientist, yet the reasoning is that of a fairy tale. Elephants would be as numerous a thousand years hence as they ever were, if the cupidity of man did not kill the animals for their tusks. It is idle to talk about a lack of favorable surroundings for the thrift of such large creatures. Mastodons lived and died, and left their ponderous remains, and that is the substance of all we know about the matter.

An early feature of Darwinism was that the transitions going on in the vegetable and animal kingdoms were exceedingly slow and by almost inappreciable grades, but amendments made later prepared the way for bridging chasms by admitting leaps or the intervention of a needful *saltus*.

There is no serious objection to this modification of doctrine, especially as embryonic leaps are known to occur. It is merely a question of limitation in the laws which govern evolution. If the elevating tendencies are always gradual till the highest anthropoid be reached, and then for the first time a leap is needed to cross a chasm and land on the side of even savage man, the extraordinary intervention is not admissible.

An attempt has been made by Darwin to show that the crania of the lowest barbarians closely resemble the skulls of the higher apes. As this is a vital point in the evolution theory it may be well to quote fairly from the arguments employed. Huxley says, "the like of the Neanderthal skull has yet to be produced from among the crania of existing men." Now, if the illustrious naturalist means that no two skulls are alike, he is safe in the statement, but if he means to convey the idea that the features of that famous skull are more Simian than those of the lower savages among men, he is conveying a wrong impression. Besides, as the skull from the Neanderthal grotto has no companions, it may represent a savage dolt.

Some very low down skulls found in mounds near Borresby, in Denmark, have, by Huxley, been compared with the crania of the native Australian, also with those of several degraded types, yet nothing definitely and specifically pithecoid in any of the entire lot has been presented. There is as wide a difference in the capacities of savage skulls as there is in the crania of civilized men. The Esquimau skull is larger on the whole than the average of crania belonging to civilized nations. The heavy-jawed and retreating skull of the Carib excites a feeling of disgust on account of its variance from the outlines and proportions of a cranium bearing the features of an intellectual type of man, yet there is nothing distinctively Simian in the make-up of that brutal organization. The skull and brain are emphatically savage, but in no respect pithecoid. Then again the children of the lowest savages can be reared in such a way that they shall approximate the average of civilized men, while the young of the highest anthropoids can not be made to talk, or otherwise manifest specific human traits. In a consideration of these matters we should not be misled by comparisons made between the size of the brain of the gorilla and that of a Bushman, but we are to compare tractability, mental scope, and educability in the offspring of both characters.

The advocates of Darwinism and evolution continue to reiterate that a creature which spanned the gap between monkey and man lived at a period when what is now the bottom of a large part of the Indian Ocean was above water. Such an hypothesis is ingenious, inasmuch as it can not be successfully disputed, and correspondingly weak because no part of it can be proven.

Mr. Huxley, in his *Prefatory Note* to Hæckel's *Freedom in Science and Teaching*, page 14, says: "Equine quadrupeds have undergone a series of changes exactly such as the doctrine of evolution requires. Hence sound analogical reasoning justifies the expectation that, when we obtain the remains of the Pliocene, Miocene, and Eocene anthropoidæ, they will present us with the like series of gradations, notwithstanding the fact, if it be a fact, that the Quarternary men, like the Quarternary horses, differ in no essential respect from those which now live." But Mr. Huxley should know that the lover of facts needs something more convincing than "sound analogical reasoning" to prove that our ancestors filiated with apes, or were evolved from them. Even Hæckel admits that no pithecoid form now exists from which man could spring; and hints that the remains of the connecting link are in the bottom of tropical seas. Professor Marsh, in his *Vertebrate Life in America*, page 40, says: "The lesser gap between the primitive man of America and the Anthropoid apes is partially closed by still lower forms of men, and doubtless also by higher apes, now extinct. Analogy, and many facts as well, indicate that this gap was smaller in the past. It certainly is becoming wider now with every generation, for the lowest races of men will soon become extinct, like the Tasmanians, and the highest apes can not long survive." The "many facts" above alluded to are thus far wanting;

though the "analogy," for what it is worth, may be safely conceded.

The postulate of Darwin, that there is a wider difference between the highest ape and the lowest monkey, than there is between the highest ape and the lowest man (hence the inference that the human family may have sprung from the Simian tribes), is specious, but not logical or sound. The argument would have been just as worthless if he had said that there is a wider difference between the highest and the lowest marsupials than there is between a kangaroo and an ostrich; or, that there is exhibited a greater diversity between the largest and the smallest saurians than is apparent between the highest reptile and the lowest bird.

In considering Darwinism in all its bearings, the student of nature finds much to admire. The great naturalist, in his *Origin of Species*, has made use of two or three expressions which in themselves suggest a large amount of truth. Who does not see at a glance that in the various forms and phases of life there is an everlasting "struggle for existence?" And the logical sequence of that eternal effort means the "survival of the fittest." The earth and sea would soon be crowded with inhabitants were it not for the fact that the strongest and most favored eat up or destroy the weak and unfortunate. In this never-ending turmoil, the "fittest," *i. e.*, the best, the strongest, or the cleverest, have the surest chance to survive, and, of course, to transmit excellencies to offspring. Such a potent factor in the work of evolution ought in time to accomplish wonders. The doctrine of Evolution, as advocated by the champions of Darwinism, look upon *utility* as the object aimed at by every developing organism, and futility as the forerunner of disability and extinction, or death. To have this doctrine carried out there must be purposive elements in all organic operations. This idea takes us back to the beginning of things, where, according to the essence of Darwinism, the primitive manifestation of life was made. And it does not alter the plan, or modify the hypothesis, whether it be supposed that vivified protoplasm was the primary combination of vitality and substance, or that a simple cell represents the organic starting point. Begin the Darwinian scheme of life as we may, we have to presume that the forces of the mineral world, such as gravitation, attraction, repulsion, and other attributes of inorganic matter, were once competent, when favorably displayed upon "the physical basis of life," to start the vital machine—to inaugurate a beginning in living operations—though they had never accomplished any thing of the kind before. Previous to this departure the same potencies had been engaged in evolving sidereal systems and determining the planes and angles of crystals. In so doing these potencies had acted in a general way, no specific object or end being in view; and after the earth was accidentally or purposely ready for the reception of living beings, the forces referred to, operating upon impressible matter, began to act strongly and specifically by imparting form and function to an entirely new class of products—to germs instead of crystals—to structures possessed of functions operated independently of inorganic forces. The introduction of new forms with novel forces upon earth must have been revolutionary in character, and the most astounding change that ever occurred in the universe, unless other planets had previously experienced similar transformations.

In contemplating organic activities which develop germs into adult individuals, having powers of reproduction, we see nothing in the operations which resembles the formations of a crystal in a saline solution. Indeed there is no fundamental resemblance between a crystal and a cell, nor the slightest relationship between the products. The history of a crystal is that of a lifeless object—an accretion of molecules which never die, nor reproduce themselves. Crystals in the aggregate constitute rocks, and their elements are inanimate and inorganic. In one form or another they have existed forever, but there was evidently a time in the history of our planet when living germs were to be, yet were not. The earth was ready for the incoming of them, but nowhere did they exist. The forces which have long been operating in connection with mineral substances have elaborated an albuminoid mass, called protoplasm, "the principal elements of which are oxygen, carbon, hydrogen, and nitrogen. In its typical state it presents the condition of a semi-fluid substance—a tenacious, glairy liquid—with a consistence like that of the white of an unboiled egg. While we watch it beneath the microscope, movements are set up in it: waves traverse its surface, or it may be seen to flow away in streams not only where gravity would carry them, but in a direction diametrically opposed to gravitation. Though it is certain that these phenomena are in response to some stimulus exerted on it by the outer world, they are such as we never meet with in simply physical fluid; they are spontaneous movements resulting from its proper irritability, from its essential constitution as living matter. Liquid as it is, it is a living liquid; organless and structureless as it is, it manifests the essential phenomena of life."

The above quotation is made from the *Address of the President of the British Association for the Advancement of Science*, delivered at Sheffield, August 20, 1879. It will be seen by the teachings of Mr. Allman, the speaker, that the disciples of Darwin and the champions of evolution believe in spontaneous generation, and that they start life by an irritating "stimulus," acting upon an albuminous slime which is organizable yet not organized.

Mr. Darwin, as previously stated, adopted the leading features of Lamarck's doctrine, making of them a warp into which were ingeniously woven his own ideas in regard to organic succession upon earth. Spontaneous generation was assumed, and lower forms of organic beings were transmuted into higher grades, the motive power in the elevating scheme consisting of pure selfishness, though called "natural selection," "struggle for existence," "survival of the fittest," etc. Every individual, high or low, looks out for itself, surrounding hostilities compelling each organization to exert itself for self-preservation. Although taught in childhood that greedy selfishness is a sin, in studying Darwinism we see why the peccant humor is so prevalent in the human race. If every organism, from monad to man, has maintained existence and vital continuance through the cultivation of selfishness, it is no wonder self interest controls the attention of mankind.

Well, however chimerical the spontaneous generation theory may be, and however unreasonable transmutation hypotheses may seem, Darwin, Huxley, Hæckel, and other brilliant expounders of biology, have presented plausible arguments in favor of evolution doctrines. Palæontology teaches plainly that there have been tolerably regular successions of plants and animals during unmeasured periods of time, an appreciable improvement being made in the passage of each consecutive cycle. But as stumbling blocks to the even flow of succession in the development of the flora and fauna of our globe, there occur at frequent intervals a perplexing number of gaps or missing links; and we are complacently asked to fill them with evidence gone down with submerged continents! The supporters of the doctrine of evolution too often are forced to rely on probabilities, possibilities, and feeble sequences, to bridge ugly chasms in their otherwise plausible theories.

Mr. Darwin experimented with dogs and pigeons, and found variability existing so largely in them that he would have his readers infer how species may have been developed from varieties. The inference enforced by these examples seems to be that if the ingenuity of man can accomplish so much in a few years, how infinitely much more might be effected in the way of variation during unlimited periods of time! But before too much is conceded to the bent of the argument, let it be considered that only the most plastic of animals have been domesticated. Such alone could be coerced or coaxed into unions that promised variation. When attempts are made to obtain varieties from more rigid forms, a discouraging lack of success will be encountered. Sparrows and ferrets will not display variability like pigeons and rabbits.

It is consonant with evolution views to presume that every part of the earth fit for the existence of certain animals should have developed them through the forces of spontaneous generation, and the laws of transmutation. If vitality *de novo* can obtain a footing spontaneously in one instance, it may arise a thousand times, and in as many different parts of the earth; and with the supposition that each primitive germ be endowed with a progressive and purposive instinct, having variability as a leading principle, every island and isolated region of the earth should at length have a multitudinous variety of creatures, with grades reaching up to and embracing man. Now it is a fact that when Australia was discovered by civilized man, this continental island did not embrace many classes of animals that might have flourished there. As soon as fish, birds, and neat herds were taken to these far off lands, the exotic creatures thrived astonishingly. This shows that unassisted nature is sometimes unable to make the best of herself; and that the powers of evolution are incompetent to people all lands with the best organic forms. There was an excellent opportunity for carnivora to thrive, yet few flesh eaters existed in Australia, Tasmania, or New Zealand.

In estimating the merits of Darwinism, it should be borne in mind that there is nothing strikingly new in the "struggle for existence" doctrine. Long before Darwin lived the observing among mankind must have perceived that all organic beings are of necessity subjected to severe competition in obtaining food. All the conditions of life necessitate activity and rivalry. In the struggle for existence everywhere apparent, the most shocking injustice generally prevails. The weak have to contribute to the strength of the already strong. When an Indian tribe is about to march, the tomahawk is driven into the heads of the aged and the infirm to get rid of the burdens. An old bison is pressed out of the herd and turned mercilessly over to the pursuing horde of hungry coyotes. Working bees cast from the hive the useless drones. Where communities exist among animals, helpless individuals must be sacrificed for the general good.

In a published paper on *Polydactyle Horses, recent and extinct*, by Prof. O. C. Marsh, there is presented the strongest argument in favor of evolution doctrines that has ever been offered in the great biological inquiry. The able scientist has, by indefatigable industry, been enabled to offer unquestioned evidence of the early existence among mammals of a diminutive horse which probably sprang from a pentadactyle ancestor. The professor possesses the fossil foot of a four-toed animal, as well as that of the three and two toed, there being a gradual rise and regular succession in the development of the equine family. Besides, a living horse with an extra toe on each fore-foot is now on exhibition as a curiosity. The supernumerary toe seems to be the late out-cropping of what was once a normal state in an early progenitor.

Hæckel, in his *Evolution of Man*, has contributed a chapter on the morphology of the vertebrates, which contains interesting arguments worked up in favor of the evolution of the human brain from lower forms, the descent ending in the brainless amphioxus. If it were not for the offensive partisan character of the writer, the book would be a strong support for Darwinism and evolution doctrines. Sensible people are averse to being driven into any particular state of belief. When an argument is presented in a threatening way, it seldom carries conviction with it.

An objectionable manner of presenting the doctrine of evolution is to ask an intelligent person if he be a believer in Darwinism! The questioner seems to be short-sighted enough to suppose that an individual must take Darwinism in its entirety, or wholly discredit the doctrine. There are educated people in abundance who find reasons for crediting much which Darwin has taught, yet do not believe in the spontaneous generation theory or the Simian origin of man. Darwinism is not a structure built of blocks depending upon one another, like those of an arch, so that if one be removed, the remainder must necessarily tumble and fall; but it is an edifice erected after the designs of numerous architects, each of whom has contributed an independent part that may be removed without fatally weakening the main portion of the temple. The building material, drawn from many sources, is somewhat incongruous, yet the architecture reveals the cunning of a master mind. There is enough of truth in Darwinism to continue in some form forever, yet the unreal and unreasonable in it will in time meet the fate of the feeble and the false.

While Darwinism and the doctrine of evolution are substantially identical in many phases, if a difference between them in certain other important features be sought, a plain distinction may be found. There are many points in biological science that do not war against the theory of evolution, yet are hostile to the Darwinian form of it. Mr. Huxley, in one of his addresses, has aptly said: "It is possible to have a complete faith in the general doctrine of evolution, and yet to hesitate in accepting the Nebular, or the Uniformitarian, or the Darwinian hypotheses in all their integrity and fullness."

SENSIBILITY, INTELLIGENCE, INSTINCT, AND MIND.

(Read before the Cincinnati Society of Natural History, Dec., 1879.)

Vegetable structures are known to be destitute of nerves, yet certain well known plants exhibit sensitiveness or irritability. The delicate Mimosa displays an impressibility to touch which is quite remarkable. If one of its leaves be rudely handled, its associates close around the sufferer as if moved by sympathy; and the leaves of the entire plant fold about the branches and stock as if they felt the rude shock.

The Fly-trap of Venus possesses bivalved leaves which join at their bases with a hinge, and have their edges set with prickles. Within the trap a sweet juice is exuded. This attracts flies and other honey-loving insects. In the deeper recesses of the snare are three sensitive bristles, which, when touched by any part of an unwary intruder, excite the jaw-like leaves, and cause them to entrap whatever victim may be within the closing folds. And any effort to escape on the part of the prey is attended by a still firmer grip on the part of the plant. After the struggles of captives are over, the innocent leaves open again and wait for another opportunity to manifest their merciless powers.

The Pitcher-plant is endowed with similar purposes and activities. One variety raises its head like a cobra, and spreads a hood over the similitude of jaws. Directly beneath are red wattles that attract flies, and above in a gaping cavity, like the fauces of a serpent, is the nectar which allures insects, and the slightest touch of the irritable semblance of a throat provokes a twist in the neck of the pitcher and thereby closes every avenue of escape, except into a fatal trap below. The curious imitation of a snake in form and cunning, as displayed in a beautiful plant, staggers our powers of apprehension; and challenges the ingenious evolutionist to make the plan or purpose intelligible. It would seem as if the vegetable world was playing fantastic pranks with the forces that govern the animal kingdom; or that vegetable snakes foreshadowed the coming of deadly carnal creatures.

Orchids or air plants, in tropical climates, present for consideration some features that indicate both the desire and the ability to imitate or mimic animal peculiarities. A terrestrial orchid, of Panama, at its top has a whorl of white flowers which take the shape of a dove so completely, that the superstitious see in it an embodiment of the Sacred Spirit. In the island of Trinidad is found an ærial orchid whose flower closely resembles a butterfly on the wing; and as it floats lazily upon the breeze, the wariest observer may be deceived by the skill displayed in the simulation or mimicry. Other orchids imitate the forms of the bee, the spider, and creatures whose outlines may be shadowed upon the unfolding plants. If the imitations be accidental, chance can be cunningly fanciful; and reason may be confounded by the phantasies of the fortuitous. The oddities of shape assumed by fantastic orchids warrant a dreamy belief in all the fairy tales ever told.

The sea is not outdone by the land in the exhibition of the lower order of intelligences, as manifested in the production of fanciful forms. The corallines present a strange combination of the mineral, vegetable, and animal kingdoms, being petrous in the composition of their tree-like stalks and branches, and decidedly animal in their soft tissues.

A true coral bud is the shell, case, or house of a real polyp, and is developed with the growth and activities of the animal, just as the carapace becomes part of a tortoise, only the tiny radiate elaborates its habitation from marine salts; and to do this it must possess central or axial neurine, with volition or *personality* that is akin to consciousness. A plant or tree has no such neural center, yet a sponge, which is plant-like in form and development, possesses animal matter of a colloid character in its tubules, with no visible signs of a neural admixture. However, there is reason to suppose that the gelatinous flesh of a spongiole is not absolutely nerveless. In fact, it is difficult to conceive of living flesh without presuming the presence of nerve influence. In star fishes, as well as in all radiates and insects, there exists a series of neural knots that act as batteries for the generation or production of nerve forces. In regard to a clam, oyster, or other mollusk, it can not be said that a head exists, yet where the neural knots are placed near together, generally in pairs, there is the cephalic center or the seat of volition or "personality" already alluded to. From that leading and controlling center nervous impulses go out, and to it impressions flow for recognition. For all practical purposes it is a brain. Without that ideal "head" or center of neural activity, there can be no complete and independent personality—no volition or purpose in the display of action. With this ganglionic center of nerve force, the slug or snail can exist within its environments or surroundings as logically and effectually as an elephant or an ox. The neural knots consist chiefly of fat and phosphorus in the form of oleo-phosphoric acid; and the oxydation of the phosphorus is the chemical action that evolves nervous energy or nerve force. The neural apparatus is simple in a jelly-fish, yet it is impressible, purposive, and executive. As the creature spreads itself out into a thin net and sends out arms to ensnare prey, a plan is displayed; and when the colloid mass of living matter closes in upon or envelopes a victim to be used for food, a purpose is executed; and the entire procedure is carried out by the action of a nervous system of the simplest kind conceivable. A certain degree of intelligence is manifested in the creature's operations; and a kindred intelligence, in varying degrees of intensity, takes care of life as well as it can, in all grades or conditions of animality. In the lowest appreciable form there is collected into a knot a mass of phosphorized fat which is vitalized; and this, through the medium of oxygen constantly supplied, becomes a battery for the evolution of nerve power. Placed in the soft body of a snail it generates intelligence enough to enable the creature to crawl forth in favorable weather to gather food, and to withdraw within its shell when danger threatens. If that intelligence be not mind it answers the purposes of one in the execution of the few desires of an exceedingly humble creature.

In ascending the scale of living beings a class of animals is encountered having segmented bodies, or several parts chained together in rings, as spiders, wasps, ants, and butterflies. All these have a collection of neural knots about the mouth and throat, and a neural cord extending along the ventral aspect of the body; and arranged on this cord at each segment of the trunk is a pair of nerves to preside over the movements of the wings, legs, feelers, or ovipositors. The knots or ganglia located about the head and neck constitute the knowing part of the animal. In these knots of neural matter are developed degrees of intelligence that, in some features, rival the wisdom of man. It is flippantly declared that these articulate creatures are governed by instinct, and that they have no mind that is improved by experience, or is educable, but every trained observer has found that instinctive knowledge, so called, is sharpened by experience, and often improved by the vicissitudes of fortune. The intelligent principle resident in a set of somewhat scattered neural ganglia may not be as teachable and comprehensive as that developed in a more compact nerve-mass, as the encephalon or brain of the higher animals, yet it is both tractable and improvable. The spider has no brain, yet the creature thinks, makes snares to net prey, lies in ambush, repairs broken gins, changes hunting places when game becomes scarce, or any thing has seriously interfered with trapping operations in an old haunt.

A single neural knot or a pair of ganglia, with nervules extending to and from this center of action, constitutes the simplest demonstrable apparatus for generating intelligence; and four or five pairs of ganglia in a group about the head make a very strong battery of neural activity. As a rule, invertebrate animals are small, yet the octopus, or cuttle fish, is sometimes monstrous in size, and generally very intelligent. The centipede has more pairs of ganglia than any winged articulate, yet no more neural knots about the cephalic extremity of the body or the region in which intelligence is developed or evolved. A pair of ganglia seem to be necessary to work each pair of legs, therefore in a creature like the centipede the ganglia must be numerous. So far as general intelligence is concerned the centipede ranks low. The nerve forces of the creature are chiefly devoted to locomotion, and not to the origination and execution of purposes.

A peculiarity of articulates which have three states of existence, is that in the worm or larva state there are present more pairs of ganglia than can be found in the pupa or chrysalis state, and there are still less pairs in the imago or winged state. While undergoing the various transformations the neural ganglia become aggregated in the head and thorax, while those in the caudal region disappear or become insignificant in size and function. The metamorphosis from the voracious worm to a mysterious pupa, and then to a beautiful butterfly either not feeding at all or confining its capricious diet to the most delicate nectars, constitutes the most wonderful of phenomena, especially when it is considered that the volition, "personality," and selfish purposes undergo such radical changes.

It is said of instinct that its knowledge or intelligence extends only to restricted limits, that it admits of a certain range which is measured and bounded. Well, let this be granted; then endeavor to find out whether animals that possess brains and quite high grades of mental capacities, have given to them unlimited scope for the exercise of their ambitious desires. The white bear and musk ox stick to the arctic regions, and a thousand varieties of animals can never leave the tropics. Man is the most flexible of creatures, so far as the vicissitudes of climate are concerned, yet he has struggled in vain to reach the poles.

The lowest real brains appear in fishes; and they consist of four or five pairs of well defined masses of neural matter crowded into a bony skull. Reaching from the most posterior of these ganglia there extends along the back and toward the tail a dorsal cord running in a canal inclosed by the vertebral chain of bones. The skull ganglia constitute the encephalon or brain, and some of them are capable of very high range of development. The cerebral ganglia of man attain a weight of several pounds. Between the lowest encephalon and the highest there is more difference than between the diminutive brains of a tiny fish and the largest ganglia of a water-beetle in the same pool. The beetle is brainless, to be sure, but quite intelligent; the stupid little fish can boast of possessing brains, yet of less mental capacity than many insects. It is a fact, too, that fishes and reptiles are not capable of being far advanced by experience and education. The shark family possesses comparatively large brains and considerable intelligence.

Hæckel, in his *Evolution of Man*, page 251, says: "The vertebrates have no connection with the great group of articulated animals (arthropoda); but to the latter belong not only the crabs, but also the spiders and insects, which last form a single class, comprising probably as many, if not more, distinct species than all the other classes of animals together. Unfortunately, we lose by this the relationship which might otherwise connect us with termites, ants, bees, and other virtuous members of the articulate class. Among these insects are many well known patterns of virtue which the fable writers of old classic times held up as examples for men. In the civil and social arrangements of the ants, especially, we meet with highly developed institutions which we may even yet regard as instructive examples. But, unfortunately, these highly civilized animals are not related to us."

The above quotation, when considered in connection with the rest of the book, seems like mockery. Hæckel, regretting that we have no relationship with the ant and the bee, and other animals enjoying advanced systems of government, is in a certain sense suggestively racy.

Several well known beetles will mimic death as artfully as an opossum; and certain butterflies will assume the form and general appearance of leaves and sticks to escape the covetous eyes of birds and other enemies. Mimicry for deceptive purposes seems to be inherited in part, though the trick is improved upon by experience. The well known little striped squirrel, the first time it happens to be pounced upon by a cat, will feign death so completely as to deceive the captor, and thus obtain an opportunity to escape with a few harmless bites or scratches. Certain birds of the thrush and sparrow families will, when driven from their nests, feign to be hurt, and lamely hobble away, as if to provoke pursuit; and the artful creature will fly out of sight as soon as the pursuer is well away from the nest. In birds the cerebral masses gradually rise from the similitude of reptilian brains in the ostrich to the comparatively advanced cerebral lobes or hemispheres of parrots, finches, and canaries; and the cerebral surfaces exhibit well marked convolutions. The turkey possesses small cerebral hemispheres, and a thin covering of gray neurine, almost without convolutions, and the bird in picking up corn spread as a decoy, has not, after stooping to pass under a gate, sense enough to escape from the trap by the way of entrance, which is still left open.

Geese are endowed with a low order of cerebral matter and cephalic ganglia, yet the stupid creatures, in a wild state, have intelligence enough to fly north upon the approach of the breeding season, in order that they may have a safe and healthy place to rear their young. They have learned by experience that there is no security for them in rivers, bayous, and lagoons infested with alligators, huge gars, and other voracious enemies.

In the comparison of degrees of intelligence, and the quantity and quality of neural matter, it is interesting to observe that all animals in geological periods prior to the *Tertiary* were endowed with a scanty amount of brain; but at the commencement of the Eocene, when mammals made their first appearance, there occurred rapid and marked progress in the development of the cerebral hemispheres. It would seem as if a striking improvement in brain-making was introduced somewhat abruptly, and that the progressive tendency was kept up until the cerebral evolution culminated in the elaboration of man's elevated brain.

A purposive action originates in brain or neural knots that generate intelligence. In some of the lower vertebrates the spinal cord acts as a generator and distributing center of nerve force. However, the movements produced by irritating the spinal nerves of decapitated Saurians, are not directed by intelligence;

they result from the arousing of a headless battery of nerve matter that is still working under the stimulus of waning vitality. The battery is part of a vital machine that once possessed a directing brain, yet is now only an excito-motory center that executes function when provoked, and in directions habit has established. Thus the trunk and tail of a decapitated menopome will strike toward the part pinched or worried as if to bite or hit the cause of the irritation. The headless body, if turned upon its back, will make an effort to regain its feet; and if the attempt be successful, the trunk will remain still and at rest, there being no struggle to run away. The effort to regain the feet is not that of purpose, but one of habit. A headless creature can have no desire or plan. The trunk of a recently decapitated lizzard will poise itself upon the feet, and even take steps forward, yet no intelligence is manifested by such movements. If a toe be pinched, the stump of a neck will strike at the pestering object, as if it were executing an intelligent purpose, yet the movements are excito-motory, or automatic. There can be no will or wish in the matter. Even this excito-motory activity ceases in the course of a few hours, or as soon as the nerve-battery in the spinal centers is dead or unimpressible. The heart of a menobranchus will beat for hours after the organ is removed from the body, the muscular contractility being kept up by neural ganglia in the cardiac tissue. The throes or throbs are as rhythmic as if the heart were in the living creature. The action is excito-motory, and will continue as long as the nerve-battery in the organ be vitalized.

In speaking of the physical properties and products of the brain, I once made use of the following language, which I will repeat on this occasion :—

"In his physiology, at the commencement of the second section, Dalton says: 'In entering upon the study of the nervous system, we commence the examination of an entirely different order of phenomena from those which thus far have engaged our attention. Hitherto we have studied physical and chemical actions taking place in the body and constituting the process of nutrition. We have seen how the lungs absorb and exhale different gases; how the stomach dissolves the food introduced into it; and how the tissues produce and destroy different substances by virtue of the varied transformations which take place in the interior. In all these instances we have found each organ and each tissue possessing certain properties and performing certain functions of a *physical or chemical nature* (italics mine) which belong exclusively to it, and are characteristic of its action. The functions of the nervous system, however, are neither physical nor chemical in their nature.'"

How Professor Dalton could have considerately written the above is more than I can comprehend. He must know that brain and blood are the physical agencies in mind-making, and that the function is chemico-vital. The contact of the portal blood and the ultimate granules of the liver are not less physical, nor the elaboration of bile more chemical. The evolution of mental essence is thoroughly organic,—mind is an organic product, chemico-vital in origin. Mind springs from living brains, and ceases to manifest itself as soon as the cerebrum is dead; it becomes suspended in its activities as soon as a blow upon the head arrests circulation in the brain, or stuns cell-action in the cerebral substance. Bleed a man till the brain suffers through lack of blood—till syncope comes on—till the brain evolves mind feebly, or withholds its function altogether, and we can see the agency of blood in mind-making. Cut off all blood from the cerebral mass, and no mind will be elaborated.

When zinc and copper plates are properly arranged in a galvanic battery, and dilute sulphuric acid is poured upon the laminated metals, a force or energy —an *entity*—is generated, though its presence and activity, may not be rendered appreciable to the senses until the agency be conducted on a wire, or otherwise exibited or displayed. Although the galvanic product be not visible as is bile, it is nevertheless a chemically elaborated something that can be made manifest through proper media. The product of the brain, spinal cord, and other nerve centers, displays itself on the nerves of animal bodies; magnetism, galvanism, and electricity, move best on metallic media.

Living venous blood bathes the ultimate bodies of the hepatic organ, and an inspissated fluid, called bile, is elaborated and set aside (secreted). The chemical action of the two bodies (liver and blood), under the influence of vitality, sets the bile-making battery in action, and hepatic fluid is produced! Dead blood poured upon defunct liver would not produce bile—a vital influence must be present. So with sanguineous currents and the cerebral mass; brain washed in devitalized blood will not develop mind or intellectual force; the action is chemico-vital, yet none the less a physical activity.

The brain is an organ, as is the liver. The one elaborates or evolves mind, and the other bile. The products are quite different, yet they are both results of chemico-vital action. The bile is a liquid as dense as treacle, while the nervous fluid is as subtle as electricity; but is it less a reality because of its subtlety? And can all kinds of wonderful and unreasonable powers be ascribed to it because it happens to be subtle?

What becomes of a galvanic battery when it is burnt out, used up, or exhausted, and why is its activity limited? The acid in the bath loses its corroding (vivifying) activity, and the zinc plate becomes so far tarnished (oxidized) that the feeble erosive will not decompose it; it began to act with a feeble energy, then grew into raging activity, and finally grew weak and died. If there had been a *renewal* of materials, the battery would have kept going; if it could eat and digest, it might go on till eating and digestion were impossible. But what became of the magnetism evolved or elaborated? We are told that heat, light, and electricity are correlative states or interchangeable conditions; probably the whole story has not been related, yet we are led to understand that the generated magnetism is not absolutely lost—it is diffused in universe where nothing is lost.

A child is born with an undeveloped brain that elaborates very little mind; the cerebral mass is almost without convolutions, and the gray matter—nerve cells—unfit to unfold even dreams. If death occur in early infancy, the child never consciously thinks—it has never been conscious of existence. In time, with vigorous health, the brain-cells develop, and the cerebral mass grows rich in phosphorus; to this is pumped every second plenty of blood charged with oxygen—the nerve battery is in bounding activity, yet grows stronger and stronger until impairment of materials supervenes. The battery is active in sleep and while awake. In somnolence it generates incongruous dreams; in waking hours we exercise a *will*, or regulating power, which we have obtained by cultivation. At night we lose control of the flow of ideas, and the mind is generated in a random manner. The battery is in order and running, but the regulator is wanting.

In old age the nerve battery or mind producing organ loses its wonted activities—the cerebral mass lacks phosphorus, and the blood is less rich in oxygen. Besides, the thickness of the walls of the capillaries, and the density of the parieties of the nerve-cells, are reasonably presumed to favor inactivity.

A thrombus forms and enlarges in one of the great cerebral arteries, so that one part of the brain gets very little blood; a condition of softening sets in, and extends, for its nature is progressive. The victim loses memory, sympathies, and affections; and imbecility and deranged mental activities exhibit themselves. Mental soundness is questioned; and the veil of charity is stretched over the wreck. Did the feeble infant mind grow into the playfulness of youth, the resoluteness of adult life, and then decline to a state of imbecility? It most certainly did, and obeyed organic law all the while. That infant mind was born in connection with an infant brain—the battery was weak; it grew in scope as the brain developed into an active mind-producing organ; and it at length grew weak again, because it was associated with an old and worn-out cerebral mass. What became of all the mind developed or evolved during a period of three score years and ten? Was it lost? No, not lost. Nothing in the universe is absolutely lost.

If the brain be stunned by a blow, the nerve-cells are so disturbed that no mind is evolved—the injured person is unconscious, and he is dreamless. His mind-elaborating battery has suspended operations. At length the disturbance of function is removed; then mind-making is resumed. The chemico-vital machine gets into full operation again. The suspension was temporary, yet it might have been permanent, as in death. . . . . .

The infant mind, so far as it manifests itself, may, while developing, exhibit certain peculiarities derived from both parents, and certain others traceable to more or less remote ancestors. The mixed mental inheritance is not more mysterious than the physical combination which exhibits ancestral peculiarities of a multiple character; yet the complex influence that stamps personality upon every recurring individual is a product of general heredity and not the result of mental growth in the person. In other words, through the complexities of descent, a psychical power runs which is not wholly mental in origin, though influenced from generation to generation by intellectual activities. A child is not mentally just like its father nor its mother, nor like any of its ancestors, but it possesses a new combination of psychical powers which simply resemble those that have gone before. Each child comes into existence with a novel admixture of psychical peculiarities—it comes with a soul inheriting the features of all its ancestors commingled. In the new being are renewed all the characteristics of antecedent races of mankind; and new combinations will live forever, or as long as the human race lasts. A man need not ask whether he shall live again, for a psychical continuance, through natural descent, is unavoidable.

The ruler who designed the Pyramids and entered upon their construction, exerted an influence upon mankind that will be forever felt; the philosophers of Greece have left as lasting monuments, though in psychical impressions; the creations of Shakespeare and Göethe will endure as long as the statues of Phidias; and every deed worthy of admiration will exert an influence upon generations yet unborn.

ABBOTSFORD AND MELROSE ABBEY.

The American, whether he visits England or not, always feels as if he inherited certain rights there; and that he should, if the occasion present itself, look after ancestral interests. Although our fathers, as colonists, had a quarrel with the petulant "Home Government," and we succeeded in setting up housekeeping for ourselves, we no longer entertain a grudge against the descendants of those who thought we were wrong! We have a country of our own, and quite naturally glory in its marvelous growth, but we do not forget that our laws and customs have been largely copied from English samples; and we love to read in prose and verse the stirring words of the best English authors. Indeed, we claim partial ownership in the literary productions of the mother country. We purchase her publications, and trust that our patronage has been appreciated. If we have appropriated any thing without giving due credit, we have done it much as a boy takes a cake from his mother's pantry.

The most thrilling tales read in our boyhood are from *Border Minstrelsy;* and the general reader cannot help admiring the witching poesy of Sir Walter Scott. The knighted bard was born in Edinburgh, but spent much of his boyhood in a region of country often fought over in a strife for territory, in struggles for prestige, and in making reprisals. Then there were the endless disputes about Succession to the

Scottish crown on the part of kings and chieftains; and bloody bickerings between Scot and Britain in regard to the Anglo-Norman frontier. The results of a battle reconstructed boundaries, and provoked animosities which became chronic. The land was full of song and story; the valiant deeds of chieftains were rehearsed at every fireside on the border, and the youthful maker of rhymes wove these tales into captivating prose and verse. Walter Scott was naturally a genius, but the surroundings of the man helped to develop his talents, and to give them a turn in a given direction. He was a patriotic son of Scotia, and warmly sympathized with the gallant heroes who triumphed well at Bannockburn, but lost at Flodden Field. In these decisive battles, fought mostly in hand-to-hand encounters, were ample opportunities to display

> "That stern joy which warriors feel
> In foemen worthy of their steel."

The Lay of the Last Minstrel and *Marmion* are faithful representations of contests in armor, the weapons of the cavaliers being swords, spears, and halberts. Individual tilts took place on horseback as well as on foot. Sometimes heads were severed by the stalwart blow of a battle-ax. The issue of a fight depended more upon the display of personal bravery on the part of leaders than upon the discipline and skillful handling of troops.

The famous "Border Wars" were over before Scott was born, therefore he became a subject of the English Crown. But his heart was ever loyal to the land of his birth and that of his ancestry. He could not help bestowing glory upon Scotland and championing her causes. His burning patriotism bursts forth in the lines—

> "Breathes there a man with soul so dead,
> Who never to himself hath said,
> This is my own, my native land?"

In early life, Walter Scott was physically feeble, and a sickness resulted in a lameness which always continued. In manhood he was robust and jolly, but in the last years of his life he became a paralytic, and died at the age of sixty-one, at Abbotsford. His remains were buried beside those of his wife, in Dryburg Abbey. As a student, the youthful Scott was easy to learn, and possessed a remarkably good memory. He took to modern languages, and knew little of the classics.

Through the influence of distinguished friends, young Scott obtained a lucrative office at Selkirk. Having much leisure, he read much, and began to try his talents at ballad writing. At twenty-five he was established on a liberal salary in Edinburgh, and there wrote *Border Minstrelsy.* At thirty-two he gave to the world *The Lay of the Last Minstrel*, and stepped to the front as a popular writer. Then in rapid succession came *Marmion* and *The Lady of the Lake.*

At twenty-six he married, and lived happily with his wife during her lifetime. Sometimes they dwelt in Edinburgh, and sometimes in the country. As Scott's fortune grew, a desire developed to have a home in a rustic neighborhood. After consulting the wishes of his consort, the admirer of rural scenes bought a farm-house on the "Border," and converted the estate into "Abbotsford," as he christened his growing mansion. On some broad acres of alluvial soil, in a bend of the Tweed, still stands the "Romance in Stone;" and the renown of its founder draws thousands of pilgrims to the place every year. The location for a home was carefully selected, and the erection of the buildings and the ornamentation of the estate were conducted at intervals as leisure and income permitted. The surrounding at best is attractive only to a moderate degree. The land is not fertile, except in occasional spots near the bank of the river; and the pastoral inhabitants are plain as they are honest. The hills are not covered with timber, but with heather and brushwood—covers for rabbits and pheasants. The Duke of Buccleuch owns large estates hereabouts, and maintains a hunter's lodge in the vicinity. Occasionally he entertains members of the Royal family, and takes his visitors on a fox hunt. Then the musical bay of the hounds calls to the fields the entire population of the vicinage.

When Washington Irving paid Abbotsford a visit, he remarked to his distinguished host that the scenery of "Borderland" had been a disappointment —that "the hills were too bare to be beautiful, and too low to be impressive." Scott hummed a moment as if at a loss for a proper reply, and then bravely said: "It may be pertinacity in me, but to my eye these gray hills and all this Border country have beauties peculiar to themselves. I like the very nakedness of the land; it has something bold, stern, and solitary about it. When I have been for some time in the rich scenery about Edinburgh, which is like ornamental garden land, I begin to wish myself back again among my own honest gray hills; and if I did not see the heather at least once a year, *I think I should die.*"

A business transaction of an unfortunate character called Sir Walter Scott to Edinburgh, and kept him there during a period of life he had planned to pass in retirement among the crags and glens of the "Border;" and there in the great mart of trade he delved like a galley slave, with an unwavering purpose to free himself from every pecuniary obligation. And his prolific pen and his popularity as a writer soon wiped out the larger part of a debt which at first seemed a mountain. But the incessant toil sapped the foundation of a vigorous constitution, so that the recreative influence of foreign travel failed to restore vigor to the impaired body and mind. Death did not too soon close a life which at length became a burden.

A lineal descendant of Sir Walter Scott now resides at the old homestead, and shows tourists the most interesting features of the somewhat extensive demesne. From the large windows of the breakfast-room is a view of rare loveliness. Cattle and sheep graze on the grassy mead which stretches a few hundred yards to the gurgling Tweed, which is here shallow—Abbot's *ford*. A large hall is filled with old armor, and other curiosities of a multitudinous character. A drawing-room is hung with valuable paintings, and embraces carved furniture, with images in ebony and ivory. The library is the largest room in the house, and contains seventy thousand volumes. The grounds within the domain are kept in fine order; and the visitor feels quite well paid for the time and money spent in a pilgrimage to the villa.

The railway which takes the traveler to the vicinity of Abbotsford runs from Edinburgh to Carlisle, passing through Hawick (where is the manufactory of "tweeds") and having a station at Melrose, a village three miles from the Scott estate. Before arranging for the drive to Abbotsford, the tourist takes a survey of Melrose Abbey, a cloistered ruin of beauty and renown. The dilapidated monastery was built in 1136, under the liberal patronage of St. David, or David I., of Scotland; and a colony of Benedictine monks was invited to conduct the ceremonies of the conventicle. The English, in a foray over the border, destroyed the structure in 1322, and scattered the pious band. This hardship made the members all the more influential. They were a highly educated class, and skilled in the arts of an advanced civilization; therefore, they naturally became schoolmasters for the rising generations, and cultivated the arts of peace among the warlike dwellers on the Border. They shed a refining influence on every hand, and earned the protection and patronage of those in authority. At length Robert Bruce was moved to rebuild the Abbey, and through the scattered monks to re-establish the ceremonials and hospitalities of the place. In the restored condition the monastery continued to flourish until the throes of the Reformation despoiled the sacred vestments and art treasures, and defaced the venerated structure.

While tenanted by monks of the Cistercian order, the Abbey was often a place given to wine and wassail; and the following verse was perpetrated to satirize the doings of the cloister:

> "The monks of Melrose made gude kail
> On Fridays when they fasted;
> Nor wanted they gude beef and ale
> As long 's their neighbors' lasted."

The inclosing walls of the Abbey are nearly entire, and a part of the roof, supported on the arches of Gothic columns, still shelters the foot of the crucial nave. The body of St. David was buried near the head of the auditorium. To the left of the King's grave was placed the embalmed heart of Robert Bruce.

Adjoining the ruin on two sides is a burying ground, whose moss-covered head-stones can scarcely be seen, and whose graves are level with the intervening ground. The most ancient of English lettering is on the more pretentious monuments; and the curious among tourists spend days and days in attempts to decipher the epitaphs. Nearly all the interments are centuries old. A few families of the neighborhood possess rights in the grounds, and there are some recent burials made by them. Fragments of sculpture, half overgrown with grass, are to be seen here and there, but whether wrecked by time or iconoclastic hands is left to conjecture. A few statues still hold their places on the cornices of the Abbey, and serve as samples of what might have been the original ornamentation of the architects. The first stanza in Canto Second, of *The Lay of the Last Minstrel*, is a metrical and rhymed description of the famous ruin:—

> "If thou wouldst view fair Melrose aright,
> Go visit it by the pale moonlight;
> For the gay beams of lightsome day
> Gild, but do not flout, the ruins gray.
> When the broken arches are black in night,
> And each shafted oriel glimmers white;
> When the cold light's uncertain shower
> Streams on the ruined central tower;
> When buttress and buttress, alternately,
> Seem framed of ebon and ivory;

When silver edges the imagery,
And the scrolls that teach thee to live and die;
When distant Tweed is heard to rave,
And the owlet to hoot o'er the dead man's grave.
Then go—but go alone the while—
There view St. David's ruined pile,
And home returning, soothly swear,
Was never scene so sad and fair."

The good people of Melrose are timid about following Scott's formula; they are not given to viewing the Abbey at night. In fact, they declare the night air in the vicinity of the ruin to be unwholesome, and hint that on certain crispy nights in autumn the narrow galleries are visited by phantom monks who chant weird music to the accompaniment of lute and harp. The belief is that specters and goblins haunt the place, and do not relish having their nocturnal orgies viewed by mortal eyes. The testimony is that spirits have been seen flitting in dark corners of the crumbling pile; and the suggestion that the mysterious movements may have been produced by the wings of bat or owl is treated with derision. Scott's advice to "go alone" to the ruined pile, and *at night*, is treated with contempt, the idea being that we have no right to trifle with the powers of darkness! A brave citizen stated that he should not be afraid to visit every part of the dilapidated building at midnight, if there were any good reason for so doing, but he should not go unbid. Why should he disturb the repose of the dead at night? Scott might do it, but he would not. He believed the low musical notes, like the subdued chants of a choir, were produced by the wind while forced through the fluted corbels. He did not think that the spirits of departed monks revisited the consecrated place.

At the inn adjoining the Abbey are apartments looking upon the ruin and the adjacent burying ground, and guests aim to secure lodgings in these rooms. There is so much fascination in connection with the old monastery that occupants of these favored quarters spend much time in gazing upon the "scene so sad and fair," and in musing upon events connected with the history of the "ruined pile." The desolate and dismantled Abbey was constructed of such durable material, and the foundations were so well placed, that the sanctified and despoiled structure is liable to last a thousand years. The ravages of time alone are likely to disturb the interesting ruin. A pious reverence for the founders of the notable Abbey, and a cherished hate for its destroyers, tend to perpetuate a profound interest in the hallowed shrine.

AMERICAN ARCHÆOLOGY.

(Read before the Cincinnati Natural History Society, Nov., 1877.)

Archæology pertains to people now extinct, and whose history could not be traced were it not for imperishable objects which bear marks of a display of human skill. Scratchings or markings on the face of a rock near Dighton, Mass., the Round Tower at Newport, R. I., the Earth Mounds so plentiful in the West and South, and the Pyramid of Cholulu, in Mexico, are among the larger objects of an archæological character. It is possible that the first two are apocryphal, or were the production of the early colonists, but there is no question in regard to the genuineness of the last two. The ancient Mexican pyramid is two hundred feet high, and so sloping that a horse can be ridden to its truncated summit. It is constructed of thin slabs or bricks; and the work bears evidence of great antiquity. The earth mounds alluded to are covered with old forest trees, and otherwise furnish proof of being at least five hundred years old, and possibly two thousand years have elapsed since their construction. The Indian tribes found in the country have no traditions in regard to the builders or purposes of these works. They are usually found in the vicinity of rivers, yet on the second terrace or above high water. This would seem to indicate that they were forts, especially as the positions and outlines of many of them show that they would make good places in which to stand a siege. Those in Wisconsin mostly take the form of alligators, birds, and other animals, and are not so certainly erected along large streams, though an abundance of water is never far away. These earth mounds are the most frequently met in Ohio, and are the thickest in the more fertile regions—a fact which indicates that the people who built them were of an agricultural turn. Where the soil is poor the mounds are small and scattered. If the builders of these monuments had lived chiefly by fishing and hunting, they would have erected the greater number by the ocean and lakes, and little attention would have been paid to the fertility of soils. A few mounds have been met in New York and Pennsylvania, and occasionally in Canada. The North-western States embrace several, and the Southern States as many. The mound building race can be traced from Labrador through the United States and Mexico, and even into the interior of South America.

Whether the "Mound Builders," as they are called, were radically different from the Indians who succeeded them, and from savages inhabiting other parts of the earth, is a question not yet settled. Their implements were mostly made of stone, and fashioned much as are the utensils which characterize what has been denominated the "Stone Age" in Europe. Copper axes, bracelets, and amulets are not unfrequently found in graves and mounds, but as the native ore in its purity existed in various parts of the country, especially in the region of Lake Superior, the working of copper did not indicate a higher development of art than in the modeling of stone; therefore the Mound Builders could not be said to agree in intellectual advancement with a people that wrought bronze in Europe, and established the reason for styling its products as those of the "Bronze Age," a period intermediate between the Stone and the Iron Ages. However, the graves of the Chiriqui Indians have been found to contain ingeniously wrought utensils of gold in its virgin purity, and of gold amalgamated with copper, which is a feature in advance of the Bronze Age of Europe. Silver ornaments are occasionally found in graves and mounds in various parts of the country. But, notwithstanding the unmistakable evidence of a knowledge of working the precious metals, this feature does not prove much, for the ores in their purity exist in the country, and could be worked with as little skill as is required to manufacture pottery or to chip flint implements.

Although the Indian tribes of North America were incapable of making the earthen pottery, implements of flint, and utensils of stone which were devised and constructed by the Mound Builders, the natives of Central America, who do not differ essentially from many of the Indian tribes found further north, seem to be competent to fashion as high an order of weapons, ornaments, and utensils as were executed by the mound building race. Indeed, there is much to convince the archæologist and ethnologist that they were all one and the same people, differing no more than the various tribes of modern savages.

Many of the earth mounds have been opened, and their contents carefully scrutinized. Commonly a perpendicular shaft is sunk from the apex or most prominent point to the bottom of the tumulus, and a drift is carried on a level with the original ground so as to strike the vertical well in the center. At this point or near it a bed of ashes and charred wood is met, and beneath this the remnants of a human skeleton. It is not uncommon to find pieces of pottery and a few stone and flint implements near the skeleton and the spot where the fire was. There is no evidence that the body was cremated, but probably a funereal fire was built near, and perhaps sacrifies were made, as bones and teeth of deer, bear, and some of the smaller animals, are generally found about the ash heap. In sinking the shaft and in driving the drift it is common to find relics of a rude or savage people, in the shape of flint arrows and spear heads, stone axes and pipes, bone awls and drills, or other kinds of weapons, implements and utensils. If a grave or two be struck near the summit or surface, the bones of a body buried in a sitting posture will indicate that the remains of an Indian have been discovered. It was quite common for the Indians to bury their dead in the slope of a mound. The bones found beneath the ashes and charcoal have been buried so long that they readily crumble. If a cranium comes out in its entirety it is apt to tumble in pieces as soon as exposed to the air. The animal matter has been dissipated, the lime only remaining, and retaining the form of the bone as long as left unhandled. As mounds are made of the surrounding alluvium, gravel, and sand, skeletons in the centers of the tumuli have been subjected to about the same influences, consequently if one will easily crumble, all may be expected to fall in fragments. It is rare to find a strong and unbroken Mound Builder's skull. Many of those taken from mounds in a good state of preservation are of modern Indians, and may not have been buried a hundred years. Skeletons in the centers of mounds have probably been there from one to two thousand years.

It is highly probable that a skeleton taken from the depths of a tumulus has been that of a chief or noted personage, for a people could not afford such a laborious burial for a common individual. Ordinary persons of the mound building class were buried in graveyards, some of which are occasionally stumbled upon while excavating building sites, canals, and railroads. In some instances the bones are in a good state of preservation. They are generally recognized by their position, which exhibits horizontal burial, and not the sitting posture common to Indians.

The features of the mound builder's skeleton are not very distinctive. The height of adults was moderate, though occasionally the bones of a giant are discovered. The skulls are flattened in the occipital region as if compressed in infancy; and their walls are thick or otherwise savage or semi-civilized. The brain capacity of the skulls is below the average among civilized peoples. The forehead is rather low and retreating, consequently the intellectual powers of the race must have been medium or below that of ordinary men. Evidence of great mental development is nowhere met. The teeth of the Mound Builders show that the possessors lived in part, at least, upon the fruits of agriculture, for they are not worn down in adult life, as are those of savages who are universally given to the chewing of roots, the grit on which grinds away the faces of the teeth.

In some parts of the country the mound building race buried their dead in graves walled up and covered with stone. In these the skeletons are apt to be tolerably well preserved, together with the pottery and utensils placed beside the dead. When children were buried in stone-lined graves, an earthen cup and shell spoon were placed on one side of the head.

It is easy to speculate upon the uses of the mounds, as places of sepulture for the chieftains, look-out stations, elevations for the distinguished at noted gatherings, and for a thousand other objects equally plausible, but all is the merest conjecture. These tumuli may have served several purposes, though erected with a single object in view. One prominent theory is that the Mound Builders were sun worshipers, and that the people or priests assembled on these elevated places to welcome the rising luminary, and to bid him a reverential adieu at evening. The early settlers conjectured that these artificial earth works had treasures deposited in them, hence many tumuli were opened solely through avaricious motives. At present a mound is rarely opened except by an association of reliable men whose chief object is to make archæological discoveries; and the work is so conducted that little opportunity is given for the practice of deceit. The country is thronged with relic hunters, and some of them can not be trusted to make honest reports of "finds." Although a curiously wrought pipe, vase, weapon, or utensil possesses no intrinsic value, as a relic the article may sell to collectors of such things for several dollars. It is not uncommon for ten dollars to be paid for a rare specimen. Common stone axes, hatchets, and skin dressers, will not command more than a dollar or two, and if the lot is somewhat indifferent, two or three pieces may be obtained for a dollar. I have known fancy and highly wrought relics to sell for twenty-five dollars, but such sales are exceedingly rare. In all large cities there are parties who get a good living by trafficking in archæological goods. The dealers buy, sell, and exchange, and become experts in the purchasable worth of relics. The plow and the spade are constantly turning up new material. The best preserved hollow utensils, as vases, water jugs, pans and plates, are now brought from Missouri. Some specimens are so fresh and perfect that the suspicion has arisen that a modern manufactory may have been started in that region. At McCutchinville, in Northern Ohio, a man has a large and curious stock of "archæological goods," which he has made with his own hands. He has agents out to supply those persons who have a desire to possess a rare collection of "relics." A critical and experienced collector will determine what is spurious and what is genuine as readily as a banker can detect a counterfeit note.

In this connection it may be stated that several noted frauds have been committed by persons who at first were deemed incompetent to practice them. There has been such a desire to discover alphabetical signs or characters which should indicate the origin of the mound building race that the inducement to acquire fame by unearthing a pictured or inscribed stone, or one bearing engraved characters that might be interpreted, has actually led to the execution of a few gross deceptions. In 1860, an engraved stone was put on exhibition in Cincinnati. The specimen was called the "Holy Stone" by its alleged finder, possessor, and exhibitor. It was claimed to have been exhumed from a mound opened near Newark, Licking county, Ohio. Every body supposed the stone was genuine, until some critical Hebrew scholars examined the characters plainly chiseled on the face of the "dornick." These Hebrew critics discovered that the consonants were attended with vowel marks that had been introduced in the twelfth century, consequently the engraving was comparatively recent, and, of course, a barefaced deception. Although the exhibitor was denounced as an imposter, he unearthed a stone from another mound which bore an epitome of the Ten Commandments in the same modern Hebrew characters. The neighbors of the finder of these astounding relics declared that he was as ignorant of Hebrew as he was of tattoo marks on the Fegee Islanders, therefore the inscriptions must be out of his power to design. After the death of the finder, a Hebrew Bible was found in his house, and from that he had patiently copied the letters.

The so-called "Grave Creek Stone," which has several characters or letters engraved upon it, is alleged to have been taken from the bottom of a mound seventy-five feet high, which is located on Grave Creek, near the Ohio River, twelve miles below Wheeling, in West Virginia. The mound was opened in 1838, by sinking a shaft from its apex to the level of the ground on which the earthwork was raised, and a horizontal canal or "drift" which should meet the vertical well in the center of the base of the tumulus. Just as the central point was reached the perpendicular earth fell into the horizontal shaft or drift. The loosened earth was carried out in wheelbarrows, and while it was being dumped, a stone as big as a Mexican dollar, and about twice as thick, was discovered. This was scrutinized very closely by the several gentlemen present, for one of its surfaces bore three lines of characters or letters that could be distinctly seen. Some of the characters were thought to be Runic or Phœnecian, therefore the stone was sent to Europe for an interpretation by scholars and pundits of the "universities." Casts were taken of it in plaster and wax, and the genuine stone and its copies received extended attention. Our Government had a drawing made of the famous stone, the work being done to illustrate "Schoolcraft's Indian Tribes." At the time the stone was found, and for a number of years afterward, no one questioned its genuine character, but at length Mr. Squier, an eminent archæologist, suggested that the whole thing might be a fraud, although the "find" was made before many impositions of the kind were practiced. Prof. Charles Whittlesey, of Cleveland, a man well versed in archæological science, in his pamphlet, No. 33, denounces the Grave Creek Stone as an imposition. Mr. J. E. Wharton, of Portsmouth, Ohio, claims to be the only person now living who saw the stone taken from the earth when dumped from the wheelbarrow. He says that the loam adhering to its lettered surface bore evidence of having been there for centuries, and there was no opportunity for fraud in the case, nor inducement, inasmuch as the relic was never offered for sale by its owners. It is now in the Smithsonian Institute, at Washington.

The next engraved stone in the line of importance, perhaps, is the one taken from a mound in this city. The tumulus was at the intersection of Mound and Longworth streets, and was razed to grade the ground for street purposes. While the loam was being carted away a stone five inches long, three inches broad, and half an inch thick was found, and upon cleaning its surface a fine display of ornamental flutings was discovered. This stone bears the name of the "Cincinnati Tablet," and is here believed to be a genuine "find," though Mr. Whittlesey, before quoted, pronounces it a fraud. The genuineness of the stone has this in its favor, that it was picked up by honest hands, and the act was witnessed by those whose word has never been questioned. The history of the finding of the Tablet, together with an able description of the ancient earthworks that once existed on the plateau where Cincinnati now stands, was prepared and published by Robert Clarke, in a pamphlet whose title page bears the following words: "The Pre-Historic Remains which were found on the site of the City of Cincinnati, Ohio; with a Vindication of the 'Cincinnati Tablet,' 1876."

While I have no reason to question the genuine character of the Cincinnati Tablet, I do not see as much in its engraved flutings to convince me that a written or pictorial language existed among the Mound Builders, as I find in other sources. Mr. Mercer, a dealer in archæological goods of this city, possesses a vase in good state of preservation which has figures upon its outer surface that were molded there when the utensil was made. The figures are of a different colored clay from the main part of the vase. The vessel will hold a gallon or more; is truncated at the base, bulges in the middle, is constricted in the neck, and flaring a little at the mouth. The decoration may be tortured into a bird with a long neck extended over the wretched outline of a man, the feet of the bird reaching in a circular sweep toward the beak. The ancient artist may have had no intention of representing any such thing, but merely meant to lay on the red clay in a fantastic manner, chiefly designing to have the vessel ornamented.

Vases ornamented with turtle's feet and head are not uncommon. The outlines of birds, frogs, and of the human figure, are frequently found wrought in pottery, as well as in stone pipes, and other implements.

The language of a savage people is largely made up of animal forms, and ideas associated with their nature. If Sitting Bull were to construct his autobiography, he would take a dressed buffalo skin, and paint its entire surface with pictures of birds, snakes, beavers, wolves, bears, antelopes, panthers, and such animals as he conceived to represent his authority, his achievements, his ambition, his revenge, his victories, and his defeats. If asked to read this pictorial life history or autobiography, he might be an hour in putting these symbols of extended thought into words, and he would declare that what he said was all embraced in the signification he gave these animal forms.

If the Mound Builders ever employed figures to represent ideas, so much was left to the imagination to supply, that the knowledge could not be conveyed to a stranger, nor handed down from one generation to another, except that the figure of an eagle, a bear, a wolf, or a snake was the heraldic emblem of the family. All savage races possess a disposition to ornament their weapons and utensils; and some of them tattoo their persons. A Cannibal Islander may have his skin covered with ornamental figures, yet none ot them may represent an idea.

I believe it to be unreasonable to expect the discovery of any thing that can be dignified with the name of a written language among the relics of the Mound Builders. They were in the habit of fashioning weapons, implements, and utensils from stone and other imperishable materials—they grooved, drilled, polished, and engraved them, yet they have left no connection of characters that can be interpreted as conveying more than the meaning that may be attached to a frog or a bird. As long as people are intensely interested in archæology and ethnological studies, individuals will be met who earnestly believe that a race capable of accomplishing so much, must have been ingenious enough to construct a written language, whether it be alphabetical or pictorial; and they will also cherish the idea that a key—a Rosetta Stone—will yet be found which shall unlock the mysteries now hanging about the animal figures represented in the shape of mounds, and engraved upon stone implements, or molded in the soft clay that was to be baked into pottery.

Some years ago the extensive collection of archæological objects brought together by Messrs. Squier and Davis in their explorations of the tumuli and earth-works of the Ohio and Mississippi valleys, was offered for sale, and as no Antiquarian Society in the United States seemed disposed to buy it, Mr. Blackmore, an English gentlemen of wealth came into its possession by purchase, and added it to his museum at Salisbury, England. The departure from our shores of such a rich and varied cabinet of American antiquities was regarded as an irreparable loss to the nation, but the contributions of kindred articles to the Smithsonian Institute, the Philadelphia Academy of Natural Sciences, and other institutions of a similar character in various parts of the country, and the extensive and growing cabinets of a private nature in almost every large town and city in the land, will in part compensate for the collection which left us with so much regret. Every year adds largely to the stock of archæological goods in American hands; and the zeal for collecting relics is evidently on the increase.

In Cincinnati, which is a somewhat noted place for large collections of "Indian Relics" in individual hands, can be found cabinets embracing thousands of specimens, and nearly all were obtained in Ohio and Kentucky. Mr. Thomas Cleaney has paid thousands of dollars for his exceedingly rich and rare collection. Dr. H. H. Hill has made exchanges with European collections, so that his cabinet is quite interesting by the intermixture of foreign patterns. Among these importations are stone axes having a hole drilled for the fixation of the handle, as in our modern steel axes.

In Europe an attempt has been made, with a rational degree of success, to divide the "Stone Age" of savage man into the Palæolithic and Neolithic periods. It is not denied that the one reached into the other, and continued as such while the other was progressing, but the former is presumed to represent the earliest and crudest productions of savage man, the stone implements being rough and ill-shapen, while the products of the Neolithic period are polished and more artistic in form. In America no such distinction has been drawn by archæologists, though a rude and unpolished axe is pronounced to be the production of the "Palæolithic Age." It may be suggested that the earliest savage men came to this country from Europe, and their migrations may have occurred during the Neolithic period, consequently relics of the Palæolithic period need not be looked for on this continent. But, specimens of handiwork obtained from modern savages in various parts of the world show that representatives of the Palæolithic and of the Neolithic periods have reached our time, just as the elephant, the rhinoceros, the hippopotamus, and a few other thick-skinned animals, have come down to us from the Miocene period of the earth's geological history. These animals became extinct on the Western continent, but recent upheavals in the Eastern world, near the Equator, in passing through their phases of terrestrial evolution, were in a state favorable to the continuance of Miocene productions.

It is not easy to conjecture what may have been the uses of many of the stone manufactures of the pre-historic races. Most of them bear evidence of having been used extensively, as they are worn away or polished by contact with the hand. The flint arrow and spear-heads are easily recognized, and so are the stone axes, but other forms are not so readily distinguished. The pipes for smoking "soothing weeds" are correctly pronounced upon at once; and so, perhaps, are the jars, vases, and water jugs, but when we come to amulets, ornaments, badges of distinction, or signs of office, much guess-work has to be done. Flint utensils chipped to the form of a spade may have been used as such, and as hoes and plows. Flints broken into semi-lunar forms, with a sharp edge on the concave arc, were probably used as knives and scrapers. Slender flints brought to a point at one end may have been employed as drills; others brought to a sharp edge at one end may have served as gouges and chisels, or as cutting tools for various purposes. Bone awls and needles, generally fashioned from the leg bones of a deer, are met quite often. Perforated shells and the grooved teeth of the bear seem to have been employed as beads or money. Double concave stone discs may have been used in amusing or gambling games. Bark peelers, root and twig cutters, have been so named from the fact that certain hematite implements with a wedge-like extremity, could serve for such purposes.

Stone mortars, pestles, and rollers are exceedingly common; so are molded and burnt pieces of domestic ware, to answer our use of pots, kettles, stew-pans, mugs, pitchers, and jugs. Globular stones are found which have been used much in the hands, possibly as hand-hammers, nut-crackers, or sling-stones. The stone axes mostly have a deep groove near the head to receive a withe which served as a handle. These were sometimes very large, weighing from twelve to fifteen pounds, though half that weight was more common. Many were light, and may have been employed as hatchets. As compared with modern steel instruments, these stone tools are clumsy enough to be laughed at, but in strong hands they were made to serve the purposes of the savage in maintaining a vigorous existence.

HEREDITY.

(Read before the Cincinnati Natural History Society, March 5, 1889.)

Inheritance signifies the transmission of peculiarities, properties or qualities, from parent to progeny, or the descent of ancestral features to posterity. In the bequest, both paternal and maternal instincts are transmitted. Inasmuch as the son takes the name of his father—the family cognomen—the popular impression is that paternal impressions are the stronger, and therefore likely to dominate, or to be leading, swervingly influential. In this there is a chance to perpetuate a mistake. A child is not the descendant of the father or the mother, but of the two combined or commingled, there being a compromise and not an individual feature from either parent. Furthermore, there may not be an equable division of parental qualities, but the child shall inherit unequally, as it were, partaking physically of the father, and mentally of the mother, or *vice versa*, yet closely resembling neither in any peculiarity. Besides, heredity does not necessarily mean the direct transmission of parental qualities, but refers to more or less remote ancestral forms which are inclined to crop out and assert themselves upon the first favorable opportunity.

The fact that a child can not possibly follow either father or mother establishes the necessity for *variation*, which is opposed to heredity in a restricted sense. Although there may be a proud satisfaction in the thought that children are to be like their parents, the contemplation is somewhat illusory; progeny is a tangle between sire and dam, and the intricate relations of ancestry. A long nose in a father and a short nose in a mother do not necessarily impart a medium nose to offspring; nor does a brittle temper in a mother with one slow of anger in a father to a certainty insure a model spirit in a child, but there will be a combination quite puzzling to the analytical observer. In some instances an advantage is gained, and in others a depreciation is the result. It has been asserted as a scientific presumption, that the child follows the father physically and the mother mentally, but there is no substantial ground for the asseveration. Among stock breeders it is well known that the dam and sire must be of goodly heritage if fine descendants be sought; an excellent pedigree on one side is not sufficient. And then in each new generation there will be apparent some divergence from parental stock.

The farmer who sows wheat expects the same kind of grain, and not oats, barley or "cheat." The latter appears here and there almost every year—a barren spike showing itself among well filled heads; but when the season is unpropitious, and the environment unfavorable, the sterile spikes become more numerous, and in rare instances they may be in the majority. The husbandman will remark that there is much "cheat" in the fields this year.

It has been demonstated, I believe, that wheat, oats and barley were once grasses; but through selection and cultivation, have been developed into a high order of cereals—wheat becoming the most valuable of all, the richest in starch granules, in bread-making qualities. The botanist recognizes several kinds of wheat, though all appear much alike. The kernels of one variety may develop beards while another kind may be quite bare of barbs. Then, again, a still other variety may be short in the spike, and another long or multiple, making quite a notable variance in brands, though all may pass in the markets of the world as belonging to the great bread producing staple.

Sometimes growing wheat is said to be "blasted," the spikes failing to fill with seeds, and the plants presenting a grassy appearance. The solution of the matter is that there has been manifest a "reversion," a retrograde movement, a return to graminaceous states—to ancestral stock. It is a rare field of grain in which every spike or pericarp is filled with plump kernels; but light or imperfect seeds in the process of winnowing are blown away with the chaff; thus a selective procedure is unconsciously carried on, the best being preserved for food and for the next season's planting. It is common for the agriculturist to select the fairest ears of corn for a coming seedtime, hence a selective process, aiming at betterment, is continually practiced in the development of farm products.

All varieties of apples, so far as known, have been evolved from crabstock by processes known to horticulturists. The original fruit is small, white, hard, sour and unpalatable, yet how delicious have become the finer grades of fruits in our orchards! If it were not for the principle of variation in hereditary descent, we might be compelled to eat repulsive crab-apples to the end of time. The laws of evolution have rendered improvement possible, as well as demonstrated the vigilance needed to prevent a return to primitive worthlessness. A fruit tree of any kind left untrimmed and untended soon becomes a tangle of twigs and branches, and the fruit small and unpalatable.

The cotton plant, if well cultivated, will become a tree and develop hundreds of bolls, yet left to itself, to be choked with weeds, is an insignificant stalk with only two pericarps. I can cite no vegetable cultivated as a crop, which develops in such multiple ratios by agricultural attention as does gossypium, or the common cotton plant.

As the finest garden seeds are selected by the farmer's wife for the next year's planting, so the stock raiser chooses the finest specimens for reproduction among kine, horses, sheep, and swine, while the progeny of scrub stock goes to slaughter; yet, so strong is the tendency to return to original or primitive ugliness or worthlessness, that ever watchful care is required to sustain an elevated status in farm products. Even with the exercise of eternal vigilance, a lapse will now and then occur. Though winning horses are the parents of winners, colts with pedigree are often worthless. The best breeds having been attained by intelligent selection through many generations, it is logically presumable that an average status of the most valuable stock can be secured and reproduced over and over again. But the tendency to degenerate is ever present and pressing. Stock breeders are always in a speculative state of mind in regard to what anticipated progeny may be worth. Perhaps uncertainty adds to the mysterious interest, especially in stock with a reputable pedigree.

It is generally supposed that plants and animals are at their best when they were first discovered, or existed as primitive stock, but there is abundant proof to show that improvement often takes place by furnishing a better environment or by offering more acceptable nutriment. The soil and climate of America have contributed beauty to exotic flowers, and added flavor to foreign fruits. The Arabian horse grazed for generations on the blue grass of Kentucky, has acquired qualities superior to those developed or manifested in ancestral stock.

The followers of Darwin and the champions of evolution are prone to utilize certain terms or expressions; for instance, "survival of the fittest," "sexual selection," "tendency to reversion," and the like, as if they expressed laws or signified principles, when they are merely catch-words to represent vital operations or sequences. On the other hand, the advocates of heredity—of Biblically attested inheritance—cite old formulas to prove that there has always been an unvarying transmission from sire to son, from parents to offspring, generation after generation, organisms continuing ever the same to the end of time.

Now, to both of these methods for conveying information there are valid objections, because neither is absolutely true. The fittest, or strongest, or most favored, do not always survive or continue, but accident or chance has something to do with heredity. Once the elephant and the horse flourished on this continent, but became extinct through causes beyond control; and when, at a subsequent period, they were reintroduced from the old world they throve as though fitness were in their favor. Sexual preference is a fancy, and often damaging as an influence in shaping the destinies of the race; and "reversion" only means a backward oscillation of the pendulum which has swung too far from the center of attraction. As previously stated, direct inheritance without modification can never occur, from the fact that the inheritor is a compromise between two beings, and therefore can not be like either—must vary from both. Admitting that all nations of the earth were originally of one blood, the evidence of variability is every-where pronounced. If there came from the ark two of a kind (male and female) except so far as Noah was concerned, the carnivorous must have destroyed many kinds of animals not mentioned and not represented since that time; and, what is now to be observed, the yellow lion of South Africa will not consort with a black variety in Algiers and Morocco; and the Bengal tiger of India will have nothing to do with the great feline of Thibet, though it be well known that the cat family varies less than almost any other. If ancient notions of heredity be true, how are we to account for the tailless or manx cat of the Isle of Man? Here seems to be a "sport" or *saltus* as great as that which robs an ape of its caudal appendage!

When a sudden and marked change takes place in the organic world, quite violating the accepted or avowed principles of heredity, we are forced to admit something like a saltatory influence to account for the spanning of wide gaps in the history of organic life, or for the accomplishment of what has taken place without evidence of the slow transforming processes peculiar to the changes of evolution. We have seen that a plant under unfavorable surroundings may drift backward at a rapid rate. While an upward course must be necessarily slow, a retrograde movement may be in leaps—"*descensus averni facile est.*"

It does not seem that the skeletal parts of a pterodactyl could be developed slowly; they should come at a leap, with a bounce. Then how could a bat's wing be evolved by a slow process? Besides, if there were gradually modified forms, there is no fossil evidence of the fact. It is possible for the flipper of the penguin to be slowly transformed from a wing into its present fin-like form. Always swimming and never flying might exert a transforming influence. However, the chick penguin should be hatched with quills in its pectoral limbs, which logically is the fact. This calls to mind the circumstance that the young of several kinds of animals do not resemble the parents in color. The spotted fawn of the American deer squints at a change of hue on the part of the parent which had as an ancestor the mottled fallow deer of Europe. The chicks of grouse are striped like the recently hatched broods of domestic fowls.

Palæontology teaches that vast changes have taken place in the size and general features of plants and animals in certain portions of the earth. For instance, there was a time when the megatherium, an animal of huge proportions, inhabited Brazilian forests. Being now extinct, the character of the great beast has to be judged by its bones. A finely preserved skeleton is to be seen in the National Museum of Madrid. The skeletal parts indicate that the animal in form and habits was allied to the sloth, a small animal which now inhabits South American forests, living among the branches of trees, and rarely coming to the ground. The megatherium was strong enough to uproot trees, that it might feed upon the twigs and leaves, and the arboreal bradypus (sloth), with nails developed into long hooks, lives where it can feed upon foliage. Now, the question suggests itself whether the gigantic animal was developed from the little sloth, or the large animal degenerated into the small one. Possibly they were distinct creatures, the larger having become extinct from causes which at present do not appear. It is quite certain that intermediate types did not exist.

In New Zealand a similar relationship exists between an extinct bird and an existing one. The moa, or dinornis, was a wingless bird ten or twelve feet in height, and once lived where the apteryx, a bird not larger than a turkey, now exists. The skeleton of the moa is destitute of wing marks, while the little apteryx has rudimentary wings with a nail or claw at the tips, thus corresponding to the dwarfed wings of the ostrich, the nail being a reptilian feature. The point to be settled is, whether, in New Zealand, there were two distinct creations, or by the forces or influences of evolution the one was related to the other in a rising or falling scale.

A peculiarity of the fauna of Australia is that the marsupial type prevails, the kangaroo being the largest and the most pronounced. The platypus is an exception to the marsupial characteristic in the animals of the island or continent, and seems to combine the features of a mole and a bird. In the peculiar combination the evolutionist finds a puzzle, and the supporter of heredity sees evidence of special creations. Neither "natural selection" nor "reversion" will solve the organic riddle; and in a creative fiat the reason for the intermixed combination is not apparent, especially as the singular production is in proximity with the echidna and other unusual forms.

In the contemplation of Australian animals, the speculative mind might see a novel fauna in a state of arrested development. However, the country is capable of sustaining exotics, whether vegetable or animal. Rabbits taken there have multiplied to an alarming extent, there being few carnivorous creatures to hold them in check. The only carnivorous animal, native to the island, is an arboreal bear not larger than a common cat.

In tracing the lineage of a class of animals, say that of pachyderms, a certain peculiarity is to be observed in the muzzle and in the digits. The elephant presents a wonderfully developed proboscis, or prolongation of the upper lip and nose; and the huge creature possesses an odd number of toes. The rhinoceros is a perissodactyl (odd toed), and presents a long snout. The tapir, odd-toed, has almost a proboscis. The peccary is a rooter, and so is the pig, though they are generally artiodactyl (even-toed). However, a "mule-footed" swine in Florida and Texas has three toes incased in a single hoof. The variety is not much cultivated. Possibly through a superstition that the animal is unclean because it does not divide the hoof. To an Israelite the pig is unclean, because it is not a ruminant, and would be more repulsive if odd-toed.

The horse has a palæontological lineage which is quite remarkable. The Eocene animal was not more than three feet high, and possessed five toes. Its equine character is determined by its teeth and vertebræ. The Miocene *orohippus* had three toes to each foot, and was as large as a Shetland pony; and the Pliocene *hippus* had one toe, and was the ancestor of the modern horse. It will be seen that the perissodactyl type clung to the beast through all its transformations. No other animal presents such a wonderful record. Whether the progression was steadily upward from the primitive horse to the present equine animal, can not be clearly determined, but the presumption is that no *saltus* is needed to span gaps. An interesting circumstance confirming the evolution theory is, that a three-toed foal occasionally appears in the breeding of horses. In other words, "reversion" sustains the hypothesis of equine evolution; and all horses have dwarfed splint bones in their legs, which plainly indicate a three-toed ancestry.

There was once a larger elk in Ireland and Denmark than now exists in any country, yet so nearly resembled a modern animal of the class, that we can not help being impressed with the idea that there existed some kind of relationship between them, though no direct connection could have been maintained; there must have intervened some kind of a chasm. The saber-toothed tiger, whose bones were found in Kent's Hole and other caverns in England, must have been a larger feline than now exists.

The bones of the cave-bear indicate the existence of an ursine monster considerably larger than the grizzly of the Rocky Mountains, or the great bear of Russia. But whether these enormous creatures were primitive or ancestral, we have no means of knowing, except that they lived at a period earlier than any species of an order now in existence.

But I propose to introduce other kinds of matter to elucidate heredity. Writers upon mental qualities would have us to believe that the average criminal is not responsible for his acts; that he has inherited a predisposition to indulge in criminality; and that while indulging his propensities, he is merely obeying impulses over which he has no control! While there is something worthy of consideration in the argument, the danger is in going quite too far in the defense of evil doers. A man may inherit a predisposition to gout, but by a rigid course of living may avoid the disease. So it is in regard to the tendency to commit crime. If an inherited impulse to do wrong be felt, the feeling should be all the more resisted—criminals *know* when they are doing wrong!

Maudsley, in his *Responsibility in Mental. Disease*, has taken a very rational view of the subject he has ably treated, but may have gone too far in an attempt to apologize for criminality. It is a mistake to think that a suicide can not abstain from taking his life. In the majority of instances there is ability to turn from the deed, but not the inclination. I know of a suicide who wrote just before committing the deadly act: "I do this deliberately, fearing that in an approaching state of senility I shall not have the resolution to do what I think is best for me and my friends." Another wrote: "I have no purpose but to execute a long-settled plan, that I have a right to take my own life when threatening infirmities remind me that I may not have the courage in later life to do what I may know to be best."

In neither case was there an inherited predisposition to suicide; and in both there was premeditation, no maniacal influence being present.

The strongest point made by apologists for crimes and misdemeanors on hereditary grounds is that drunkards inherit a predisposition to drink or tipple. The argument made is that a love of temporary brain-joy is transmitted from parent to child; and that the predisposition can not well be resisted. Now, it seems to me that the drunkard returns to his cups through a habit he has established—a habit which has become a disease, an abnormal state. The lover of stimulants can abstain from indulgence while he is well and in control of his appetites, but the toper is a diseased man, and feeble of intellect; he is not wholly responsible for his acts while his brain is crazed with drink. But there was a time when the sot realized that he should govern his appetite for drink, even if he inherited a love for alcoholic stimulants; he is therefore responsible for his acts, and to hold otherwise is to grant license to crime. If a man knows that alcohol crazes his brain, he certainly knows that he should not risk taking the intoxicating stuff.

The disease of inebriety is not inherited, but acquired. The morbid condition is felt in the brain, in the fauces, and in the stomach; and grows worse by indulgence in alcoholic beverages. The bad sensations are relieved temporarily, yet to return with aggravation. Bright ideas awakened by the accustomed stimulant pass away like a disappointing mirage.

As a general thing, drunkards do not spring from drunken parents. Quite often they come from most exemplary parentage. The children of a besotted father or mother are often ashamed of the family disgrace, and in the intensity of their grief resolve to steer clear of the distinctive stain. The vice of inebriety is like other crimes—it must be hated to be avoided; and to be detested it must be contemplated and understood. In the beginning of a drinking career, the craving for tipple is never so strong that it can not be resisted; but indulgence leads to irresolution; therefore it is a sin and a crime to continue. The law punishes the criminal for the crime under investigation; but the moral lapse reaches back to a time when the incentive to criminality should have been held in restraint. Parents are at fault for not instructing their children to avoid the road that leads ultimately to evil. A "taste for liquor," in the ordinary acceptance of the term, is never inherited, but a love of mental exhilaration may be hereditary.

The opium habit, so called, is not often inherited, except among Chinese, yet may be readily acquired. A few doses of morphia administered to allay pain or to overcome insomnia, may beget a liking for the drug's intoxicating influence. The average man is not harmed by the medication, but the exceptional partaker is. At least so experience proves. An "opium eater" may spring from the most temperate and self-denying family in Christendom, and become as debased as the most degraded among mankind.

As I stated in regard to alcoholism, the taste of the intoxicant is not bewitching, but a depressed mental state calls for a stimulant; so it is with opium. The nauseous drug is not beloved, is generally disgusting, yet the stupefying effect of the opiate is enticing, too much so to be resisted by a person whose moral strength has been undermined by long periods of indulgence.

The chewing of tobacco is not an inherited, but an acquired habit. Think of a child with an instinctive love for the taste or effect of "the weed!" There is a worm which feeds upon the tender leaves of growing tobacco, which inherits a love for the succulent plant, but a desire to chew the narcotic which man has *acquired* is not transmitted as a legacy to children. A disposition to chew something as a pastime is easily acquired, and if that something be a narcotic, a habit hard to resist is soon established.

Not only a quid is craved, but one which embraces an appreciable amount of tipple. The first time a boy uses the filthy weed he is sickened and disgusted, but forces himself to overcome the nausea in order to appear manly!

In a review of Galton's "Hereditary Genius," it is plain that his citations lend strong support to the position he has taken, which is that men of marked talent have sprung from parents or ancestral stock of acknowledged ability; and this is as might be expected.

It is easy to see that in a country like England, where so much hinges on traditional descent, a paternal chief-justice, statesman, or divine should be succeeded by a son who at length attains the same or a similar office of honor and trust. On the other hand, the distinguished genealogist does not mention the distinguished men who have not left sons eminent for ability, nor has he been particular to enumerate the instances in which men of brilliant talents have sprung from humble origin. In the latter condition there have been intellectual leaps which quite outmatch any to be cited of a saltatory character in physical transformations. It is easy to understand how and why inheritance helps in the unfolding of talent, in the evolution of genius, and in the elevation of progeny favored with influential parents; yet to rise in the world while stemming a tide of adverse circumstances is to approach the borderland of the marvelous. In Queen Elizabeth's reign, the people of England were divided into villains, yeomanry, burgesses, squires, clergy, and noblemen; and there was, from the fixed nature of the affairs of the time, a meager opportunity for even a daring and ambitious individual to ascend from one condition in life to a higher sphere. Americans esteem the inheritance of property and the worth of a good family history; but we hold in higher estimation the opportunity to attain through perseverance and integrity the most exalted stations in the Great Republic. Woman in the past, Biblically and otherwise, has been treated as inferior to man, and thus the human race has been degraded. In America the son does not feel disgraced from evidence of servility on the maternal side. We are assured that as we sow, thus shall we reap; and that grapes do not spring from thorns, nor figs from thistles. Or, as Horace poetically expressed the idea in Ode IV:

"Fortes creantur fortibus et bonis,
Est in juvencis, est in equis patrum,
Virtus, neque imbellem feroces,
Progenerant aquilæ columbam."

THE PENTADACTYL TYPE.

Medicine is a branch of natural science; in its range it dips deeply into Zoology. The anatomy of man does not differ essentially from that of other mammals. The philosophic anatomist finds interesting and instructive material for reflection in the structures of what are called the "inferior" animals. Indeed, it has been asserted by the most distinguished scientists that the human body is best understood by those who have compared each part of it, so far as comparisons can be made, with homologous parts in the lower animal forms. And those who are just entering upon such studies will be astonished to find how closely nature sticks to a primitive *type* or form. If she departs from the typical formula for special or adaptive purposes, there seems to be a disposition to return, fully or in part, to the original and favorite model. This tendency to adhere to a fundamental rule is exemplified in the number of cervical vertebræ in mammals. Man in his comparatively short neck has *seven* bones, and so have the bat, the porpoise, and other almost neckless creatures; and in the long-necked giraffe, camel, horse, deer, and weasel, there are but seven vertebræ—a typical number which prevails with wonderful pertinacity, considering the scope for adaptive variety in the length and functions of mammals' necks. The only exceptions are in a species of sloth and the tropical manati.

Five is a common number for digital division among vertebrates; and our own hands and feet present these digits in a high degree of perfection. Our fingers, with the opposable thumb, are not equaled in function by the digital development reached by any other animal. Man has been classed alone as bimanous, on account of his possessing two hands. A unity of method in the construction of the carpal and tarsal terminations is strikingly apparent not only in the higher, but in the lower vertebrates, fishes alone forming exceptions. The pentadactyl has a wide range of application—it reaches reptiles as well as walking, swimming, and flying mammals. Divergencies are common, for the necessities of modified organizations enforce variety. The herbivora must have feet and legs suited to their manner of living; and the carnivora need digital terminations which shall enable them to capture and tear in pieces their prey. If the claw be sharp its point is protected by a sheath and by being raised from the ground. Amphibious animals adhere quite closely to the pentadactyl type, though their digits may be concealed by a web. Birds apparently depart considerably from the prevailing order of digital division, yet in their legs and wings may be found the evidence that they are constructed in accordance with the somewhat rigid formula.

Variations of digital termination can not be fully comprehended without considering, anatomically and functionally, all the bones which constitute what are denominated the shoulder and pelvic girdles. In an anterior limb may be found a scapula, humerus, radius and ulna, and carpal and metacarpal bones, to which the phalanges are attached; and the greater the number of digits, the nearer certain it is that a distinct ulna and the usual complement of metacarpal bones will be present. A posterior extremity embraces a haunch bone, a femur, tibia and fibula, tarsal and metatarsal bones, and phalanges; and when five toes are fully developed, as many metatarsal bones exist, and the fibula is present. But if two digits disappear, there is a corresponding shrinkage in the metatarsus, and a dwindling effect manifested in the fibula.

The Simian thumb is not opposable to all the fingers—it is dwarfed and imperfect; and in the inferior animals this digit is the first to shrink and disappear. The fifth or "little finger" is occasionally rudimentary, yet it puts in an appearance oftener than the pollex, or first digit. The third and fourth digits not unfrequently attain gigantic proportions, and usually at the expense of the other digits. The hallux, or "great toe," is functionally important in the monkey, but it is apt to shrink and vanish in the lower animals. The raccoon, which is anatomically allied to the monkey, and exhibits many Simian freaks of character, possesses five digits upon each pedal extremity. The opossum is also pentadactyl, and the hallux is placed at right angles with, and is opposable to, the other four digits; it has a short and thick terminal phalanx that bears no nail. Foxes, dogs, wolves, and hyenas, possess four functional toes which reach the ground, and a rudimentary digit of greater or less development, which bears a nail, but does not come to the ground, nor have any functional importance; and this dwarfed toe is on the inside of the carpus or tarsus, where the most important digit exists in man.

All the feline race are pentadactyl, yet the first digit in each foot is rudimentary and mostly devoid of function. Minks, otters, and beavers exhibit five digits on each foot; and so do many of the great aquatic mammals. Frogs have five toes behind, and four in front, with a knob on the carpus to represent the fifth. The alligator has five digits in front, and four behind, with a mark for the fifth. Animals with a lizard-like conformation have from three to five toes; and in some lacertian swimmers the shoulder and pelvic girdles are rudimentary all the way through, the legs being too feeble and undeveloped to sustain the weight of the body.

Herbivorous animals have mostly, for each foot, two strong toes that come to the ground, and two rudimentary digits which are called "dew claws," and have no functional importance. The latter bear diminutive hoofs, embrace phalanges, and have metacarpal and metatarsal splint bones. The fifth digit in these cud-chewers, or ruminants, is rarely or barely represented by a mark or sign, hence such animals are denominated artiodactyl, or even-toed. Most of them present no upper incisor teeth; and they grind their food imperfectly while it is being cropped and swallowed. Their intestinal canal is long and complicated, for the purpose of extracting nutriment from herbage not always rich in nutritious supplies.

Man possesses a distinct radius and ulna, and a tibia and fibula; and so do most of the perissodactyl or odd-toed animals—those having one, three, or five digits. The pig has upper and lower incisor teeth, ankylosed radius and ulna, and a distinct tibia and fibula. Its toes are like those of ruminants, two functional and two rudimental on each foot.

The sheep, the goat, the ox, the buffalo, the moose, the deer, and the antelope, have an ulna with a well developed olecranon process, but the lower extremity blends with the radius; the fibula of these animals is wholly wanting, or is represented by a mere knob on the upper extremity of the tibia. The limbs of turtles and alligators possess a radius and an ulna, and a tibia and fibula, all being as distinct and evenly divided as corresponding bones in the limbs of the human race.

The horse is a one-toed creature; but the fossil remains of its extinct predecessors show that the original *hippus*, or the earliest of the *equine* family, possessed five toes, and was not larger than the smallest ponies now in existence. The fossil bones of a horse with three toes, the central digit being the largest, are found in the Eocene and Miocene beds of the Upper Missouri River—in the "bad lands" of Wyoming. In the Pliocene strata are found the fossil bones of a bigger horse, which had a large toe that reached the ground, and two lateral toes that were rudimentary, as are the "dew-claws" of an ox or other even-toed animal.

The horse of our time is one of the most beautiful and highly developed of the great animals. He is fleet of foot and strong of limb. Each pedal extremity possesses a series of toggle-joints, as the articulations of the limbs may be called, consequently in him is made the best provision for an outlay of muscular and mechanical power. The legs are long and slender, and moved by muscles which are admirably arranged for the development of strength and speed. The spinous processes of the anterior dorsal vertebræ are long and high, to give an elevated attachment to muscles which indirectly lift the feet from the ground. A horse "high in the withers" is not likely to stumble when he trots. The moose is a trotting animal, and has few smooth roads to travel upon, consequently it is very high in the withers, even higher than the horse. The deer runs by leaps, and rarely trots, therefore it need not be high in the withers, and is not relatively so high in that region as the moose. The humerus of the horse is buried in the flesh of the shoulder, and the femur in the tissues of the hip, so that neither can be traced in the outline of the limb; yet these bones are very large and compact; and so obliquely placed as regards adjacent bones that they afford admirable angles for dissipating jars and shocks. What is ordinarily regarded as the knee in the front and hind limbs, is really what in man are the wrist and the ankle. The ulna is prominently developed in the olecranon process, but becomes a splint below, and blends with the radius; the fibula is represented only by a process of bone projecting from the upper extremity of the tibia. The carpus and tarsus of the horse consist of two chains of comparatively small bones, as representative parts do in man; but the metacarpus and metatarsus are wonderfully transformed or differentiated. The central metacarpal and metatarsal bones—called *cannon* bones—are large, long, and strong; and the lateral metacarpals and metatarsals are represented by spints, which can be barely outlined from the upper end of the cannon bones to a point a little below the middle of the great central shaft, which represents about all there is of the metacarpus and metatarsus. And below this is a central continuation of a single row of phalanges, without even splints to represent lateral digits. Five sets of phalanges are consolidated in one row. This consists of the upper pastern, the lower pastern, and the coffin bone, which represents the terminal or ungual phalanx, and supports a hoof instead of a nail, as in man and many other animals.

The horse has long lips to gather in its food, and six good incisors in each jaw to crop grass; behind these are short tusks in the male, then comes a toothless space for the "bit," and still further back are the immense grinders which do such excellent service in mashing and pulpifying the food, whether it be grass, hay, or grain. And the grinding is so well done that the food does not have to be regurgitated and chewed over as a cud.

The elephant's foot conforms pretty nearly to the pentadactyl standard, for it terminates in five toes; yet the inner toe (hallux and pollex) is somewhat imperfect, or rudimentary in its fundamental character. The hippopotamus treads upon four toes, and has the rudiment of a fifth, which is on the *inside* of the carpus and tarsus. The rhinoceros goes upon three toes, the "little toe" vanishing entirely, and the "great toe" existing in a rudimentary state, or is not developed sufficiently to reach the ground.

The kangaroo has five digits in each of its fore-paws; and apparently three, though really four, in each of the hind feet. The failure is on the inside of the foot, the hallux is wanting, and the next two are so dwarfed that in the seemingly combined state they are not equal to the outside digit, which again is smaller than the immensely developed *fourth* toe reckoned in the order from "great" to "little." The two dwarfed toes which appear in the living animal as single, have but one metatarsal bone that reaches back to the tarsus; and this is very slender. When the animal sits at rest the os calcis reaches the ground, but in hopping about the two outside toes in each hind foot receive the weight of the body, and break the shock by means of a well developed plantar arch and elastic plantar ligaments which stretch from heel to toe as a cord subtends a bow. The tracks of the kangaroo are much like those of a hopping bird. The bandicoot has a hind foot similar to that of the kangaroo, yet the "little" or outside toe is comparatively dwarfed, and the one next to it is as much more enlarged and elongated—it becomes the greater part of the foot, while the others dwindle to insignificance.

In the fore foot of the mole there is seemingly a violation of the pentadactyl type, for *six* terminal claws are found. But upon dissecting the limb it is shown that the supernumerary claw is a falciform hook that springs from the radius, and is not therefore carpal except in function—a splint to give width and strength to the spade-like hand.

The sloth has but two toes functionally developed in front; and two rudimentary digits exist, yet the animal is called two-toed. The nails on the developed digits are long, strong, and so curved that when hooked upon the branch of a tree, they will not let go, though the animal be asleep or even dead. A species of the sloth has three toes in the fore foot, and a rudimentary fourth. The jerboa has three toes to each hind foot, and three ankylosed metatarsal bones. The conformation of the entire limb is much like that of a bird.

The anterior extremity of the bat has four enormously extended phalanges to give expanse to skinny wings; the fifth digit is only a hook or undeveloped claw. The posterior extremities present five digits to each foot; thus, in the anterior and posterior extremities, the pentadactyl type is followed.

"THAT SAME SWEET FACE."

As a notable Swedish songstress, who was about to depart from home to win fortune and fame in foreign lands, bid farewell to parents and friends, she said to her mother, "What shall I bring you when I return?" The maternal reply was, "That same sweet face." But the mother was asking for something which is flitting; she was governed by an emotion; she sighed for that which could not be. That face must change—its semblance could only be retained in memory and marble. If the daughter of the Swedish matron had never returned, the same sweet face would have been ever present, but after years of exile, of toil, of hope, of triumph, of rivalry, of disappointment, and of heart-rending scenes, the features of that still lovely countenance must have changed. In fact it could not remain as it was. Time is exacting. The varied experiences of each passing year leave their indelible impress. What did it avail when the maiden said,

> "Backward, roll backward, O Time, in thy flight,
> Make me a child again, just for to-night!"

The man of fifty has a face on which are written in somewhat mysterious hieroglyphics, the character of the individual. If the possessor of the countenance chiseled by half a century of time has lived a spiritual, intellectual, and moral life, that face is a study for the painter and the sculptor; but if the owner has indulged in stormy passions, partaken of bloating and gluttonous drinks and foods, and cultivated selfish propensities, the features of such a face beget aversion in the mind of the beholder.

It has been eloquently declared that every man is the architect of his fortune; it might as truthfully be said that every man is the carver of his own facial expression. If a man wear a severe look, he has cultivated that tone of countenance. It never came by accident, nor grew carelessly like a weed. An habitual face is the work of years. That disappointed maiden of fifty never acquired a hateful visage in thinking and wishing well of her neighbors; and the old shrew around the corner never obtained that woeful countenance while doing good to the feeble and unfortunate.

The good Mrs. Bountiful did not stamp that lovable face of hers with benign expressions while trying to pull down a rival or somebody enjoying prosperity. Her smile is a perpetual benediction. Every body that meets her looks happy.

The Rev. Mr. Holly has the expression which the coal-heaver would pronounce "Apostolic," yet how was that facial expression obtained? Why, it was secured during many years of divine thoughts and noble actions. A right-minded man has been limning that face for a long time. That serene beauty never came by chance—it was attained little by little, and is a marvel of excellence.

Canova said he could not appreciate the beautiful in the world till he had made it a study for years. We are not critics of human faces till we have had great opportunities to study character in its various aspects. A keen detective at a crowded fair will catch a glimpse of every pickpocket present, though he may not catch one in the thieving act. He has cultivated an accuteness for the special work. On the other hand, the experienced thief recognizes the detective at once and avoids meeting him.

The profession a man pursues leaves its marks upon the possessor. The average physician can be pointed out on a crowded thoroughfare; the attorney need not have his green bag with him in order to have his vocation known; nor need the clergyman wear a white neckerchief to be recognized in his true character.

The physiognomy of avocation is well understood and every-where acknowledged. If a physician would be regarded as an earnest, honest, conscientious man, he must cultivate those qualities of head and heart. If a common-place doctor thinks he will succeed by thinking and talking ill of his competitors, he will find at length what a grave mistake he has made. If a crusty old physician thinks he can crush that studious, polite, and genial young doctor who has had the hardihood to settle in town, he will egregiously blunder. People have been tired of the old curmudgeon for years, and are delighted with the idea of making a flattering change.

Lately I met on the street a woman clad in sable weeds, and with a face plainly stamped with despair. Ten years ago that face and form were divine. What had wrought the change? Thank heaven, she had no mother to ask for "that same sweet face." The original loveliness had nearly all disappeared. The figure was still slight, and the threadbare dress neat and tidy. From a friend I learned that the girl had married a handsome choir singer, and speculator. Drink brutalized what manhood there ever was in him; and he beat his poor wife for his bad luck and ill-fortune. The death of a beloved child, sickness, and poverty drove the woman mad with disappointment and hopelessness. In a few years that once beautiful face was fixed and furrowed like the countenance of a maniac. Can lovely features be made to take the place of those so wo-begone? No, time never rolls backward in its flight. Hope and an agreeable change of circumstances would do something toward restoring cheerful features, yet the same sweet face will never return.

But, what is to compensate for this loss of youthful comeliness? Are our faces to be agreeable only in youth? Let us see. Mrs. Linneman, a lady of fifty in our acquaintance, does not appear old, even to children. Her features are those of a cultivated woman; her posture is superb; her general presence is gentle, winning, and commanding. Her face is expressive of matronly goodness, kindness, and grace. Was that face ever so handsome before in her life? Probably not. As a girl she may have been beautful, but as she lost a feature of mere physical beauty, she gained its equivalent in spiritual charms; and as years rolled by the changes necessarily occurring were not against her, but in her favor. Her womanly graces are not less admired than were her youthful attractions.

The stately gentleman on our streets was said to be handsome when he was twenty-five; he is fifty now, yet he is still handsome—every body acknowledges it. That head, face, neck, and shoulders all combine to display the portraiture of a man. Those eyes kindle with light almost divine. There is an intellectual halo emanating from that head. It is not the brazen aureola painters have thrown around the head of Christ and the Virgin, but it is appreciable, and actively impresses the beholder. How was that wonderful face obtained? The handsome youth of twenty has no such attraction—his is all physical—it cost no effort—it is what time effaces; but that scholarly and cultivated countenance exhibited by the man of fifty or sixty, or even seventy, is a work of art. It is worthy of study; and the more it is observed the more it is admired. In that maturity of manly beauty are peace, plenty, and assurance. The student in science or morals may show premature wrinkles, but these lines are not repulsive—they seem to be the etchings of elves engaged in the portrayal of expression. The face as a whole may exhibit the marks of care and sorrow, but they do not detract from the interest centering there. The man of fifty who has not passed through solemnizing scenes, who has not been chastened by untoward events, is a phenomenon, and not representative.

I will not depict a face of fifty, wrung with misfortune, pinched with selfishness, and warped by avarice. Such visages are common as clods, and need no delineation. Cultivated faces alone are worthy of study, for they show a subjugation of the lower instincts, and a forcing to the front of the higher intellectual and moral qualities. A fine face costs a lifetime of good thinking and well-doing; bad features are the result of passive negligence. Every individual is largely responsible for facial expression. The juvenile feature is the sport of time, but the beauty of the mature face is a work of artistic elaboration, the soul officiating as the divine limner.

DEPRESSIONS IN THE EARTH'S SURFACE.

(Read before the Cincinnati Society of Natural History, Oct., 1888.)

The contents of oceans and seas hold in solution a variable amount of chloride of sodium and other saline matter, the degree of salinity depending largely upon the relative aqueous waste through evaporation. If a kettle of brine be boiled till all the water has escaped in steam, the utensil will contain the saline ingredients as a crystalline incrustation at the bottom. The dissipated steam represents ordinary vapor rising from the surface of a pool, pond, lake, or sea, through the heating agency of the Sun. The watery particles floating in the atmosphere are at length condensed into clouds and precipitated as rain, returning to the earth what was seemingly lost through evaporation. Thus the circulation of water goes on; and the general level of water in basins having no outlets is maintained.

In ordinary ponds and lakes the water is confined by dams, dykes, and natural barriers till it attains a height equal to the lowest point in its surroundings. Then as much will be discharged as the inlets furnish. If, however, a pool or pond evaporate more water in dry weather than the feeders supply, the outflow ceases, and the shore line sinks or retreats within a smaller circumference. Now, if this shrinkage continue, the basin must at length become dry, or nearly so, and the residue would be brackish or salty. Conditions of this kind exist in almost every country as a normal state of things. Where the rainfall is abundant, as it is on most mountain chains, or the precipitation is in snow, the rivers reach the ocean ; but in arid districts the streams are small and the evaporation correspondingly large, hench fresh water lakes are few, and brackish pools prevail.

The ocean is a boundless body of water with no outlet, and the salts of the earth being washed into it, and having no means of escape, must constantly accumulate. The inflowing rivers are innumerable, yet the loss through evaporation equals the supply, and maintains the recognized sea-level.

Seas are defined as basins of salt water, and lakes as bodies of water whose contents are fresh, though the reverse exists in exceptional instances. The Sea of Galilee is perfectly fresh, and the largest lake of Utah is intensely saline. A body of water may be fresh a part of the year, and brackish the rest of the season. When the inflow is great enough to maintain an outlet, the pool of water is strictly a lake; and is a sea when a reverse state exists. There are bodies of water in California which are legitimately seas in summer, yet lakes in winter.

Fresh water lakes are mostly located far above sea-level—sometimes at vast heights. The most elevated thus far known is Lake Sirikol, its surface being 15,000 feet above the Sea of Aral, into which its waters flow through the river Oxus. Next to it in height is Lake Titicaca, in Bolivia, at an elevation of nearly 13,000 feet above the ocean.

The Caspian Sea is the largest inland water on the globe, covering 130,000 square miles. The Volga and the Ural supply the basin with vast quantities of fresh water, yet the evaporative agency is so enormous that these great rivers scarcely supply the demand, though they keep the sea less saline than the ocean.

The Aral is less salty than the Caspian, yet its saltiness is increasing every year. The Aral once communicated with the Caspian through a depression still to be seen, but both seas have been gradually sinking, till they are now below the surface of the ocean. The increasing salinity of these inland seas is extinguishing many kinds of fish and aquatic animals; and the plants are becoming more and more marine. If evaporation be not on the increase in those seas, their tributaries are furnishing less supplies.

The steppes of the Volga embrace immense areas of low lands which overflow during rainy seasons, and in droughty weather present multitudes of brackish basins. The river flows so sluggishly that in places it is difficult to observe which way the water runs. The country about the Caspian and Aral Seas is practically a great depression in the continent, and habitable only in restricted areas.

The Caspian Sea, for convenience of description, may be considered in thirds:—the northern or upper end is kept comparatively fresh by the inflowing rivers, and shallow from the deposit of sediment; the middle third is deeper and salter, and its border is broken into gulfs and bays, with sand-bars deposited in front of their entrances. The largest of these pockets is the Gulf of Scythia, which has an expanse of several thousand square miles—and has become intensely saline from the circumstance that a current from the sea is always setting into the basin. The inflow is exhausted through evaporative agencies, and not carried out by subterranean passages as was supposed by the ancients. If the straits should completely close, as the tendency seems to be, the gulf would become an isolated and independent sea, and rapidly shrink to a restricted area—perhaps to a dry basin with the bottom incrusted with salt.

The lower or southern third of the Caspian Sea is very deep, its greatest depth being 3,000 feet; and the water is much salter than in the upper third. It is highly probable that the contents of the Black and Caspian seas once commingled, but became divorced through causes already mentioned, the Caspian lowering gradually through excessive evaporation, till it is now 85 feet below the level of its old associate. An ancient waterway can still be traced between the two seas, sand-ridges appearing here and there which were once bars thrown up in shallow straits and by a process now going on at the mouth of the Scythian gulf.

If the Caspian Sea should, through diminished evaporation, regain its ancient level, its contents would obliterate the Volga as far up stream as Saratov, and inundate plains of vast extent, so low and flat is the country stretching northward. The water-shed between streams flowing into the Polar Sea and those descending into the Caspian basin is so slight an elevation that, at an earlier period, the waters of the White and the Black seas may have connected with each other. Lake Elton seems to be a remnant of the old communion. Its waters are so intensely saline that it must have been refilled many times with sea water after repeated lowerings through evaporation. Being very shallow, it constitutes an excellent evaporating basin, its contributions of salt to the needs of commerce amounting to thousands of tons annually.

An arid area reaching from Persia through Turkistan to the eastern confines of the great desert of Gobi, a distance of 3,000 miles, embraces a vast inland depression in Asia which is growing in interest, though still an inhospitable region, with only here and there an oasis or habitable locality. Spurs of mountain chains extend into the desert waste and contribute supplies of fresh water, yet the rivers are not large enough to push their way to the ocean,—they dwindle as they flow, and at length end in a brackish marsh or a saline basin having no outlet. Irrigation is carried on in districts where the contents of streams can be utilized for such purposes, yet a fixed population can barely obtain a sustenance. This barren belt constitutes a formidable barrier between Russia and the government of India, yet both powers seem to be projecting railways into the uninviting waste,—probably for political purposes.

The deepest depression in the earth's surface, except ocean beds, is "the Valley of the Jordan." It extends from defiles on the borders of Palestine and Syria, and nominally ends in the Dead Sea, but really extends to Akaba Gulf, an arm of the Red Sea. The low-lying ravine may have been produced by volcanic action.

The River Jordan, an historic feature of the famous valley, rises in the Lebanon Mountains near Mount Hermon, sharing a division of the waters of the range with the classical Orontes, a wild stream which empties into the Mediterranean.

The Jordan begins in rills and rivulets, as other rivers do, gathering contributions as it proceeds on its rapidly descending course; and after attaining the size of a scarcely fordable stream, expands into a shallow and reedy lake—Huleh by name—a pool 100 feet above sea-level. Resuming its course, the river runs southward, descending hurriedly through a wild channel, then expands into "the Sea of Galilee, which is the Sea of Tiberias." (John vi, 1.) This lake, which was sometimes called Gennesaret, is the only body of fresh water on the globe which is below the level of the ocean, being 636 feet lower than the surface of the Mediterranean. As might be expected, the water being fresh, the lake is well supplied with fish and other organic products of an aquatic character. On the shores of Galilee the fishermen, Peter and Andrew, were "casting their nets;" and in the immediate vicinity John the Baptist, preaching in the wilderness, said, "Repent ye, for the kingdom of Heaven is at hand;"—and here is where the marvelous Nazarene sought the itinerant preacher "to be baptized of him."

The Sea of Galilee is quite restricted in area, being 13 miles long and 6 broad; and it is so shallow that the current of the Jordan can be traced clear through the still water, from inlet to outlet. After the river leaves Lake Galilee, it descends rapidly southward 70 miles in a ravine, and then discharges its contents into "Lake Asphaltites," or the Dead Sea, a body of intensely salt water, 1,298 feet below the level of the Mediterranean. The area of this historical water is 40 miles in length and 7 miles in width; and its greatest depth is 1,300 feet. The shores of the sea are precipitous in places, yet shallowing to a beach on the eastern boundary. Near the southern border is an isolated mass of rock-salt; and not far from this is a pillar or shaft of pure salt 40 feet in height. But, as far as known, the salinity of the Dead Sea does not come from masses of salt within its immediate vicinity, but from saline matter washed into it by the Jordan, evaporation doing the work of "boiling down," long periods of time having been consumed in the condensing process. The salinity of the ocean is about $3\frac{1}{2}$ per cent, while that of the Dead Sea is 25 per cent. However, a sink or basin in Asia Minor contains water with 32 per cent of saltiness, which is less than is found in Lake Elton.

The Dead Sea was so named because neither plant nor animal could exist in its waters. A lowly marine plant is occasionally seen near an inlet, and a foraminiferous crustacean bores in mud along the beach. If the Jordan carry a fish into the bitter water the creature immediately dies. It has been asserted that the presence of bromine makes the waters deadly, but the high degree of salinity is enough to account for the hostility to life. All waters which contain 20 per cent of salt are incompatible with vital operations. It is fortunate that the ocean is not too salty for the thrift of marine organisms.

Storks and other aquatic birds find plenty of food in the Sea of Galilee, but obtain nothing eatable in the Dead Sea. Water fowls occasionally alight on the surface, and attempt to bathe in the waters, but soon wing their way to more inviting scenes. In fact, birds can not dive into waters as dense as those of the Dead Sea.

Although the atmosphere is appreciably condensed in the low level of the Jordan Valley, the tourist is not rendered uncomfortable by the pressure. Indeed, the asthmatic breathes easier in a depression below sea-level than on an elevated plateau. The lungs seem to be more easily filled by the denser air.

The Jordan is a famous river in which to bathe, though the fact has not been demonstrated that the sacred waters possess therapeutic virtues.

In a country where pools of fresh water are scarce, it might naturally be supposed that wayfarers and nomads would long to lave their tired limbs in the cool and refreshing eddies of so bountiful a stream. No wonder the tourist feels like resting when such an inviting environment is presented. In this historic valley Christianity was cradled; the solemn scenes of the Crucifixion and Resurrection were not far away; in this vicinity the sublime teachings of the Gospel were first uttered, and the miracles of Christ performed. Truly this is Holy Land!

Africa has many depressions below ocean level. The ancient "bitter lakes," now in the course of the Suez Canal, are below sea level; and an arid depression between the shores of the Red Sea and the table lands of Abyssinia embraces Lake Assal, which is 700 feet below the ocean. Although only 25 miles from the port of Tajurrah, caravans resort to the saline basin for supplies of salt—some of them coming from the interior of Abyssinia. The shores of the lakes are incrusted to the depth of six inches, and present the picturesque appearance of being covered with freshly fallen snow. The salinity of the water is fully equal to that of the Dead Sea.

In South Africa, near the 20th parallel of latitude, is an extensive depression in which there is a series of saline lakes and brackish lagoons. It is almost a rainless region, and repulsively sterile.

Bovines and antelopes resort to these saline basins for the coveted salt, and their paths become infested with lions, leopards, and other great felines which lie in wait for salt-loving ruminants. A thorough exploration of this desert region will develop features meriting more than the mere mention of them.

In the Libyan Desert, three hundred miles west of Cairo, is the oasis of Siwah, which, by barometrical measurement, is 120 feet below ocean level, and the oasis of Araj in the same desert is 265 feet below the Mediterranean. These oases contain fresh water springs and brackish sink holes; and the moisture from them lends growth to palm and other tropical trees.

To the south of the Barbary plateau is a desert country having wadis and oases here and there, and many saline basins which have water in them a part of the year. To the south of Algeria is the bed of an ancient sea which once communicated with the Mediterranean, but is now 160 feet below the Gulf of Cabes.

In striking contrast with the general level of the Desert of Sahara is Mount Djebel Haggar, sufficiently elevated to be covered with snow from December to March—and in the midst of the Great Desert, where the sun at noon-day is scorching hot, there is an occasional frost at night.

A large portion of the great African desert, from the plains of Senegambia to the Nile, is made up of depressions and dunes for a distance of over two thousand miles. To obliterate this vast waste and to modify the torrid climate, it has been proposed to cut through the barriers along the Atlantic coast, and permit the ocean to inundate the sterile plateau. It is possible thus to create an inland sea larger than the Caspian.

What the effect of inundating a large portion of the desert region of Northern Africa might be is open to speculation on the part of those who take an interest in problems of mammoth proportions. The contemplated sea would be too shallow for navigation; and the evaporation from such an expanded surface would render the water salter than the sea, and thus become destructive to organic life, enforcing the question, what advantage a barren sea can have over sterile lands. Besides, it is now practicable to bore artesian wells in rainless districts of country, and bring to the surface sufficient fresh water to irrigate arid wastes, making "the desert rejoice, and bloom as the rose."

Australia has a depression all through its center, its general outline being compared to a dinner plate, the rim on the border keeping out the ocean. In places there exists a shore range of mountains; and in the south-western portion of the great island, is a small river system sustained by rains and melting snows. The Murray River, when full, is navigable for some distance inland, yet Lake Torrens is little better than a brackish lagoon, and is below sea level, though it once communicated with Spencer Gulf. In droughty seasons, and nearly all are such, the rivers which find a place on maps dwindle to mere "water holes," or occasional basins. The Murray has been known to shrink to a chain of pools with no water flowing between them.

South America, like other large countries, has mountain ranges, great rivers, and desert tracts. In the latter are numerous salt lakes, brackish lagoons, and saline basins. Along the Atlantic coast, in the vicinity of large rivers, there exist circumscribed areas of stagnant and brackish waters, the surfaces of which through evaporation are often below sea level. On the Pacific side, between the Andes and an upraised shore line, there are saline marshes which have no outlet. Patagonia embraces rainless areas which exhibit saline depressions, though all are above the level of the ocean.

Land-locked tracts in Chili and Bolivia constitute the desert of Atacama. A series of pits along the western border of the imprisoned desert are literally packed with masses of salt, showing that the sea once had access to them. Some of these salt mines are worked at a great profit to the government of Peru.

Central America and Mexico cover arid and sterile tracts, and not a few saline depressions. Most of these basins are above sea level, being located on the table lands of the interior; and would not exist in a country favored with a normal or plenteous rainfall.

The United States have what is sometimes denominated the great inland or central basin. The depression on the west is near the Pacific coast, being separated from the sea by the Sierra Nevada or coast range of mountains. Within this extensive area is located Salt Lake, a body of water larger than the Dead Sea, though not so deep.

The general aspect of the arid plateau is forbidding, yet is far from being a sterile waste. Its borders present an irregular outline, winding in and out as headlands and ravines alternately occur. This vast depression was once a sea, and shorelines in parallels can be distinctly traced at higher and lower levels around the entire basin. This inland sea was filled with fresh water, but after evaporation shrunk it below a normal outlet, its contents became gradually brackish or salty. And after an incalculable period of time the waters fell to the present dimensions of Salt Lake.

Intermingled with the soil in the great depression are particles of saline or alkaline matter which, as moving dust, penetrates the eyes, nose, mouth and throat, and creates a smarting sensation. The soil is coarse, and furrowed by rivulets produced by occasional rains. The sage bush—artemisia—grows everywhere, its aroma being omnipresent. The stunted tree or shrub affords shelter for grouse, rabbits and coyotes. Tufts of grass grow here and there, affording scanty food for antelope. If the soil in the depressed area be irrigated, the finest crops can be grown. Wherever artesian wells have been sunk, the watered land is easily and profitably tilled. Experience has proved that an abundant harvest is more reliable on irrigated land than it is where the development of a crop hinges upon the earlier and the later rains.

Salt Lake is a body of water 250 miles in circumference; but its greatest depth is only 32 feet. The degree of salinity reaches from 23 to 25 per cent., so that incrustations of salt are plentiful on its shores. Its tributaries are Bear and Weber rivers, and the Jordan which flows from Lake Utah. These are all dashing streams fed by melting snows on the western declivity of the Wasatch range of mountains, whose snowy tops are in plain view.

On islands in the lake the pelican rears her young, and secures food—trout—in the rivers named. All forms of organic life are debarred from existence in the saline waters, as in the Dead sea. Aquatic fowls may rest their wings for a short time on the bitter waters, but finding no food they soon fly to more welcome haunts. The passing gull turns its eyes askance at the lifeless waters, and quickly flies away.

Salt Lake City is built at the base of the snow-capped range, at a distance of three miles from the lake's beach ; and the thrifty and enterprising inhabitants have conducted bounteous supplies of fresh water through the streets. The founders of the city are Mormons, who, while on a pilgrimage in search of a promised land, were forced, through exhaustion, to sojourn in this inhospitable spot. They were polygamous, and sought a remote place where they could sustain the peculiar domestic relation and not be molested. By their industries and economies they have become prosperous in worldly affairs—they have "made the desert like a garden."

To the westward of Salt Lake, other basins of water exist, with a high per cent. of salinity. The Humboldt sinks or brackish pools, into which streams from the inner slopes of the Sierra Nevada find their way, have no outlets, though the hypothesis has been advanced that subterranean passages give exit to accumulating waters. But, if there were underground means of escape, water in these pools would be fresh, and not brackish. The evidence is that the inflowing waters penetrate the coarse gravel of the valley, and at length escape through evaporative and other dissipating agencies.

To the southward of the great Utah depression, in the semi-desert regions which extend through Southern California, are basins and circumscribed depressions much lower than the great Utah basin. The deepest of these is in San Diego county, a hundred miles south of Los Angeles. It bears the name of Dry Lake or San Felipe basin, and is 365 feet below sea-level, being the third, as regards depth, of known depressions in the earth's surface. The Southern Pacific Railway, beyond Fort Yuma, runs along the border of the depression, Indio being the station where the tourist may stop to visit the bottom of the basin. On the borders of the Lacustrine bed a few fruit-bearing date-palms lift their heads, showing that the arid environment is not unsuited to the nature of the trees.

Since the railroad was constructed, extensive mills have been erected in the dry valley for grinding and putting up salt for commercial purposes, and hundreds of tons are shipped every month. Indio, 20 feet below sea level, is already visited by consumptives, rheumatics and asthmatics; and accommodations for permanent residence in the deeper levels of the depression are contemplated. The theory has been advanced that those persons who suffer from respiratory troubles may breathe easier in the condensed atmosphere of the low-level of the valley.

A few miles to the east of Indio are some geysers and mud volcanoes which have acquired a reputation for benefitting patients once consigned for treatment to the Hot Springs of Arkansas. Thermal waters coming directly from the bowels of the earth are every-where presumed to be curative, though their therapeutic qualities are apt to be overestimated. However, steaming geyser water, bubbling baths of mud, with the dense atmosphere of a valley 350 feet below sea-level, may offer a combination of attractions not presented to invalids elsewhere.

In the valley of the Jordan a wealthy American is about to erect a commodious sanitarium for the residence of such patients as are benefitted by inhaling compressed air in "cabinets" and pneumatic chambers. The enterprising individual claims to have been cured by a year's residence in the immediate vicinity of the Jordan.

The depression in Southern California is much more accessible for American invalids than the valley of the Jordan, hence they are likely to patronize the basin of San Felipe, especially when eligible accommodations are offered as an inducement to visit the sanitary retreat.

The depression of Amorgosa, near the eastern border of California, is a saline basin below sea-level; and has the advantage of being remote from the cold winds of the ocean; but at present is not accessible to invalids. The San Felipe valley is excessively hot in summer, and chilly in winter, yet is favored with almost uninterrupted sunny weather.

"HUNTERIAN ORATION."

(Addressed to the Cincinnati Natural History Society, May, 1877.)

Biographical sketches do not confer great benefits upon mankind if they are brought out for the sole purpose of bestowing fulsome flattery upon favorite characters in history; but when salient points in the career of those who have made themselves illustrious, are placed in a light calculated to inspire us with ambition to repeat good deeds, and to shun what ought not to be followed, the higher advantages of instruction may be secured.

One who has attained the highest honors in scientific pursuits, and accomplished a great work in honorable ways, must have possessed qualities which can be studied with profit. It may not be wise to attempt to imitate the career of a man who has risen to eminence in any profession, yet it is interesting and instructive to review his incentives to labor, and the methods he has employed successfully. A person springing from the humbler walks of life does not become distinguished in any branch of learning without bringing into play a vast amount of energy and perseverance. Even the most favored can not reach the higher levels of scientific repute without toil and drudgery.

The history of scientific men furnishes few characters which are as pronounced as that of John Hunter. His early life was not attractive, nor characterized by striking incidents. There is no evidence that he was a promising lad. He was inclined to be idle, and his education was neglected. At the age of eighteen he worked a year or two at cabinet making with a brother-in-law at Glasgow; and might have continued at that trade had his relative succeeded in business, but financial disaster threw him out of employment. At twenty he was casting about for means of support, and accepted the first offer which presented itself. If this had been to go on a whaling trip, he would have gone, for he was listlessly waiting for something to turn up. He was as likely to become a vagabond as any youth floating about with nothing to do. As it happened, the opportunity was auspicious and improved. From this time he worked diligently, and finally became one of the world's great men. Westminster Abbey, the burial place of England's illustrious dead, contains a tablet that bears the following inscription: "Beneath are deposited the remains of John Hunter. Born at Long Calderwood, on the 13th of February, 1728; died in London on the 16th of October, 1793. His remains were removed from the Church of St. Martins-in-the-Fields to this Abbey on the 28th of March, 1859."

The circumstance that opened the way to greatness for John Hunter consisted in his having an older brother who had obtained a reputable medical practice in London, and who invited John to live awhile with him, the conditions being that if he made no satisfactory progress in dissections and anatomical studies, he should go into the army.

Dr. William Hunter, who thus gave his brother an opportunity to display his talents, was teacher of anatomy, and possessed quite a collection of specimens in natural history; and it is highly probable that such surroundings kindled in the mind of the younger Hunter an ardent desire to study comparative anatomy, and to learn all he could about plants and animals. At any rate, it was not long before the untutored rustic drifted into the habits of a scientific student. Although biological subjects had begun to be discussed at that time, there were no schools where comparative physiology was taught or encouraged as a practical study. Young Hunter had to be his own teacher; and he pursued his own methods of investigation. And notwithstanding the many blunders he must have made, his progress was so marked that he soon attracted the attention of the scientific men of Europe. But what puzzled the wiseacres most was to fathom the object Hunter had in view. The fact that he was an enthusiastic worker showed that he might become somebody in the world, yet was he intending to be a surgeon or a biologist? Was he endeavoring to find out the cause of organic development, or was he seeking facts in a general way for the sake of ripening his understanding? Perhaps he found the ordinary details of the medical profession too dry, and was inquiring into the origin, growth, decline, and death of organic bodies just for recreation. Possibly he was seeking physiological knowledge which might prove serviceable in curing surgical diseases. To the shortsighted it seemed that too much time was spent over comparative anatomy and physiology if the practice of medicine was in view as an end; and too much attention was devoted to surgery, if the student was preparing himself to be a naturalist.

The contemporaries of Hunter, rather his competitors in the medical profession, looked upon him as a man possessed of an erratic mind, and little dreamed that he was building upon the only foundation which would sustain a massive superstructure of science and art, such as he was aiming to make out of surgery. Certain of his friends supposed that Hunter, while he was at work upon animal structures, might be making a private cabinet of stuffed birds and pickled fishes; and if they desired to get rid of him as a rival, they were undoubtedly willing that he should spend his time at such an innocent amusement. Hunter published few papers, rarely engaged in discussions, and was a dull lecturer; therefore what reason could there be to suppose he was obtaining knowledge which should overthrow many of the old ideas in surgery, and establish a new system upon a physiological basis? And could it be expected that the rivals of Hunter in surgical practice would admit that he had made any substantial improvements? They accused him of being an enthusiast and innovator; and were slow in admitting that he ever developed a new and valuable idea.

John Hunter rested in an humble grave for more than sixty years, or until all animosity springing from rivalry had vanished, and another generation of cultivated men occupied the stage of life. Then it was that the unrivaled talents of Hunter were fully appreciated—then it became known what his cabinet was designed to illustrate. A succeeding generation discovered the great talents of Hunter, and acknowledged the improvements he had made in surgery. After the heart-burnings which spring from rivalry had passed away, the most famous of modern burial places was not too distinguished for the ashes of the profound student of nature.

In 1814, what is called the "Hunterian Oration" was founded in the Royal College of Surgeons, by Dr. Matthew Baillie and Sir Everard Home; and for forty years a festival was held on each returning birthday of the great experimental surgeon. The oration and celebration are now repeated biennially; and the occasion does not decrease in interest as time passes. The high character of the orations, and the intellectual status of the guests, indicate the esteem in which the memory of a man of transcendent ability is held. Although the remains of John Hunter rest in Westminster Abbey, the example of patient labor the great physiologist set, and the value of his discoveries, exert such an influence upon mankind to-day, that it is easy to see that the spirit of the man still lives.

If it be legitimate in this country to reverence the name of Shakespeare as profoundly as it is done in England, why may we not bestow praise upon the eminent mental qualities of John Hunter? Indeed, the right has been acknowledged. In 1860, when a call was made in London for contributions to aid in the erection of a statue to the memory of "the father of modern surgery," a respectable sum of money was forwarded by physicians in the United States. All English speaking people, and the scientists of every country, will ever hold in lively appreciation the name and worthy fame of John Hunter.

The interest which is now taken in biological studies has brought the labors of Hunter into renewed prominence. The advocates of organic evolution have appropriated as their own such facts developed by Hunter as could be warped into the support of their theory; but nothing which Hunter wrote can be tortured into the support of biological evolution. While making a collection of fossils, Hunter became acquainted with the products of the different geological strata, and recognized the order in which they are superimposed, generally finding that the lowest forms of animal and vegetable life appeared first in the order of succession, and that higher grades followed, yet not systematically. He often found the remains of higher forms in the lower beds; and called attention to the fact as demonstrating that the simplest organic structures did not always exist before those which were more complicated in their organization. These points show that he would not have been a champion of evolution if he had lived at the present time, for the same arguments yet remain unanswered. Those who would make out that Hunter was an evolutionist, make him say while he was studying the development of embryo-birds that "he had seen enough to convince him that every higher creature, in its transformation from a germ to the end of its fœtal state, passed through a series of changes, in each of which it exhibited traces of the perfect form of some order lower than itself." But this does not show that he believed in spontaneous generation, and that protoplasm was the origin of life. Many of those who look upon the doctrine of evolution as fanciful, are willing to admit that a part of the scheme is true—true to a certain extent—true as a method of organic development, but not as the beginning of organic life—not as demonstrating the origin of the vital principle. Vitality may have attributes which, under the influence of various forces in nature, might be able to modify the organic material with which it is inseparably connected. Hunter believed that the vital principle combined with it, as one of its attributes, a moiety of intelligence, and that this was in some degree conservative or protective in its nature. He indicated that physical force, which is inseparable from the inorganic world, is blind; and that vital force, which is never separated from an organism, can see, or is adaptive in its scope. What is called instinct in animals may be a higher development of it. When the root of a tree extends several rods for the sole and unquestioned purpose of obtaining an abundance of moisture or nutriment, this intelligent principle, which is an attribute of vitality, leads the way. It may be thwarted, and stumble, and fail, yet an intelligent purpose is manifested. John Hunter did not attempt to investigate the origin of life, but spent his time in experimenting with life in order that he might understand the principle of growth, and the essential features of repair, his object being to understand the recuperative processes in the human body. He was a practical surgeon, and desired to know as much of life as possible, in order that all knowledge thus obtained might be utilized in the treatment of the diseases of his fellow-men. He was such an enthusiastic student of pathology that he inoculated himself with a loathsome disease for the avowed purpose of observing its phases. He inflicted wounds upon trees and animals, and then watched the vital disturbance, and the almost intellectual processes of repair. He transplanted the spur of a cock to the comb in order to learn under what circumstances the grafting of animal structures could be rendered successful. He froze one ear of a rabbit to ascertain how the frosted organ compared with the other after inflammation had set in; he made deep incisions in the muscles of a donkey, and then took the temperature of the cavities every day while the wounds were healing. He labored long to find out what constituted the essential difference between a warm and a cold-blooded animal. He employed a thermometer to learn the variation of temperature in a hive of bees in winter; and speculated upon the cause of an increase of heat as soon as the insects were aroused from their usual torpidity. In short, he carried on at the same time a great variety of experiments for the purpose of obtaining knowledge *per se*, and with the object of utilizing in his surgical practice such facts as he might discover. And while he was delving for the good of surgery he was pursuing the very best course to develop a philosophical biology.

At the end of a moderately long life spent in professional labor and in the preparation of specimens illustrative of pathology and comparative anatomy, Hunter left little for the support of his family, except a huge collection of materials that came through his hands, a considerable portion of which being unfinished. These specimens were at length sold for fifteen thousand pounds sterling; and thus the famous "Hunterian Museum" was established. The funds were sufficient to render comfortable those of his immediate kin who had been dependent upon him. The cabinet, now considerably enlarged, shows what can be accomplished by the utilization of odds and ends of time which are too commonly wasted by those who flatter themselves that they are busy. It is reported of Hunter that he never seemed tired nor weary; he always expressed himself as being intensely happy, only regretting that he had no more time to devote to the study of nature. If he felt chagrined at the trivial way in which his boyhood was spent, he never confessed it, but worked on as if to regain what had been lost.

Hunter did not make much headway in collecting for his cabinet until the income from his surgical practice would warrant the outlay; and his professional fees were not lucrative until he was about fifty years of age. As soon as his pecuniary circumstances would warrant the expenditure, he sent orders to distant parts of the earth for specimens in natural history. Often the captain of a fishing smack would bring in rare and valuable animals; and a liberal compensation was sure to be obtained. Hunter contrived to secure most of the caged animals that died in the Tower and in traveling menageries. The flaying, dissecting, mounting, and preserving of these animal structures served to convert Mr. Hunter into an expert taxidermist; and the manipulation led to observations in regard to the mechanism of organization, and contributed to a deeper knowledge of the habits of animals.

Although Hunter never took a lesson in drawing, he acquired the art of making sketches, an accomplishment which proved valuable in illustrating his lectures and publications. The acquisition was all the more valuable from the fact that it was never easy for him to explain a subject under discussion unless he could employ a diagram.

While surgeon at St. George's Hospital, Hunter wanted parts of a whale to elucidate some point in physiology, anatomy, or surgery, and the following letter shows how determined was his purpose and how little came from his enterprise in trying to supply the want: "As the opportunities for ascertaining the anatomical structures of large marine animals are generally accidental, I have availed myself as much as possible of all that have occurred; and, anxious to get more extended information, I engaged a surgeon, at considerable expense, to make a voyage to Greenland in one of the ships employed in the whale fishery, and furnished him with such necessaries as was thought might be requisite for examining and preserving the more interesting parts, and with instructions for making general observations; but the only return I received for the expenses *was a piece of whale-skin with some small animals (barnacles) sticking upon it.*"

The labors of a naturalist can not be carried on in a great city, therefore Hunter purchased a piece of land, and put on it a cottage, with suitable outbuildings, at Earl's Court, about a mile beyond Brompton. This retired spot became at length a moderate Zoological Garden, and was shunned by all who are shy of wild beasts and doctor's things. At the back of the house was a lawn stocked with animals of the strangest selection; and in the lofts of his barn were eagles, owls, and many kinds of rare birds. Moving free in his grounds were ostriches, tortoises, kangaroos, and penguins. On the slope were bear-pits, and dens for the fiercest of beasts. One day two leopards escaped, and were creating great commotion in the neighborhood. Hunter, knowing the animals intimately, went to them, and taking each by the nape of the neck, led them safely back to their cages.

In an underground retreat which few visited, Hunter made many of his anatomical preparations. It was there that the giant skeleton of O'Brien was cleaned and mounted; it was there "the old copper kettle" came often into use. This subterranean passage was heated in winter to keep the equatorial animals from suffering and dying with cold. The hedgehogs, coiled up in the leaves of the garden when the weather was frosty, were occasionally taken into a warm room to see what effect heat would exert upon their appetites and activities. The bottom of an artificial pond was dredged in winter to ascertain what the eels and turtles were about.

During the earlier years of Hunter's career as a naturalist, there was no system in his collections nor in his observations. He would pick up any thing that could be found, purchased, or levied upon, if it promised to be serviceable in making a comparison. Every junk-shop was visited for bones, teeth, horns, hoofs, and claws. Every butcher in London was acquainted with Hunter, and many a fisherman on the coast was watching for an opportunity to secure a rare contribution for the "knowledgeable man," especially as Hunter understood the seductive influence of a generous fee. One day a boy, who had heard of Hunter's inclination to purchase specimens in natural history, carried a land-turtle five or six miles in order that he might obtain the reward. Hunter had plenty of such creatures on his estate at Earl's Court, which he would be glad to sell at six-pence apiece, but he gave the lad two shillings for his prize, saying, "Now bring me a live otter and I will give you a guinea for it," well knowing that he should not see the boy again very soon.

A museum such as Hunter established and left for the benefit of future generations, can not be erected in a day nor a year. One specimen after another is gathered in, and when several of the same family or species have been collected, the work of classification can commence; and when many classes get a representation, the successful first steps have been taken. No one knew the difficulties and extensive labors of such an enterprise better than Hunter; and few ever entered upon such a great work with his zeal and assurance of success.

Hunter had the faculty of making one branch of study help another; and he always exhibited a disposition to institute comparisons while carrying out experiments. One night he dressed the leg of a man who had sustained a compound fracture; and the next morning he broke the leg of a pig, leaving it to get along without treatment, in order that some valuable hint might be derived from the phases of a case left to take care of itself. The humane laws of England recently passed to prevent vivisection and cruelty to animals, would, if enacted a hundred years ago, have deprived Hunter of many prolific sources of observation. No wonder the scientific men of to-day have raised their voices against these encroachments upon the right to carry on investigation, especially as many of these kind-hearted law makers own *preserves* where animals are kept for the sole pleasure of the chase.

As an author Hunter was a success, although he did not live to carry into execution the half he had prepared for publication. His first work—that on Human Teeth—is clear and comprehensive, though not so large as the topic would permit at the present day. His work on the Blood and Inflammation, which is crammed with original observations, he labored upon more or less for a period of forty years, and had only begun to put it in type when he suddenly died. The stock of unpublished manuscript left behind was immense. It is to be expected that a busy man will begin more than he can finish. Mr. Flower, in speaking of the writings of Hunter, says:

"He had before the time of Cuvier and Meckel, collected materials for a work which needed but the finishing touches to have made it one of the greatest, most durable, and valuable contributions ever made by one man to the advancement of the science of comparative anatomy."

Hunter's surgical teachings contain so much that is fundamental and authoritative that no teacher of surgery in any medical college of Europe or America fails to inform his class in the course of his instruction, that such and such an idea originated with Hunter. Sometimes, to be sure, with the remark on the part of the egotistical "professor," that *he has improved upon the great author.* Hunter was the first to demonstrate that aneurism could be cured by tying the artery on the cardiac side of the disease. Other plans of cure have been devised, but none which has wholly superseded the Hunterian method. Great improvements had been made upon the surgery of mediæval times, yet Hunter found it "an empirical handicraft, and raised it to a scientific art." He introduced so many rational ideas into surgical practice that he fairly earned the right to be crowned "the father of modern surgery."

One of the grand mistakes committed on the part of those who would imitate the career of Hunter, has consisted chiefly in a misapprehension of the character of the man copied after. It is a blunder to suppose that Hunter won renown by simply making a great collection of anatomical rubbish, and by getting together a heap of facts and fossils. Any body can make observations in physiology and pathology, but how few possess Hunter's philosophical method of investigation, or the mental scope to classify fossils and facts so they shall convey an intelligent meaning? Large cabinets of natural history specimens are being formed in the large cities of the world, yet unless they be collected and arranged with the view of portraying the leading features of the organic world, and the wisdom manifested in organization, the objects brought together will mean little except a display of natural curiosities.

MORAL RESPONSIBILITY.

How often we hear the outspoken grief of a woman who is deploring the debased condition of a son or a daughter. In the depth of her woe she will exclaim: "What have I done that such wretchedness should come upon me?" It would suit the situation better if she should inquire what she had left *undone*. The mother of a child is the molder of its future. The plastic and pliant creature is as clay in a potter's hands. If the expanding mind be impulsive, irritable, and impatient of restraint, the peculiarity is largely due to inheritance—the unruly spirit came from father or mother or other progenitor, and is to be duly considered, and wisely modified. A parent may be proud of a pretty feature in a darling girl or boy, but feature alone is not conveyed to offspring—mental peculiarities are also inherited. Not a beautiful eye alone is transmitted, but a splay-foot and a vicious will are reprodued and entailed. If the twisted foot and wicked temper be judiciously treated they will nearly disappear; and in the course of several generations of thoughtful management, the defects may be substantially eradicated. Intelligent parents should know what their children's tastes and inclinations are to become by a consideration of their own. Children are not exactly like either parent in mental endowment or physical make-up, but they exhibit a blending or compromise of the two parents. If the mother be the daughter of a good mother, she will be the grandmother of good grandchildren. If a mother possesses a noticeable lack of moral qualities, her daughter will display a like defect at a corresponding age. If the mother be a kleptomaniac, the daughter will be "light-fingered." The heels of a filly foaled by a kicking dam can not be trusted. This is *Nature;* and who would have it otherwise? Each kind reproduces itself, yet with a capability for improvement in offspring. If the capacity for betterment were not in the hereditary scheme, bad stock should be squelched at once, and not be permitted to reproduce. As it is, a better race is within the range of possibilities. By crossings, trainings, and provident attentions to a thousand influences more or less swerving, a breeder of stock may develop desirable or valuable qualities in the objects he would improve. Thus it is with human beings—as a family or race we may rise in the world or degenerate; and the elevating and depressing influences are not wholly beyond our control. If a boy is ambitious enough to aspire to wealth and distinction, he may accomplish wonders—he may mount higher than he ever dreamed of ascending. What possibilities are within the grasp of every fairly favored youth! What degradation and misery are in store for those who follow their baser instincts, and trust to the foolish proverb that "the world owes them a living." How came the world thus in debt to any body? What values have the shiftless imparted that they should be recompensed by an unearned living?

But, I have departed in some degree from the idea I aimed to elucidate. Let parents study the favored and weak points in their offspring; and let them endeavor to be wise in the management of peculiarities. The boy that is unhappy, unless entertained, can be made contented at home at a cheaper rate than in a neighboring saloon. Evening gossip at a corner grocery may be quite engaging to a lad who hears nothing but snaps and snarls at home ; but home should be made more attractive to the young than a tavern or a news-room. Story books, pictures, and games are needed to entertain and instruct a child. It is less costly to have a billiard table at home than to pay the contingencies of a boy's sports at a billiard saloon. A wise father should take his sons to reputable places of amusement, and endeavor to hold companionship with them. A mother should hold conversations with her half-grown boy, and impart simple lessons that impress indelibly the youthful brain. A young man discreetly handled will not marry beneath his rank—he will aim to win *the daughter of a good mother*. A daughter properly trained will not run away with her father's coachman. Young people must have access to the world in order to see its various sides, and thus become enabled to discriminate between its good and its evil.

As appetites develop in the sexes, the virtue of chastity has to be cultivated. Says Robert Collyer: "In the far-reaching influences that go to every life, and away backward as well as forward, children are born with appetites fatally strong in their nature. As they grow up the appetite grows with them, and speedily becomes a master, the master a tyrant, and by the time he arrives at manhood the man is a slave. I heard a man say that for twenty-eight years the soul within him had had to stand like an unsleeping sentinel, guarding his appetite for strong drink. To be a man, under such a disadvantage, not to mention a saint, is as fine a piece of grace as can well be seen.

There is no doctrine that demands a larger vision than this of the depravity of human nature. Old Dr. Mason used to say that as much grace as would make John a saint would barely keep Peter from knocking a man down."

The teaching of the Rev. Dr. Collyer is that a man has to struggle to hold his passions under control; and that John has no besetting sin to compare with that of Peter. It requires repeated effort for a man to hold his temper, his passions, and his egotism in subjection, yet the exercise of the will to gain the restraint is to develop personal grandeur; all persons need about the same amount of saving grace. Grace will not still a flaming desire, but an effort of the will conquers the flesh. I have little respect for whining men and whimpering women, whose complaints are that their burdens are too great to be endured. Let the cowards try with determined wills, and they may astonish even themselves, becoming heroes and heroines.

The boy who can not resist the temptation to lay out money should open a bank account if he have but a dime for an initial deposit. To cultivate economy and a disposition to live within one's income, is to develop a quality in human character that leads to financial success, and avoids theft, forgery, and the penitentiary. It is not always dishonorable to be poor, but poverty often leads to crime, and it is silly to pretend to despise wealth.

A Board of Trade will excuse a financial blunder, but never can forgive a dishonorable act. In the mercantile world fortunes may be made and lost a dozen times, but a reputation for dishonesty is an abiding and indelible badge of infamy.

THE PROGRESSIVE ATTRIBUTES OF INANIMATE MATTER, AND THE PURPOSIVE OPERATIONS OF ORGANIC STRUCTURES.

(Read before the Cincinnati Natural History Society, Aug. 5, 1879.)

Long before algæ, mosses, ferns, and other plant-like forms appeared in sea or on land, floral shapes had been created in frost-work and congealed water. The vegetable form is one which did not originate in organization, but in forces governing crystallization. Fronds were traced in crystals of ice before they ever grew. From this it would seem that the forces or attributes of inanimate matter are, in some of their activities, prospective—something higher being foreshadowed by them. It is possible that the elegant shapes we behold on the window pane in winter are due to electrical influences, yet electricity is an attribute of inanimate matter. The outlines of frost-work vary from time to time, and seem to be governed in shape by hygrometric and magnetic conditions, yet this does not smother the spontaneous inquiry in regard to the origin of cryptogamic forms first fashioned in ice. The crystallographer may assert that the outlines of lichens and ferns in frost-work are a necessity; that it is a law of crystallization that the vapor of water in a freezing state must congeal in just such forms, and in no other. Well, to be told that quartz crystallizes in hexagons, and by a law or force inherent in the material, it can not congeal or crystallize in any other shape, is interesting yet not satisfactory to a mind seeking ultimate causes. Perhaps we shall be told that all minerals have attributes, such as cleavage, specific gravity, and frangibility, and that each mineral has a peculiar attribute that determines the form it shall take when undergoing congelation or crystallization. Then, if we ask whence came the attribute, we may be told that it always existed; that it was never created any more than the mineral substance was elaborated from *nil*. Quartz without its attributes is not conceivable; quartz is only such when substance and attribute are combined. The substance can not exist without the attribute, nor the attribute without the substance. A similar course of reasoning leads to the conclusion that the vapor of water congeals at a certain temperature; and the law of its crystallization is, that the frozen particles shall arrange themselves in shapes which correspond to those of certain cryptogamic plants—to those of club-mosses, for instance. The poet, in giving rein to his fancies, might say that Puck invented these beautiful forms, and displayed them in crystals of ice!

If the ordinary geological interpretation of the earth's cosmogony be accepted, it would seem that what was once a molten planet became at length sufficiently cooled to exhibit sea and land; and that the internal fires warped the outside crust into mountains and valleys, hills and plains, with vistas and landscapes. In a restricted sense there is nothing purposive in all this—nothing but changes brought about by disturbed forces seeking equilibrium; yet in a more liberal interpretation of the matter, a scheme may be seen in every feature. The introduction of life upon the planet was seemingly an aim of Omnipotence, and every change was effected with an object and end in view. Such are the opinions of the religionist or the optimist who believes that "every thing was made for the best." Views of this kind will always prevail, for they can not be successfully attacked and overthrown. The evolutionist may declare that this planet in its present state is a necessity of matter and force in the universe, and that there is no evidence of design in the entire cosmogony. Running counter to this materialistic view is the fact that the earth is enveloped in air (a combination of oxygen and nitrogen), which in its purity is essential to life; and that water (a union of hydrogen and oxygen), a necessity for organic life, is every-where abundant. If these compounds occurred in an accidental manner, without influences that execute purposes, the occurrences were more fortunate than fortuitous actions in general. Furthermore, a planet with crystalline surfaces, with glittering prisms, and planes and angles in mathematical proportions, would be an inhospitable place for plants and animals; but after the rocks had been disintegrated by the action of alternate heat and cold, and ground to powder by moving ice and dashing water, a soil, loam, or humus would be elaborated, which should prove a necessity for the sustenance of vegetation; and such operations have been going on for thousands of years, as if to prepare the earth's surface for the support of life. The result was not brought about quickly, but was slowly elaborated during cycles of time. The forces at work were never exhausted; and the ends accomplished show a spirit of progress that is not seen in the ordinary operations of inorganic matter.

The evolutionist, on the other hand, contends that all has not been created for "the best;" he declares that the thunderbolt kills, and that the rain often falls unpropitiously. He claims that if there were an original scheme to introduce life upon the planet, and make the most of it, the failures are so numerous, and the disasters so frequent, that the good will not balance the bad. The world is so full of thorns, and stings, and fangs, that the dull of comprehension might readily suppose that an Evil Spirit exercised a controlling influence in the government of cosmical affairs. . . .

The optimist says that the earth was specially made for the enjoyment of life, and that every thing has been managed by a wise Creator for the best. It would be illogical as well as irreverent to question the cosmical scheme, for Omniscience made every thing, and all things for good! . . .

The geological representation of the earth's history is that a bad state of affairs, so far as life might be concerned, gave place to better and better conditions, until the sea and land were habitable. The water and the air became gradually purer, and the temperatures lower, or nearer what they now are. Progress was observable from one period to another; a progressive spirit seemed to pervade inanimate matter. If the geologist be a materialist, he speaks of the attributes of inorganic substances, and ascribes to them inherent properties and powers, which are made to do all that has been done in bringing about the present state of affairs. A Creator, as generally understood, is wholly ignored, and all purposes and designs, except such as the attributes of matter may develop, are denied. Now, if there be no divine wisdom or scheme in cosmic evolutions, a considerable degree of intelligence must be assigned to the attributes of inorganic matter. In truth, a much higher degree of intelligence is demanded than can be reasonably supposed to belong to ordinary gases, fluids, and solids. Although a peculiar plant appears in yeast, and another in vinegar, and *fermentation* is alleged to be the origin of these products, there is no evidence of spontaneous generation in the process, nor proof that the attributes of inanimate matter are capable of producing and supporting organic structures.

The surface of the earth is broken into mountains and valleys, ridges and ravines: rain falling upon these uneven areas helps to pulverize the rocks as it runs down to the sea in streams large and small; but movements of glaciers grind mineral substances to powder faster than running water. Now, it seems that glaciers have moved over a large part of our hills and plains; and in the pulverizing process have prepared loam as food for our plants. Whether there was any original design in these cosmic operations, or whether the whole is the result of unavoidable circumstances, will be left to speculation. If the barren earth was accidentally prepared for the introduction and sustenance of plants and animals, the fortuitous circumstance was an exceedingly lucky one. It really seems as if the activities that unfolded the earth until its surface was habitable, and afterward introduced life and directed vital energies, were intelligent, progressive, and purposive; and until the evolutionist is able to show that the inherent forces of the universe are more sapient than those which the forces of inanimate matter display in their usual manifestations, he will be unable to convert mankind to an implicit belief in his novel doctrines.

On the other hand, the optimist will have to concede something to the liberalism that is rapidly gaining adherents through scientific discoveries. The inquiring nature of the average man's mind will never be satisfied with any thing short of the reasonable truth, though actual demonstration may never be attained. There is nothing necessarily purposive in all the operations of inanimate matter. An earthquake may alter the phases of a mountain range, and lift the bed of the ocean above the sea's level, yet accomplish no definite object; there need not be any design in the disturbing movement, though the subsidence or upheaval greatly deranges the flora and fauna of the shaky region. Many large and important islands, as the Sandwich, Society, and other groups, are of volcanic origin, and are still the abode of igneous eruptions. In contemplating the birth of these new lands, is it rationally supposable that the moving cause had wise intentions? The optimist might cut the Gordian knot by declaring that all cosmic changes have a good purpose to fulfill, and that these transformations were contemplated by Omniscience, nothing having turned out differently from what was expected.

Another feature of the optimist's belief is that life is the chiefest of blessings, and that Creative Wisdom has prepared the earth for the cultivation, multiplication, and conservation of the inestimable gift. As soon as this doctrine is examined, it becomes apparent that the most has not been made of the "blessing." We find that to have the most of life on the planet, animals should be all vegetable eaters. Instead of such a paradise on earth, where all should be peace, there is eternal war, and animals curtail life by eating one another. Voracious sharks infest every sea, and fish in general prey upon their kind. The smaller of the finny tribes are in imminent danger of being swallowed alive. Small fry are devoured by the thousand when a big fish comes along that needs a meal. How much of life is daily lost in this way! And what substantial happiness can there be among those in mortal terror of being swallowed?

On land the same state of things prevails; the fox lies in wait for the timid hare, the cat crouches in ambush for prey, and the high-soaring hawk stoops and bears away the screaming small bird. Even our own carnivorous appetites lead us to forget how many lives are sacrificed for the alimentation of our bodies. Life is undoubtedly sweet when its conditions are favorable; yet the well-grounded fear of being eaten is horrible. The pitiful toad that, while still alive, is being swallowed by a snake, has little to be thankful for, unless it be that its misery will soon end. A man justifies his carnivorous career by Scriptural authority. He was given "dominion over the fish of the sea, and over the fowls of the air, and over every living thing that moveth on the earth." Possibly *dominion* did not mean the right to slay and eat every creature that might please the palate.

The Mosaic account of how life found a way to earth is graphic and plainly expressed. The appearing of "dry land" as a preparatory step to the introduction of "grass, the herb yielding seed," is somewhat in accordance with the geological record. Afterward the earth brought forth animals which might feed upon the grass; and lastly, man put in an appearance, just as geology affirms. This method of peopling the earth is by a direct *fiat* of the Almighty, and is called miraculous, because a pair of a kind is made at once and with adult capacities, and never grew or passed through an embryonic state. The entire machinery of the organic world was set in motion in such a way that there should be no hitch nor catch. All had plenty to eat at once, though it is difficult to understand how the lions and tigers got along among the sheep and goats. As the cud-chewers would require months to increase their numbers by reproduction, it is not easy to see how the flesh-eaters managed to live and not render extinct pairs and pairs of creatures included in the original scheme!

The radical evolutionist can not start his plan of peopling the earth without supposing that in some fortuitous way a monad got here spontaneously. He presumes that nitrogenized slime—called protoplasm—was in a favorable condition to be vivified, and a stroke of lightning, or some other "favorable influence," kindled the vital spark. At this primeval birth was born an organism that was capable of reproduction, and of improving gradually, so that the variation would establish a higher species. In time the advancement and variability evolved all the plants and animals now on earth! The scheme is an interesting and ingenious one, and accounts for many peculiarities in our flora and fauna that before were mysterious. But to start such an enterprise is attended with a stunning difficulty at the outset. Is it not about as strange, wonderful, and miraculous for a monad to spring into existence without any other progenitor than "fortunate circumstances," as it would be for Omnipotence to create at once an adult elephant?

Inasmuch as the religionist and the evolutionist encounter difficulties in attempting to defend their peculiar views, it might be profitable for both to make concessions, and live together without jealousies and animosities. Let the evolutionist concede Omnipotence as the author of all law, force, and energy exhibited and excited in the universe; and let the religionist admit that the Ruler of heaven and earth may have rendered this planet habitable, and then peopled it by first introducing the lower forms, then a higher, and so on till man took his place at the head of created things. There is little that is unreasonable in the theory, and much to support it. The admission would deprive the evolutionist of much of his stock in trade, and not shock the sensibilities of the ecclesiastic. This liberal interpretation of mundane operations would allow of a premeditated scheme, of a rational method of procedure, and of results in harmony with the entire enterprise.

Whatever may have been the cause of organic structures, there is on every hand a striking display of *purpose* in vital operations. If a tree be upturned in a ravine, it will be found that the roots extending to the moisture and rich loam at the bottom of the declivity will be large and numerous, as if to absorb moisture and nutriment abundantly, and that the roots reaching upward and laterally will seek a rock or stable substance, around which the rootlets coil and cling as if to gain support or anchorage. It is difficult to see where this conservative purpose came from, though it is easy to declare that the different parts of a tree, as the roots on either side of the stem, know what is best for the general good of the structure in its entirety.

A neglected potato in a crevice of the cellar wall will sprout under the influence of the warmth of advancing spring, and the colorless shoots will, in their growth, bend toward the light of the nearest cellar window, even emerging to open day if there exist a chink in the glass; and at length exhibit green leaves as other plants exposed to sunlight. In order to reach the light the white stalks develop to a much greater length than the ordinary stems of potatoes planted in a field. These vegetative operations seem to show that every organism is endowed with an intuitive sense of the necessities of its being, and with ability to better its condition, especially if circumvented or embarrassed. In reviewing the more common of vital operations, it becomes apparent that some degree of intelligence attends the development of every part and portion of an individual. It seems as if vitality embraced intelligence as an attribute, and never engaged in the evolution of organic structures without utilizing the attribute as a guide.

In the evolution of an animal it appears as if the pressing need for a helping peculiarity operated like a desire and as a force to develop an excess of organ and function. The terminal end of a pig's snout has an osseous development in it, called the pre-nasal bone. No other animal, so far as I know, has such a bone, though some snouted ant-eaters possess a cartilaginous approach to it. What developed this peculiar bone in the gristly end of the swine's snout? Well, suppose the earlier of the race had no bone in the nose, yet an excess of dense structure, such as cartilage and fibrous tissue. The creature in rooting for food would use the snout excessively, and thus tend to elaborate a better rooter. Use improves an organ. Cartilage hardened to bone, and fibrous tissue became muscle, so that at length the osseous pivot was moved with ease. A useful snout was thus evolved by the needs of the creature! At any rate, this is a sample of the reasoning of the avowed evolutionist.

It is pretty generally conceded on the part of those who hold to the Mosaic account of creation that the earth was first peopled with low orders of plants and animals; and that the time since the earliest forms of organic life appeared must have been incalculably long from the fact that layer upon layer of sedimentary rock reveals beds of fossils which show what manner of organism prevailed from cycle to cycle in the earth's history. Possibly millions of years elapsed from the dawn of organic life, to the creation of a fish—the lowest backboned animal—then there had to be a reign of reptiles and birds before mammals came, and improvements seem to have been going on all the while. Man did not come with all the endowments and acquirements of a philosopher, but in the state of a savage, and there is no evidence—nothing but inference—that primitive man was sired by an ape. There is much to show that he was originally much like the savages of uncivilized countries. The optimist affects to believe that the first pair of human beings came directly from the hand of the Almighty, and therefore were necessarily "perfect," but in the anatomical manipulation of man's organism it is found that his mechanism has some important defects. The most of his special senses are excelled by those in some of the inferior animals; and it is only in his entirety that man is superior to any of the lower animals. . . .

In the purposive operations of organic structures we sometimes see a progressive tendency in one part of the organism and a retrograde action in another region of the body. In the Ateles and some other long-tailed monkeys, as the prehensile character of the caudal extremity is developed, the thumb shrinks and loses its function. This looks as if vital activities were intelligent enough to be compensating in the display of economics. All birds that are excellent swimmers make a wretched appearance while walking on land. The bat which flies quite easily can scarcely crawl when upon its fettered feet. The transforming processes that give a horse length of limb, and raise the creature upon the end of a single digit for each foot, have not given the animal perfect legs, but have allowed splint bones to remain alongside the shank or cannon bone. This defect in fashioning the mechanism of the horse's fore-leg often proves serious. The rudimentary metacarpal bone, called by farriers a "splint," is so nearly independent that it sometimes becomes detached or loosened, and then the animal gets lame,—the creature has a *splint* in the leg! All horses have splints or splint-bones in the fore-legs, but only occasionally does lameness spring from a loosening of the undeveloped metacarpal. Cows and camels have the merest signs of splint-bones, and are, therefore, exempt from the splint lameness peculiar to the horse.

The Italian mole, which rarely if ever comes to the light of day, has an eye-mark in the skin, but no eye that can see. A retrograde action, caused by the withdrawal of light, at length made the animal blind. The creature has a rudimentary optic apparatus which indicates that its progenitors were not eyeless, and perhaps not blind. A similar remark may be made in regard to cave fishes which are blind. Living in the dark, generation after generation, allowed the eye developing part of the creature to retrograde. To compensate for this loss of sight the cave dweller had the rays of its fins lengthened and rendered more sensitive by use, so that the creature can very readily feel its food and then catch it. Of course, its prey is blind, all the cavern's inhabitants being placed upon an equality so far as seeing is concerned.

Certain animals that live in mud, or alternate between land and water, have two sets of breathing organs, a bronchial and a pulmonary apparatus. The frog in its transition from the tadpole state is temporarily thus; the mud-fish in the swamps of Southern Australia has gills and lungs, and so does a kindred fish in Africa, and the South American lepidosiren is similarly equipped. These singular creatures show how the forces of organization can adapt themselves to the infringement of circumstances. There is an exhibition of intelligence in the excess and defect of development; and the most far reaching investigations fail to reveal whence came this intuitive sense.

BIOGRAPHICAL SKETCH OF BARON LARREY.

Jean Dominique Larrey, according to his own statement in his *Campaigns and Memoirs*, was born at Baudean, a village of the upper Pyrenees, in the year 1767, and died at Lyons in 1842. He says little of his boyhood, but begins his personal narrative by asserting: "At the age of thirteen, I left the place of my nativity with a view of studying medicine under the direction of my uncle, Alexis Larrey, Director in the Medical School at Toulouse. After passing the curriculum of elementary and medical studies, I determined to visit the Universities in order to acquire that knowledge which is requisite to a reputable standing in the honorable profession I was ambitious to take rank."

"At the age of twenty-one, I repaired to Brest, to enter a competitive examination for auxiliary surgeon in the navy, and had the good fortune to obtain an appointment. In this position I had opportunities to dissect, and otherwise to gain scientific knowledge. Soon I was consigned to duty on the frigate *Vigilante*, which was destined for duty on the Grand Banks of Newfoundland, to protect French interests in the cod-fisheries.

"At Belle Isle the ship took on board twenty ship-wrecked mariners, who were starved and frozen. The treatment of these wretched creatures gave me an experience which served me a useful purpose in Polish and Russian campaigns. In the treatment of frost-bites, warm water poultices induce gangrene, while cold and camphorated washes assist in the return of vital activity.

"After nearly a year's cruise, sailing as far north as Labrador, the ship returned to Brest, where I was discharged. I went directly to Paris, and soon entered upon the 'Campaign of the Rhine.' A revolution was developing about Paris, and many wounded in emeutes had to be treated. To acquire experience, I volunteered to serve under Surgeon Desault. In April, 1792, I was appointed Surgeon Major, and joined the army, which was then beyond the Rhine. The first military exploit of the campaign was to capture Spire, a fortified city. The general order was that the hospitals were to be located at a league's distance from the line of battle. This operated so disadvantageously for the wounded that I got permission to improvise ambulances, each with a corps of young surgeons and soldiers who would go to the front and bring the disabled to a designated place near at hand, where I could amputate, extract missiles, and treat fractures while the battle was raging. This was the beginning of an ambulance service, which grew into significant proportions, and which at length embraced two and four-wheeled carriages, drawn by two and four horses, and driven by charioteers, who dashed between contending armies, and, gathering loads of the *hors du combat*, galloped off to a located ambulance, where the surgeons could work undisturbed, and immediately after a wound was received. This system of ambulancing in time became very popular in the French military service. There was a corps of ambulances for each division of the army, each embracing about four hundred men. If a general fell, those near at hand bore him to a flying ambulance, and away he went to surgical head-quarters. Not infrequently he underwent an amputation in fifteen minutes after receiving a shattered limb. If a battle were not attended with many wounded, they were all treated by the time the conflict was over. When thousands were wounded, the ambulance surgeons had to work far into night, even till noon of the following day. Then to get all into hospitals, churches, private houses, barns, sheds, and under grain-stacks, might require another day, or several days. As a rule, we treated all alike—the wounded of friend and foe—though the candor was not always returned in kind. Not infrequently we had to feed the sufferers on horse-flesh, and the poor fellows were very thankful even for such rations."

Peace having been declared between France and Prussia, the Austrian army fell back from the vicinity of the Rhine, and took part with the Italians; and General Bonaparte was sent upon what was called the "Campaign of Italy." Napoleon made Larrey Surgeon-in-Chief of the army in the field, with a six weeks' furlough before entering upon duty. He improved this respite from labor by going to Toulouse and marrying the daughter of Leroux, once Minister of Finance under Louis XVI.

After a brief honeymoon, Surgeon Larrey repaired to Italy, and entered upon official duties. The army crossed the Alps near Mount Cenis, where Hannibal found his way into fair Italy. The tourist who reaches Turin through the railway tunnel may see a stone bridge built by Napoleon to cross a stream on his way to the beautiful and fertile fields of Lombardy. In this campaign Napoleon's progress was disputed by the Austrians at the "Bridge of Lodi." Here the wounded were so numerous that Larrey had to bring all his ambulance corps into use; and he had to force the innocent inhabitants to furnish supplies of milk, bread and fruits to the wounded cantoned among them. Although the simple hearted peasantry had nothing to do with the unexpected and unexplained war, they had to endure some of its burdens. Not a few of these ruralists, who had to be economical, living largely on chestnuts and goat's milk, found it a hardship to feed a wounded soldier imposed upon their strained hospitality. But such was the result of cruel war.

The Italian campaign was not conspicuous for sanguinary battles, yet the loss of life in sickness was fearful. In such cities as Verona and Bologna, where it is presumably healthy, the most devastating of fevers broke out. Larrey and his confreres investigated the causes, and could make out nothing but ordinary "camp fever," aggravated by bad water and unhealthy cantonments. There, at the foot of the Alps, on the Italian lakes, should be plenty of cool and fresh water. But, besides lakes, there are stagnant fens and miasmatic pools. Larrey set about draining the marshes by ditching around bivouacs, which caused the health of the soldiers to improve. And zeal to keep the soldiers well made Larrey exceedingly popular with the army.

In May, 1798, the "Egyptian campaign" was planned, and Larrey took its surgical lead, although Baron Desgenettes outranked him as medical head of the expedition. The latter was one of the great men France developed from the lower walks of life to the highest, and who deserves to be noticed for his arduous duties in the Syrian campaign. After the naval battle of Aboukir, which the English fleet so gallantly won, communication was cut off between France and her Egyptian army, yet Napoleon kept his troops in activity, winning the battle of the Pyramids against the combined forces of Mamelukes, Arabs, Kopts, and Bedouins. Larrey describes the Mamelukes as the handsomest troopers in the world, and the best caparisoned on beautiful horses. They charge with heavy sabers, and smite their foes with an onset that can hardly be resisted by the most experienced infantry. The Arabs are good fighters, but the Kopts make indifferent soldiers.

Perhaps to open Jaffa and Acre to blockade runners, Napoleon marched his Egyptian army to Suez, and crossed the desert to Syria. This proved almost disastrous to the troops. Heat and thirst were intolerable. At stagnant pools here and there, men and horses sucked up the water, and their noses and fauces became affected with leeches, which, increasing in size, mechanically occluded the respiratory passages. Victims of the leech were in the greatest distress. Larrey, with polypus forceps, was able to withdraw them. In crossing the Lybian desert, similar leeches being found, straining the water was resorted to, and porous earthen jars proved the best strainers.

The glare of the sun, and the fine dust of the desert contributed to the development of annoying ophthalmias. At first there was conjunctivitis, then granular lids and pterygia appeared, which in the end resulted in imperfect vision or total blindness. At least one-third of the Egyptian army which returned to France was invalided through ocular defects.

It required twenty days to cross the Arabian desert; and then the way to Jaffa was not plentiful in food or potable water. However, the troops took hope and courage, and assaulted the outworks of the city with alacrity, and carried them by storm. In the barracks were sick and disabled Mamelukes, Bedouin Arabs, and Oriental tramps, and here for the first time was seen evidence of the bubonic plague. A number of the French soldiers took the disease, and in a few days the army was threatened with the hateful malady. After the siege of Acre was entered upon, and prisoners from sorties were captured, it was ascertained that the besieged were afflicted with "*the plague*." Under the circumstances, it is no wonder the siege was not conducted more vigorously. Not well men enough could be found to excavate parallels and to conduct hand-to-hand assaults. About twenty thousand English soldiers had been thrown into the city to help the Turks in the defense of the fortress. The French were greatly dispirited through fear of the pestilence. Following the "chill of invasion" came the dreadful aching in the bones and muscles, swelling of the lymphatics in the axilæ and groins, suppuration, delirium, and death. One day, while Napoleon was walking through the hospitals, he said to Drs. Desgenettes and Larrey, who were in consultation: "Why don't you give these poor fellows a dose of opium and put an end to their sufferings?" Larrey playfully replied: "It is your avocation to kill, and ours to save life."

After sixty-eight days of varying fortune before the fortifications of Acre, the French army, decimated and discourged, abandoned the fruitless siege and hurried back to Egypt. The desert had to be repassed, and the Mamelukes and Bedouins hung on the rear and flanks of the dispirited soldiers, ready to strip the body of a tottering straggler. Some of the famished were sustained by equine soup. Horses about to die were killed to furnish food for the starving men. Many of the soldiers were so nearly blind that they kept in line by joining hands. No relief from sufferings of one kind and another was experienced till the fertile plains and sweet waters of the Nile were reached. Again in the luxurious city of Cairo, where food was plenty, and baths were charming, Surgeon Larrey had time and opportunity to recuperate. But the season of comparative bliss was not to be lasting. A large Turkish army landed on the coast, and the English fleet held Alexandria. From Upper Egypt came Arabs and Kopts in hordes, and the chivalrous Mamelukes threatened every avenue of escape. But the French recrossed the Lybian desert and reached the shores of the Mediterranean. Here, after fighting a fierce battle with the Turks and English, they made a treaty which permitted the remnant of the once grand Egyptian expedition to return unmolested to France. Napoleon had already escaped from the Nile country in some swiftly sailing craft. Upon his arrival at Paris he was proclaimed emperor, and a new army was raised. Larrey was honored with a knighthood—that of the "Iron Cross"—and made Surgeon-in-Chief of the "Army of the East," the name for the military organization. This campaign began on the Rhine and ended at Austerlitz. Enough of the Egyptian veterans were present to infuse a chivalrous spirit into the raw recruits; and the French were every-where victorious. The army marched with such celerity that the enemy were always taken by surprise and at disadvantages. Ulm was captured by assault, and a large division of the Austro-Russian army annihilated. The military stores captured enabled the French to follow the enemy down the Danube, and enforce the capitulation of Vienna. Larrey was able to get all the wounded of Ulm into hospitals and private residences, so the army was not incumbered on the eve of the great battle of Austerlitz, or of the "Three Emperors,"—Alexander of Russia, Francis of Austria, and Napoleon of France. The campaign was conducted in the winter, hence there was much suffering from frost; but Surgeon Larrey was enabled to protect the wounded from outdoor exposure. He utilized barns, sheds, stacks of straw, and every-thing that might add comfort to the invalid. The ambulance corps rendered valuable assistance. They conveyed thousands of wounded from Austerlitz to the city of Brunn, where there were hospitals, churches, warehouses, and other shelters for thirty thousand wounded Russians, Austrians and French. But the concentration of so many mangled men developed a fatal fever, which spread to the citizens, and created a panic among the inhabitants. This was a trying and anxious time for the medical and surgical corps. Gangrene attacked those who crowded about hot stoves, and "camp fever,"—typhus—was most fatal where the sick were in unventilated quarters. The contagion of Brunn was more deadly than the Syrian plague, though attended with less dismay.

An armistice put an end to the campaign, but another was instituted during the winter of the following year. This was called the "Campaign of Poland." The initiatory expedition covered the battles of Jena, Eylau and Warsaw, and all were fought in intensely cold weather. Larrey says: "The cold was so intense that instruments frequently fell from the hands of surgical assistants who held them for me during the operations. Fortunately I enjoyed an unusual vigor, doubtless produced by the great interest which I felt for the safety of so many brave fellows. The desire which we all felt to save the lives of the wounded, enabled us to persevere in the discharge of our difficult duties. Night often came on, and we had not been able to appease the cravings of hunger. In the midst of such heart-rending scenes, how could we attend to any thing but the performance of our sad but humane tasks? While I operated on one, I heard the most pressing calls for similar service on every side. After the operation a surprising calm, and a kind of internal satisfaction, succeeded to the cries of these soldiers, which they expressed by the most lively acknowledgments."

In this most arduous campaign hippohagy became common—and why not, if the necessity existed? Larrey declares that a soup of horse flesh is both nutritious and delicious. A dash of savory herbs makes it a luxury.

At the battle of Friedland, the Russians left six thousand dead on the field, and twenty thousand wounded to be cared for. These, in addition to the large list of French rendered helpless, taxed the ambulance corps to their utmost. Surgical supplies were scarce, so that any textile or fabric might be utilized as a dressing. The treaty of Tilsit ended the campaign. As a reward for distinguished service, Napoleon constituted Larrey a baron of the empire, and bestowed an annual pension of 5,000 francs—one thousand dollars. This was in 1809.

The most renowned of Napoleon's military operations was the "Campaign of Russia." This was inaugurated rather secretly, but its objective point was the capture of Moscow. On February 12th, 1812, orders were issued for the several divisions of the grand army to move eastward. In cavalry, infantry, and the different branches of military service, there were four hundred thousand men. Larrey conjectured that a descent on England was contemplated, and that the eastward march was a ruse to deceive the enemy. But after the troops had moved into Russian Poland, it became plain that the Army of Alexander, of Russia, was to receive special attention. On the 10th of May the city of Posen was occupied, and the army was pushing for the banks of the Vistula. At this time about half the entire army was mounted, horses along the line of the march being appropriated and utilized for that purpose, and forage being derived from the agricultural products of the adjacent country. Not one half the army was French, but there were volunteers and conscripts from several countries. There was even a cavalry regiment of Mamelukes from Egypt—soldiers of fortune, ever ready to engage in any warlike expedition. There were Italians, Spaniards, Bavarians, Saxons, a corps from Austria, Wirtemberg and Westphalia. The peculiar make-up of the grand army is the reason the combination so rapidly dissolved in the disastrous retreat of the expedition after the conflagration at Moscow. The French naturally kept together, for they were anxious to get home; but the troops of other nationalities as naturally straggled, taking the shortest routes to their own country.

The grand army reached Wilna on the 24th of June, and thus far had met with little resistance. But from this point onward the Russians interposed every obstacle to the advance. Mounted Cossacks drove away cattle, destroyed forage, and cut down bridges. The approach to Smolensk was hotly contested by the forces commanded by Alexander. The wounded Russians always fell into French hands, and gave the ambulance corps all they could do. At the storming of Smolensk the French lost heavily, but carried their point. They had twelve hundred killed, and six thousand wounded; and the Russians left as many more upon the battle field. The city was given up to hospital purposes, but could not accommodate all who needed timely succor. Hospital supplies were nearly exhausted, so that the silky cuticle of the white birch was utilized in dressings. One day Larrey executed over one hundred capital operations, eleven of which were amputation at the shoulder-joint. Rarely not over five minutes were spent in amputating a leg or thigh.

After the fall of Smolensk the Russians retreated toward Moscow, but offered battle at every advantageous point on the way. Great rains rendered the roads miry. Forage for men and horses became scanty. At best the great plains about Moscow are not fertile; and the army of Alexander destroyed what it could not consume. At Giad, a fortified place, the Russians made their last stand, and fought bravely. This was on the fifth of September, with the signs of autumn palpably apparent. Two thousand wounded Russians were to be cared for, yet hardly a rag could be had to wrap a shattered limb. For the time it was thought best to abandon them, the expectation being that a relief party could be sent out from Moscow to care for them. There already began to prevail a foreboding that the destructive policy manifested by the Russians might be carried out in Moscow. The army of Alexander was still large, and might make obstinate resistance to the invaders at the walls of the great city. Fate was beginning to dictate matters. It was now necessary that the French army should come in possession of Moscow's supplies. On the 14th of September the French went into bivouac under the shadows of Russia's ancient capital. There was no enemy to offer resistance, so on the morrow Moscow was entered. On every hand was the evidence of oriental grandeur. There was the Kremlin, and in its vicinity were palaces, triumphal arches, and great warehouses. But all was marvelously quiet. Few human beings were visible, and they were fiendish and squalid. The better class of houses contained no tenants, stocks of goods had been carried off, so that a disposition to pillage was not to be gratified to a large extent. In cellars was plenty of liquors, and drunkenness became common. Pickled meats and dried fish were plentiful, and some bread-stuffs; yet evidence of abundant food supplies was wanting. To the dismay of the invaders fires began to appear in all parts of the city, and the incendiaries could not be discovered. Attempts were made to extinguish the flames, yet they spread too rapidly to be controlled. It now became evident to Napoleon that the burning city must be evacuated, and an ignoble retreat entered upon; hence the order to retire was issued, and the homeward march begun. Improvident soldiers took much loot along with them, but soon threw the trash aside. An army of something less than three hundred thousand men is formidable in numbers, yet without food it becomes feeble in force. On the ever memorable retreat horrible sufferings were endured. Famished with hunger, the troops straggled along without order, and the Cossacks cut them down in hecatombs. The weather turned cold, and the roads became next to impassable. Horses were killed and eaten to prevent starvation. When it became necessary to halt, and re-organize for active operations; it was marvelous what a chivalrous spirit could be aroused by the presence and encouraging words of the Emperor. At his command the enemy could be severely punished for unendurable audacity.

At the river Berezina, the enemy held the bridge, and had an opportunity to capture the whole army. But during the night a frail bridge was extemporized and enough troops thrown over at a point above, so that a comparatively safe passage was guaranteed to the entire force. However, the bridge broke down, and thousands of men lost their lives in attempting to cross on floating ice. Larrey got well across, but returned to secure some surgical instruments. The Cossacks made a dash upon the remnant, and came near killing the Baron. The soldiers seeing him in peril, sprang to his rescue, and safely bore him across the treacherous river. The dilapidated army then pressed on to Wilna, where most of the forces, not French, marched by the nearest route home. When the French reached Koenigsberg, on Christmas day, they numbered twenty-eight thousand men who were still able to do military duty. The brunettes from the South of France stood the hardships of the campaign better than the blondes from the northern districts of the country.

Napoleon left the retreating squadrons at Wilna, and hastened to Paris to raise a new army to rescue the remnant of the old one. On the Elba the two armies, the new and the old, united forces, and gained victories over the Russians and their allies at Lutzen and Bautzen. An armistice was there established, and peace became prospective.

Baron Larrey became surgeon in the Hotel des Invalides, and remained popular with the soldiers. At the battle of Waterloo he was wounded and captured; but was treated with great consideration by Alexander and his allies. Upon the Bourbon restoration the pension of Larrey was temporarily suspended. In time, however, the income was again granted. After writing his Memoirs he went on official business to Algiers. While on his way back to Paris he died at Lyons.

Thus ends the epitomized biography of one of the most remarkable military surgeons that ever lived. In the "Memoirs" are essays upon peculiar diseases encountered in his campaigns—like the *plica pelonica*, *camp fever*, *the plague*, *tetanus*, *gangrene*, *frost-bite*, *amputations*, etc. Many of his pathological ideas are in accord with latest views. His essay on amputations can hardly be excelled. Perhaps from deficiency of other means, Larrey made frequent use of the moxa and actual cautery. While these remedial agencies have gone out of general use, I have employed both with pronounced benefit on several occasions.

It is remarkable that Larrey could endure a repetition of the greatest hardships, yet survive with mind and body unimpaired.

In condensing this sketch I found it impossible to keep clear of the military operations with which his important labors were connected; they need not be disassociated. The great surgeon helped to organize an important branch of military service. He devised and put in operation a grand ambulance system, which has never been surpassed. He demonstrated the necessity of early amputations after severe gun-shot wounds and attacks of gangrene. He did not wait for reactions and lines of demarkation; he amputated as soon as there was a seeming necessity for such an operation.

FOLK-LORE—WITCH-HAZEL.

The folk-lore of Europe has reference on multiple occasions to the mythical properties and virtues of witch-hazel. In most instances pronounced magical powers are ascribed to the shrub, bush, twig, or tree. A forked staff of hazel-wood is employed by witches as a wand to wave over a road or path, or over a stream or pond of water, to influence the presiding deities or sprites of the locality for good or evil to those passing. Sometimes a wand of ash was selected to execute a potent purpose; and the leaves of the ash tree were presumed to antidote the venom of serpents. A Swedish peasant will assure you that the touch of a hazel twig will extract the virus of a snake's bite; and that after a battle between serpents, the wounded reptile will repair to a hazel bush, and there remain until the venom has been antidoted.

In the "*Mythology of the Aryan Nations*" we read that amulets to cure and keep off epilepsy are made of mistletoe; and that children are relieved of hernia by wearing a girdle of ash and hazel twigs or leaves. Mr. Fiske, in his "*Myth and Myth-Makers*," says: "The notion that snakes are afraid of an ash tree is not extinct even in the United States. The other day I was told, not by an old granny, but by a man fairly educated and endowed with a very unusual amount of good common sense, that a rattlesnake will sooner go through fire than creep over ash leaves or into the shadow of an ash tree." I can assure the writer that

I heard the same or similar statements in New England when I was a boy. Not many years ago I was visiting an uncle in Massachusetts, and while there I saw three or four men slowly pacing a piece of ground on a side hill a short distance away. I asked what the solemn appearing individuals were about. After being told that the elder of the group, who held a crooked stick in his two hands and watched the wand very closely, was a "locator of wells" and "finder of hidden treasure," I hastened to the scene with a view of learning the secret, or what I could in regard to it. I had heard of the mystery before, but had never seen the practical working of it. The wand was forked and of green hazel; the diviner's hands grasped the two branches of the stick, and the body of the little tree—the thickness of the thumb—stood upward, when the implement had been properly manipulated and was in condition for the subtle action. The forked hazel stick was called a "divining rod" or the "witch's puzzle." When the bifurcate hazel stick had been grasped and held for manifestations and demonstrations, the front aspect of the hands did not face each other, but the *backs* were turned to one another, the little fingers being uppermost. Now, if anybody will thus grasp the forks of a "divining rod" made of apple tree, elder, or birch, and have the central stub or stump a foot long, the weight of it will incline the stalk to tip one way or the other; and if the wood be freshly cut, and the hands clutch the forks with firmness, the twisting force will wrench the green bark from its foundations. This part of the trick ends the experiment, and demonstrates the fact that a good spring of water is not far under ground. And what is a clincher of the feat, the sinkers of a well are about sure to find an abundance of pure water if they go deep enough into the earth! In the case referred to, the manipulator of the divining rod received a fee of three dollars. He had been summoned a distance of a few miles; and the owners of the land, who desired a good well for watering grazing cattle, were among the most intelligent and carefully educated in New England. To question the propriety of thus having a spring scientifically located, would be to risk the reception of a severe rebuke! In Nebraska I saw a split piece of whalebone employed as a divining rod to locate a spot to be bored for water. The user of the implement received five dollars for his services. A doubting Thomas had the hardihood to say that a bore a hundred feet deep, more or less, the variation depending upon the surface, whether on a ridge or in a hollow, would surely strike a bed of gravel in that part of the country, where water existed in the greatest abundance. The bore was made with what are called "drive-wells;" sections of iron tubing were driven into the earth till water flowed from the top segment. The "diviner" was engaged mostly in locating the presence of valuable minerals; and if his word could be credited, he never failed to find gold, silver, or lead, in soil where the rod "worked" in his hands. The "rod" was made from a piece of whalebone about fifteen inches in length, and split from one end to within five or six inches of the other. A copper ferule inclosed the wand at the point where the split terminated. I believe the ring of metal was to prevent the whalebone from splitting in two parts. The diviner remarked that he had to employ a leaden ring when testing for copper! Thus it is ever with diviners; they know the worth of mystification, and how to practice deceit. They understand the gullibility of human nature. It seemed to me that the Nebraska *diviner* employed forked whalebone because green witch-hazel did not flourish thereabouts. A fakir has to conform to the necessity of circumstances. If a witch can not find a hazel bush with which to make a wand, she can impart potency to a forked stick of any other tree or shrub. But the hazel sprout is the one fancied by writers upon witchcraft.

In Scandinavia two dry sticks of hazel-wood will develop fire when vigorously rubbed together; and the revealer of the secret of fire striking does not mention that primitive people the world over have always developed fire by rubbing dry sticks together—by friction.

The tale of William Tell, the Swiss archer, whom the tyrant Gessler meant to slay, but who saved his life by the extraordinary feat of shooting an apple from his son's head, was enabled so to do by fashioning an arrow from a twig of hazel, as a mediæval chronicler relates. The weapon was then like the charmed gun which exercised such discrimination that it would miss a calf but hit a deer. I have quite shed tears over the exploits of the patriot Tell, and have seen the name of the famous Swiss coupled with that of Washington, therefore when I learned that there never was such a man as William Tell, no tyrant Gessler, no son to unflinchingly endure the sight of the flying arrow, I felt like distrusting the story of Achilles and his heel rendered vulnerable by escaping baptism in the river Styx, and like questioning the very existence of the little hatchet which mutilated the cherry tree! The earliest account of the Tell myth is the following, taken from "*Historical Difficulties;*" it is of

Danish origin. "A certain Palnatoki, for some time among King Harold's body-guard, had made his bravery odious to very many of his fellow soldiers by the zeal with which he surpassed them in the discharge of his duty. This man once, while talking tipsily over his cups, had boasted that he was so skilled as an archer that he could hit the smallest apple placed at a distance of fifty paces on a wand, and at the first shot. This boastful language soon reached the ears of his majesty, who had long sought an opportunity to involve the braggart in difficulty. The King ordered that a test of the archer's skill should be made by placing the apple on the son's head instead of the suggested wand, and with the threat that, unless the author of the promise could strike the mark at the first flight of the arrow, he should pay the penalty of his empty boasting by the loss of his own head. The King's command struck the soldier with dismay, for he was exceedingly fond of his darling boy—a lad six years of age. After the lad had been stationed at the given distance and the apple placed on his head, the father asked the privilege of speaking to his child before he discharged the perilous missile; and while whispering in the lad's ear and arranging his arms behind him, Palnatoki slipped a hazel stick into the boy's hands, and stuck an apple on the upper end of it. The stick was not discovered, and the first arrow in its flight split the apple and left the youth unharmed. The King then asked the archer why he had taken other arrows in his quiver when the terms were that he should try but once? The answer corresponded to the one ascribed to Tell: 'To kill thee, tyrant, had I slain my son.'" This story being centuries older than the Swiss production, the inference is that the latter is borrowed; and what assurance have we that the Danish tale was not taken from an Aryan fable? In fact, a kindred tale is in the folk-lore of Norway, Sweden, and Persia, and in each country the leading features of the legend are almost identical.

The Persian archer is armed with an ashen bow and a hazel arrow; therefore, his weapon embraces a double charm. In some regions, the divining staff or wand is a "wish-rod," the virtues of the implement depending more upon its shape than upon the nature of the wood. The shepherds' crook was a favorite shape for the sorcerers of Greece and Rome. In Egypt a species of reed or palm was used to prognosticate events; and a soothsayer could not practice his arts till fifty years of age. And, like hags, the older they were, and the more repulsive in looks, the deeper were they endowed with mystic wisdom.

> "'Tis the sunset of life gives me mystical lore,
> And coming events cast their shadows before."

The more profound the ignorance of a people the stronger is the belief in supernatural influences. In the jungles of Africa and Australia, the devil is presumed to have more power than the Almighty, hence there is more attention given to the former in worship. The devil is the personification of evil, and has always ascribed to him a human form, though his pictures resemble mythological Pan—one foot is like that of a goat, and budding horns are seen on the forehead. It is a question what the cornua signify or typify. Pan has them, and they are thought to be a remnant of goatlike character; but horns are also symbols of strength and power. Jupiter sometimes is depicted with ram's coils on the sides of his head; and the

Moses of Angelo has budding horns upon his head. In "The Last Judgment," the tail of the devil is barbed at the end, like that of the mythological dragon. In Scandinavia, the "evil one" carries a *caduceus* made of hazelwood, and the implement is bifurcate. Witch-hazel is a product of northern or cold climates, hence it is so often mentioned in the folk-lore of Norsemen.

THE AUTOPSY OF AN ELEPHANT.

(Read before the Cincinnati Society of Natural History, May, 1879.)

The day before last Christmas, our well known fellow-citizen and showman, John Robinson, lost by death one of the largest specimens of his fine herd of elephants. The animal bore the name of "Conqueror," and originally came from Abyssinia. He had been in America fifteen years; and for the last year or two he had been an attractive feature of our Zoological Garden. Visitors to the exhibition will remember that the bulky creature was heavily chained, and fastened by one leg to a large stump. His immediate companions were eight or ten bisons, who lunched on the fodder given to the elephant. The great proboscidian did not seem to grudge what the bisons devoured, but he would make them observe his ideas of etiquette. If a bison placed a foot on the hay, the impropriety was rebuked by a blow of the elephant's trunk that made the "buffalo" fairly bellow with pain.

After lunch, the elephant would challenge the bovines to a playful contest of strength; and would get down upon his knees to show to his companions that he was no higher than they! and solicited fair play, without favor offered or accepted. Conqueror was so fond of fun that he would in his way challenge boys to throw stones at him; and if he succeeded in cajoling them into a contest of the kind, he would gather the missiles that hit his sides and fell to the ground, until he had quite a supply upon which to draw when he chose to hurl the ammunition back. It seemed to give the ponderous pachyderm great delight as the boys scattered with a shout when a stone fell in their midst.

At length Mr. Robinson placed Conqueror in company with seven or eight other elephants, and took him about the country as a feature of his traveling menagerie; but the playful nature of the beast so often gave way to fits of anger that he proved an unwelcome part of the "show." He took the conceit that he would not obey any one except his old master, and came near killing two or three men who undertook to exercise authority over him; and he often provoked quarrels with the other elephants, and attempted to stampede the camels, dromedaries, and other animals of any significance in his estimation. He seemed to covet a contest with the larger felines, especially the tigers, against whom he appeared to entertain an instinctive hate. These caprices and freaks of temper caused him to be hampered with chains that extended around his body, over his tusks, and to bracelets locked upon his wrists. These incumbrances made him so irritable while traveling on a fenced platform car, on the railroad, that he made a desperate attempt to break loose while the train was in motion. In this struggle one fore-foot was so much bruised that the animal had to be taken to a quiet retreat for recuperation. Three months afterward, the foot had so far recovered that Conqueror went into winter quarters with his old companions, and seemed pleased to return to the company of his fellow kind. However, he could not live in peace with any body—he must play or quarrel, so exuberant were his spirits.

His companions could stand a certain amount of his rude frolics, but at length they would unite their forces and drive him to his corner of the inclosure, where he would utter the well known bellow of submission. After patching up a truce, he might be quite companionable for a few days, until his restless spirit provoked a fresh onset. His inclination ran chiefly to badgering the four Indian elephants in the corral with him; and they at length, after forbearance ceased to be a virtue, made a fierce onslaught upon the ill-mannered African, and so severely punished him with thrusts of their tusks in his neck and shoulder that a large vein was lacerated, and Conqueror cried "hold, enough," for the last time. In two days he was dead, and his carcass became the property of the Cincinnati Society of Natural History. Our taxidermist, Charles Dury, with a force of assistants, proceeded to flay the monster, and to preserve the skin and skeleton. The dissection lasted several days; and during that time I endeavored to investigate the organic peculiarities of this massive specimen of the animal kingdom.

It was estimated that the entire elephant weighed more than five thousand pounds, and that the skin, with some fat and fascia attached, would weigh over eight hundred pounds. The integument was comparatively thin on the inside of the legs, and under side of the abdomen, but on the back and exposed parts of the creature the skin was more than an inch thick. Surely the animal is entitled to be called a "pachyderm."

The prominent peculiarities of the African elephant are his untamable disposition, his prominently convex forehead, his immensely large ears, and sloping or receding rump. Although the "African" elephant was employed by the Carthagenians in their wars with the Romans and the rest of mankind, the art of capturing and taming the creature was lost to the inhabitants of the Middle Ages. It is not long since the first African elephants were placed in the London Zoological Gardens. The ivory of the African elephant is more valuable than that of the Asiatic species, hence it is sought by every trader doing business in the "dark continent." It has been estimated that seventy-five thousand African elephants are annually slain for the tusks alone; and when guns of large caliber are distributed among the native Africans from the Sahara desert to Cape Colony, the elephant will become extinct, or exceedingly scarce. The trunk or proboscis of the elephant is a curious appendage to the upper lip and nose. The attachment to the forehead is through powerful muscles, ligaments, and fascias. The free end of the trunk has a finger or thumb-like extension that is capable of picking up a straw or even a pin. Inasmuch as the elephant obtains its food and drink through the instrumentality of the proboscis, it is not strange that the animal guards the useful organ against all harm. When the huge proboscidian is attacked by the tiger, its inveterate foe, the trunk is raised high in air, and the tusks are employed to toss the great feline. On the other hand, the tiger understands the vulnerable part of the elephant, and seeks an opportunity to leap upon the forehead at the base of the tusks, and there, with tooth and nail, inflict direful wounds upon its clumsy enemy.

An elephant's proboscis is really a prolonged upper lip and snout, the nasal chambers running the entire length of the organ, and directly connecting with nasal apertures in the skull of the animal. A dense vomerine septum divides the chambers in the proboscis, and connects with the osseous vomer of the facial bones. Near the junction of the trunk with the skull, there is a valvular arrangement in the nasal chambers which is of use in sucking fluids and fine substances into the proboscis which are afterward to be discharged into the mouth or outwardly by means of air expressed from the lungs. The creature uses the trunk thus to spurt water upon its back and sides when inclined to enjoy the luxury of a shower bath.

The tusks of the elephant are a distinguishing feature of the creature. They spring from the pre-maxillary bones, hence are modifications of incisor teeth. They correspond to the gnawing teeth of the beaver and other rodents. The extinct mammoth had two others which sprang from the lower jaw, and projected forward. The dugong has two in the inferior maxillary which curve downward as the tusks of the elephant incline to turn upward. The tusks of the elephant are largest in the male, and are used as weapons, yet they become useful in breaking down branches and in uprooting small trees while food is gathered.

The grinders of the elephant are compound teeth, having ridges of dentine on their bruising surfaces. Representatively, there is but one grinder in each side of either jaw. The tooth springs from the alveolar space in the deep and posterior recesses of the maxillaries, and while growing or developing moves forward and its anterior thin edge breaks off, so that in the course of several years the entire grinder is lost; but before it is half wasted, another comes along in the rear and occupies the same place and position of the one passing away. In this replacing process, it is not uncommon for an entire tooth and part of another to be present in one side of a jaw at the same time. In several respects the dentition of the elephant is peculiar.

In the extinct mastodon and mammoth, and in the living elephant, there is a deep notch in the front aspect of the under jaw, through which it would seem a long and free tongue portruded for the purpose of gathering herbage, but the real fact of the case is that the elephant has a restricted use of the tongue, the tapering and conical end being free to a limited extent. It has been said that the elephant is tongue-tied; also that it has no frænum linguæ, and is consequently free-tongued, but neither state really exists.

The pharynx of the elephant is capacious, and, as in the ox, terminates in the œsophagus, with the bulbous larynx projecting into it. The posterior nares extend into the pharynx, but with a direction and extension which make them almost communicate with the larynx. At the upper part of the pharynx is a pocket in which, at a central point, terminates a single canal that soon, by division and subdivision, communicates with the extensive sinuses and air-cells in the forehead, and other parts of the skull.

The larynx of the elephant is very large, and bears the general features of the same organ in the horse. The trachea is a complete tube, the rings, thirty in number, coming together, though not joining, on the œsophageal surface, where in man there exists an interposing membrane. When the elephant utters its loudest voice, the sound resembles that coming from a trumpet. The lungs have no lobes, but a process of pulmonary tissue extends between the heart and diaphragm. The stomach of the elephant is thrown into ridges or partial compartments by muscular bands that nearly encircle the organ. One of these compartments at the extreme left of the organ can be made to hold water unmixed with food—an arrangement somewhat like that of the camel. The lining membrane of the stomach is coarsely plicated; and sometimes the folds join, making cups or circumscribed spaces. The organ will hold five or six bushels, and probably much more when distended to its fullest capacity. The jejunum is eight inches in diameter, and receives the biliary and pancreatic secretions in receptacles or pouches situated a short distance below the stomach. The liver has two lobes, divided by the suspensory ligament, but no gall bladder. The cœcum is large, with its inner surface rugous. The colon is about twenty feet in length, and a foot in diameter. The entire alimentary track is more than sixty feet long.

The circulatory system of the elephant is like that of most mammals. The heart is a foot or more in diameter, and in its contractions exerts tons of pressure. The aorta is over three inches in diameter, and its walls are thick with yellow elastic tissue. The current of blood propelled at each stroke of the heart must equal that forced from the nozzle of a steam fire engine. The veins have thick walls, and correspond in caliber with companion arteries. The young of the elephant are nourished in the same manner as other mammalia. The period of gestation peculiar to the elephant extends through a period of over five hundred days or nearly two years. These great proboscidians rarely breed in captivity. Some years ago the birth of an elephant took place in the Zoological Gardens in London.

The eye of the elephant is comparatively small, the organ being but little larger than it is in the horse. The sclerotic tunic is very dense, and the fascias which bind the eye in the orbit are thick and tough.

The external ear of the African elephant is exceedingly large and leathery. In fact, the size of the ear is one of the characteristic features of the species. Muscles keep the auricles in flapping motion, especially when flies or other insects are to be driven away. The external auditory passages as well as the fluted conchas are freely exposed outwardly, and not covered by the overlapping auricle as in animals with drooping ears. The hearing of the elephant is very acute, as well as the sense of sight. The membrana tympani is a complete oval, and seems to send fibers from its center where the handle of the malleus rests, to the circumference with regular radiation.

The ligamentum nuchæ of the elephant is the thickest and strongest band of elastic tissue to be found in the animal kingdom. Specimen discs of this structure were saved, some of them measured from eight to ten inches in circumference. The ligament must be immensely strong to sustain the ponderous head. The muscles which move the head and under jaw are large, coarse and terribly tough. The tendinous intersections would turn the edge of the best knives.

The brain of the elephant is larger than that of man, and the medulla is four inches in diameter. The cerebrum has a large amount of gray neurine in the convolutions; and the animal is known to be one of the most sagacious of quadrupeds. Its memory of friends and foes extends a lifetime.

The muscles of an elephant are distributed to the limbs from the vertebral column, scapulæ, and pelvic bones, much as they are in the larger and more familiar quadrupeds. The most striking feature of them is their massiveness. In the mechanism of the elephant there is provision for the outlay of physical force, and no adaptation for speed or agility. The ordinary walk of the elephant is a little faster than a corresponding gait in the horse. When hastened by fright the animal manages to escape with an ambling stride which a horse has to gallop to match in speed. The leg joints are poised perpendicularly, one over the other, so that it is difficult to determine whether the backward or forward swing of a joint is to be called flexion.

The tendons of the muscles of the legs which extend to the feet are white and glistening cords an inch in diameter; they are stronger than any cordage of equal size, and they move in sheaths with less friction than can be attained in the best machinery.

The sole of the elephant's foot is an immense cushion of yellow elastic tissue, too dense to be punctured by stubs or sharp stones. The bottom surface is quite flat, yet it shows the outline of the digital hoofs. Although the elephant takes quite long steps, and in an ungainly manner, the creature has such finely padded toes that its foot-fall can not be heard but a short distance. The track of the beast in the mud or sand leaves no digital marks. In walking, a fore and hind limb on one side of the body move at a time, and the hind-foot is placed almost in the spot indented by the fore-foot. This peculiar gate gives a swinging or swaying motion to the body as each step is taken, making it quite difficult for a person to keep his seat while riding on the animal's back.

The skeleton of the elephant presents some interesting peculiarities, one of which is the giant air-cells of the cranium, the sinuses extending into the diploic spaces, pressing the tables of the skull twelve inches apart in some places. No other animal exhibits such a chambered cranium. The nasal passages, high on the forehead, quite resemble the "blow-holes" of the whale.

So far as cervical vertebræ are concerned the elephant adheres to the mammalian type by having seven individual pieces. The spinous process of the seventh rises high, conforming in this respect to the spines of the first dorsal bones. To these spines is attached the huge ligamentum nuchæ that sustains the head weighed down with tusks. The elephant has twenty-three dorsal or trunk vertebræ, and nineteen or twenty of these sustain ribs. The shoulder-blades exhibit a branch process from the spinous ridge on the dorsum of the scapula. It extends backward two or three inches at a right angle from the regular spinous process. The glenoid cavity is shallow, and twice as long as broad. It looks downward, therefore the scapula rises vertically above the humerus. The top of the blade reaches higher than the tip of the spine of the seventh cervical vertebra. The humerus bears the ordinary characteristic of the typical bone. The great tuberosity rises higher than the articular face of the bone. The deltoid ridge extends below the middle of the humerus, and the bicipital groove is deep. The radius and ulna cross each other obliquely on their way from the condyles of the humerus to the carpus, the radius keeping in front. The ulna is the larger bone of the two. The carpal bones number eight, and are placed in two rows, one above the other. They articulate with each other and with adjacent bones above and below, by means of flat surfaces. Of the phalanges there are two in the first, and three in the other four digits. Each ungual phalanx is incased in a hoof, and all, as before indicated, terminate in a thick sole.

The pelvic girdle slopes downward so rapidly from the normal axis of the vertebral column, that the outspreading ilia look upward as in the human pelvis. The sacrum consists of four blended vertebræ, and the caudal appendage has thirty-three distinct bones. When any of the bones are comparatively small others in the same region seem to be expanded at their expense. The obturator foramen is smaller than the acetabulum. The head of the femur is globular, and free from a ligamentum teres. The trochanter major does not rise so high as the head of the bone, and the lesser trochanter is comparatively small. The bone is shaped so much like the human femur that sharpers have exhibited it as that of a giant. The tibia and fibula compare so well with those in the human leg that they might pass among the unwary as relics of a giant fifteen feet high. The seven tarsal bones in the elephant's foot bear a close resemblance to corresponding bones in man, but the inner digit which represents the hallux is a dwarfed affair, especially in the African species.

The elephant lies down and rises up with comparative ease, but in a very clumsy manner. The creature in settling down allows the hind legs to extend backward till one hip is near the ground, and then drops unguardedly upon the protuberant abdomen and side. The huge animal in this terminal movement of lying down falls so helplessly that it would seem a hopeless task to rise again. But the somewhat flexible or mobile joints help the prostrate creature to raise the hips with ease, and to poise the ponderous trunk upon the legs.

The enormous weight of a full grown elephant, and the awkward use of its limbs, would seem to warn the animal not to venture in miry places, but facts are against the supposition. The elephantidæ delight to wallow in the mud and mire of swampy places, and to sport in ponds and streams. I never knew a tame elephant to become inextricably stranded in a quagmire of its own chosing as a wallowing place.

In reviewing the peculiarities of the elephant I forgot to mention in the proper place that in the skin on the side of the head, between the eye and the ear, there exists a small opening which is the commencement of a duct an inch or two in length, running toward the lachrymal organs (if it do not actually reach a gland in the orbital cavity), that leads to a secretory apparatus. A gummy substance is produced in the canal which sometimes clogs the external opening. This lachrymal appendage is prominent in the cervidæ; and when the duct becomes obstructed in the deer the animal employs the point of one of its hind hoofs to clear away an obstacle to free discharge. The elephant, to accomplish a similar purpose, selects a straw or dry twig with its proboscidian digit and skillfully probes the canal. The keeper of Mr. Robinson's herd of elephants took me among the creatures in order to show one of the animals that was actually attempting to permeate the sinus with a piece of dead twig selected from a bundle of hay. The elephant stood still and patiently waited for the keeper to use a smooth stick, kept for that purpose, in clearing the obstructed passage.

The Asiatic or Indian elephant is more docile and tractable than the African; and in a captive state is employed as a beast of burden. Having been shown where to drag timber the faithful creatures will work all day just as shown in the morning, two or three together using their trunks, tusks, and even shoulders in the process of piling up lumber, bales, boxes, and barrels. Besides being found in India, the Asiatic elephant is met in Burmah, Siam, Ceylon, Sumatra, and Borneo. The ears of the Indian elephant are small when compared with those of the African species. The forehead of the Asiatic elephant is flat and even indented, while that of the African is convex and bulging.

An albino or white elephant, a rare creature, has superstitiously ascribed to it certain protective powers which extend to its owners. The primitive Indian princes used to wage long and bloody wars for the possession of one of these strangely marked beasts.

An interesting peculiarity of elephantidæ is that more species are extinct than now living. This has led to the speculation that the two species, Asiatic and African, now on earth, are late lingerers of a race on its way to extinction. The theory is presented that a cold period in the earth's history killed off all of the elephant family except such as were accidentally protected in tropical latitudes. And the theory obtains some support from the fact that carcasses of mammoths have been found preserved in the ices of Siberia. An ivory hunter by the name of Schumachoff, while looking along the shores of lake Oncoul for mammoth tusks in 1803, came across the carcass of an *Elephas Primigenius* which was being gnawed by dogs, wolves, and bears, so fresh and well kept was the flesh. The remains were afterward taken to St. Petersburg, and mounted. The skin was thickly covered with a dense wool, through which projected long black hairs or bristles. This protective covering shows conclusively that the animal was accustomed to a very cold climate, and does away with the theory that a tropical climate once extended to the neighborhood of the Polar regions; and that a change of temperature occurred so suddenly that elephants then abounding in high latitudes were instantly overwhelmed with cold, and became encased in perpetual ice. It is possible that Siberia is now too cold for the mammoth, yet as far North as its remains are found there are pines, willows, and birches upon which the creature might feed; and its thick and complex coat of wool and hair would enable the animal to live in as high latitudes as the musk ox which thrives in British America.

The mastodon was nearly as large as the mammoth, and they were contemporaries, though the former kept pretty closely to temperate climates. Nipple shaped cusps on the grinders gave the creature the name of mastodon. The tusks of the animal sometimes measured fourteen feet from tip to base; and they curved more gently than they did in the mammoth. The cabinet of the Cincinnati Society of Natural History contains some fine specimens of mammoth and mastodon tusks that were excavated from alluvial soil near Big Bone Springs, in Kentucky. Similar relics have been discovered in all parts of the West and South, and nearly complete skeletons have been exhumed in New Jersey and New York. Kindred osseous remains of the larger proboscidians are found in the various latitudes of Europe, showing that animals decidedly elephantine in character were once well distributed through the northern temperate zone; and observations made in latitudes south of the equator demonstrate a general distribution of the elephantidæ over all parts of the habitable earth.

Remnants of proboscidians in a fossil or petrous state have been discovered in Miocene deposits, yet the larger of the elephant family did not appear till late in the Tertiary epoch of geological history. What is called the Glacial or Drift period was probably quite fatal to huge pachyderms, yet representatives of various species reached the modern river system, for their bones are found in gravel beds, and the alluvium of bottom lands. In some instances teeth and bones are associated with those of modern deer and bison; but there exists no positive evidence that the earliest inhabitants of the American continent ever beheld a living mammoth or mastodon.

HARVEY AND THE CIRCULATION.

(Read by title before the Cincinnati Society of Natural History, Aug. 1878.)

The life of William Harvey, by Willis, a Sydenham publication, and a History of the Circulation of the Blood, by Flourens, are two books which ought not to be "out of print," as they are. If the student of to-day would possess these literary treasures, he must engage a dealer in second-hand books to look out for them. A translation of the latter was made by Dr. Reeves, of Dayton, Ohio, and ought not to be difficult to obtain. But even after these publications are possessed, there is much of interest to be picked up in various publications, concerning "Harvey and the Circulation." Many a point is to be obtained in the various Harveian Orations to be found scattered through English medical periodicals. Once these annual addresses were delivered in Latin, the written and spoken language of older scholars, but now invariably in the English tongue. By referring to almost any encyclopedia we can learn that William Harvey was born almost exactly three centuries ago; that he was the son of well-to-do people, and obtained all the advantages of the best English and Italian schools; that he made the best of his opportunities, and discovered the circulation of the blood. It does not now seem a great feat to dissect animals, and find out the circulatory channels, yet when every thing pertaining to life was a profound mystery; when dissection of the human body was a crime; when the Bible contained almost all there was known of science, and discoverers were in imminent danger of being burned at the stake, we must consider that the work of Harvey is one of the greatest of human achievements. The circulation of the blood is not easy to understand by the average medical student of to-day —it is a complex affair, which requires considerable mental application to master.

To stumble upon a thing, as a student of astronomy may hit upon a planet or satellite while sweeping his telescope through the heavens, does not imply talent of an order which leads to real discovery; but when an astronomer observes the perturbations of a planet, and can not account for them except on the ground that an exterior and unknown planet is exercising the perturbing influence, and if he enters upon a calculation of the forces engaged in the perturbation, and so correctly estimates the position of the object that a telescopic instrument may be directed to the point where the cause should be, and there it is found, a course of reasoning is pursued which indicates merit never denied to original discovery.

The reasoning which led to the discovery of the circulation of the blood was not inferior to that exercised by Leverrier when he engaged in ascertaining the disturbances of the orbits of certain stellar bodies, and directed that the instrument be turned to a certain field, as the place where the cause might be found, and there was discovered the planet Neptune.

At Padua, where there existed the best anatomical school in the world, Harvey studied five years, and had Fabricius, who had discovered the valves of the veins, as instructor. At this famous seat of anatomical and physiological learning, all that was known concerning the circulation of the blood was discussed; and it is not improbable that here a train of thought was suggested which, in a comprehensive mind like that of Harvey's, led to experimentation and final discovery. It may be mentioned that Michael Servetus, in a work entitled *Restitutio Christianismi*, had talked about the pulmonary circulation in a way that led to the supposition that he knew more than he really did. He had been a physician, and was afterward a theologian, and he used his anatomical and physiological knowledge to help along his later vocation. After he became theologian he pursued anatomical studies, and found that the devil invaded the human soul by going through the nose to the ventricles of the brain!

It has been truly said that it was fortunate for Harvey that he was surrounded with an atmosphere favorable to the discovery of the circulation of the blood; and that it was fortunate for mankind that such a man as Harvey was in such an atmosphere, for a less acute and logical observer would have lost the glorious opportunity. Harvey did not unravel the complex vascular system all at once, but elaborated one feature after another, until he clearly defined the functions of the heart and blood-vessels, and earned the unquestioned and imperishable honor of having discovered the "circulation of the blood." Other anatomists and physiologists deserve honorable mention in connection with labor which tended to the complete discovery, but to Harvey the chief credit belongs.

It is a circumstance not a little singular, that Harvey, in none of his works, discloses the manner the discovery was made. The event was of such importance to himself and the world that even the dawn of the earlier ideas must have remained in his mind as something wonderful. He made no mention of his budding views at Padua, nor upon his arrival at home. Upon his return from the Italian sojourn he entered at once on professional duties, and disclosed nothing to indicate that his mind was engaged in the unfolding of a great and novel idea. It is simply known that he engaged in a series of vivisections, and began to write letters to distinguished physicians in various parts of Europe concerning the blood-vessels and the uses of the heart. The conclusion seems to be that the discovery grew upon him so slowly, and after so many false scents, that he could never recall the moment when the scheme in its fullness burst upon his mind. It is quite certain that he expounded his views of the circulation for eight or ten years in the College of Physicians, before he published his "*De Motu Cordis et Sanguinis.*" This work did not appear till 1628, yet in 1619 the author had taught substantially the same doctrine from manuscripts. He lectured on anatomy, physiology, and surgery as early as 1615.

Harvey is known to have executed vivisections before his classes, in 1619, and to have chosen the lower animals for experimentation in order that he might for a longer time observe the movements of the heart. As he watched the rhythmic movements of the heart of the turtle—the animal having been mutilated for the purposes of study—he saw there was alternate contraction and relaxation of the muscular tissue of the organ, which corresponded with the outgoing and incoming of the blood; and he pressed the beating organ in his fingers to ascertain whether his eyes had seen aright or not. He distinctly felt the rigidity of the heart when in a state of contraction, and its flaccidity when relaxed; and thus discovered the *muscular* state and action of the heart, which was announced by no other observer before him. The cavities of the heart had been looked upon as passive receptacles for the mixture and interchange of "spirits" and blood.

The experiments of Harvey reached the ears of the King, James I., and the rising physician was appointed keeper of the health of royalty. This at once brought Harvey into intimate relations with court people, among whom he had to spend so much time that his anatomical and physiological studies were neglected. However, a love of nature, science and philosophy, such as moved the mind of Harvey, will not be satisfied with the flattery of princes—it must go to objects which early kindled it into a flame. In the reign of Charles, which followed that of his father, Harvey was held in the highest esteem by the king. The enthusiastic sovereign went to the laboratory of Harvey, and viewed with admiration the *punctum saliens* (leaping or throbbing point) in the embryo chick and the fœtal fawn. The king had deer brought from the royal parks, and placed at the disposal of Harvey for experimentation.

Although doted upon by the king and courtiers, the people at large looked upon Harvey as a crack-brained zealot who must be an unsafe medical adviser. This detraction reached such a pitch after the publication of "*Exercises on the Heart and Blood*," that the brilliant discoverer and philosopher became somewhat cramped in pecuniary affairs. Rival physicians joined in the detracting cry, and even ridiculed the idea that a discovery had been made. But Harvey was too strong a man to be laughed out of sight and hearing. He held his place at court, his position in the College of Physicians, and lectured and prescribed at St. Batholomew's Hospital. These distinctions kept him up, and saved him from financial distress.

Controversialists sprang up in various parts of Europe, who sought to overthrow the views of the English discoverer of the circulation. The onsets were vigorous and bitter, but Harvey never deigned to answer any body except Riolan. The only instance in which he undertook to demonstrate his positions was when in his travels he reached Nuremberg, and became ambitious to convince the learned and distinguished Casper Hoffman; and after a clear demonstration of points at issue, the obstinate unbeliever said he could not see the proof. Harvey threw down his scalpel, and walked out of the doubter's presence without saying a word.

Willis, the editor and translator of Harvey's works, says: "The older intellects, in possession of the seats and places of authority, regarded the views of Harvey as idle dreams. The apostles of all new truths are youthful. Were there not successive generations of men, the world would stand still. Death is essential to the progress of mankind. No man who had attained the age of forty years accepted the doctrine of the circulation as demonstrated by Harvey."

Shakespeare must have formed an honorable exception to the cloud of veteran skeptics, for he leaves unmistakable evidence that he gave credence to the Harveian theory of the circulation, and he was fifty years old when Harvey demonstrated his discovery—

indeed he may have been a companion of Harvey. He makes Brutus speak thus to Portia:

> "You are my true and honorable wife,
> As dear to me as are the ruddy drops
> That visit my sad heart."

However, the great dramatist may have understood the circulation in a crude sense, as even the unprofessional of his day did. All believed the blood was in motion, and that the heart had something to do with the pulmonary circulation. Arabian physicians phlebotomized their patients three thousand years ago, and Galen knew how to raise a vein in the arm. But it is not a little surprising that in using a cord to make a vein full, ancient bleeders did not observe that the vessel swelled below the line of contraction, and not above it, as it would if the blood flowed outward in the veins of the extremities, as was generally supposed.

As before intimated, Harvey went to the lower animals for a corroboration of his conceptions, and always found his labors in that field well paid. When his written observations on the circulation of the frog, the newt and the snake were stolen, he exhibited profound grief. He warned his friends against relying too much upon the human body for facts, as the subject of experiment is always dead, and the arteries and one side of the heart are empty. In the lower animals he could see the living heart move, and the blood flow in the arteries and veins. A quotation from the author will best give his manner of investigation:

"In the first place, when the chest of the living animal is laid open, and the capsule that immediately surrounds the heart is slit up or removed, the organ is seen now to move, now to be at rest; there is a time when it moves, and a time when it is motionless. These things are more obvious in the colder animals, such as toads, frogs, serpents, small fishes, crabs, shrimps, snails, and shell-fish. They also become more distinct in warm blooded animals, such as the dog and the hog, if they be attentively noted when the heart begins to flag, to move more slowly, and, as it were, to die; the movements then become slower and rarer, the pauses longer, by which it is made much more easy to perceive and unravel what the motions really are, and how they are performed. In the pause, as in death, the heart is soft, flaccid, exhausted, lying, as it were, at rest."

To show that Harvey went to the foundation of things, and left nothing to guess-work which could be demonstrated, a few other quotations will be made:

"I have also observed that almost all animals have truly a heart—not the larger creatures only, and those that have red blood, but the smaller and seemingly bloodless ones also, such as slugs, snails, scallops, shrimps, crabs, crayfish and many others; nay, even in wasps, hornets and flies, I have, with the aid of a magnifying glass, and at the upper part of what is called the tail, both seen the heart pulsating myself, and shown it to many others. If you turn to the production of the chick in ovo, however, you will find at first no more than a vesicle or auricle, or pulsating drop of blood; it is only by and by, when the development has made some progress, that the heart is fashioned; even so in certain animals not destined to attain to the highest perfection in their organization, such as bees, wasps, snails, shrimps, crayfish, etc., we only find a certain pulsating vesicle, like a sort of red or white palpitating point, as the beginning or principle of their life.

"We have a small shrimp in this country, which is taken in the Thames and in the sea, the whole of whose body is transparent; this creature, placed in a little water, has frequently afforded myself and particular friends an opportunity of observing the motions of the heart with the greatest distinctness, the external parts of the body presenting no obstacle to our view, but the heart being perceived as though it had been seen through a window.

"I have also observed the first rudiments of the chick in the course of the fourth or fifth day of the incubation, in the guise of a little cloud, the shell having been removed and the egg immersed in clear tepid water. In the midst of the cloudlet in question there was a bloody point so small that it disappeared during the contraction and escaped the sight, but in the relaxation it re-appeared again, red and like the point of a pin, so that betwixt the visible and invisible, it gave by its pulses a kind of representation of the commencement of life."

Harvey describes the motion, action and office of the heart in as clear a manner as any physiologist can do it to-day, showing that so far as the general circulation is concerned, he thoroughly understood what he claimed to understand:

"The auricle contracts, and in the course of its contraction, throws the blood into the ventricle, which being filled the heart raises itself straightway, makes all its fibers tense, contracts the ventricle, and performs a beat, by which beat it immediately sends the blood supplied to it by the auricle into the arteries; the right ventricle sending its charge into the lungs by the vessel which is called vena arteriosa (pulmonary artery), but which, in structure and function, and all things else, is an artery; the left ventricle sending its charge into the aorta, and through this by the arteries to the body at large.

"These two motions, one of the auricles, another of the ventricles, take place consecutively, but in such a manner that there is a kind of harmony or rhythm preserved between them, the two concurring in such wise that but one motion is apparent, especially in the warm blooded animals in which the movements in question are rapid. Nor is this for any other reason than it is in a piece of machinery in which, though one wheel gives motion to another, yet all the wheels seem to move simultaneously; or in that mechanical contrivance which is adapted to firearms, where the trigger being touched, down comes the flint and elicts a spark, which falling among the powder, it is ignited, upon which the flame extends, enters the barrel, causes the explosion, propels the ball, and the mark is attained—all of which incidents, by reason of the celerity with which they happen, seem to take place in the twinkling of an eye."

Harvey says that in the heart there are four motions, distinct in point of *place*, but not of *time*; "for the two auricles move together, and so also do the two ventricles, in such wise that though the places be four, the times are only two." The expiring beats of the heart were observed by Harvey in many ways, he thoroughly understanding that the living heart of fishes and reptiles will beat for hours after being removed from the body, and that different parts of the organ will throb after being cut in pieces—that is, he had observed the fact, though he might not have understood the origin of the nerve force which impressed the muscular structure of the organ.

Harvey's knowledge of the fetal circulation was correct. He says:

> "In embryos, whilst the lungs are yet in a state of inaction, performing no function, subject to no motion, any more than if they had not been present, nature uses the two ventricles of the heart as if they formed but one, for the transmission of the blood. The condition of the embryos of those animals which have lungs, whilst those organs are yet in abeyance and not employed, is the same as that of those animals which have no lungs."

A curious remark of Harvey in regard to the pulmonary circulation, is accidentally true. He says: "The blood is sent through the lungs that it may be tempered by the air that is inspired, and prevented from boiling up, or something else of the sort." Now it happens to be a fact demonstrated of late years, that the blood is actually *cooled* by coming into the lungs. Aeration of the blood is a heating process, yet inspired air exercises a cooling effect in the lungs. This is about the only instance in which Harvey stumbled upon a correct conclusion.

It has been asserted over and over again that Harvey never knew any thing about the capillaries, or how the blood after it ceased to flow in arteries, reached the venous radicles; and that Malpighi, by the aid of the microscope, discovered the hair-like channels of communication between the arteries and veins. But in this some injustice is done the genius and industry of the great discoverer. Is it probable that an investigator like Harvey would leave the circuit unsolved when he understood all other parts of the circulation? In fact he speaks of the blood passing through the *parenchyma* of the lungs, kidneys, spleen and liver. It is possible that he considered the passage as through *pores*, yet his idea of pores may have been that of capillary vessels. He speaks of having used a magnifying glass to observe the motions of the heart in the transparent sea-slug, therefore, may he not have made observations upon the capillaries with this magnifying instrument? It is not reasonable to suppose the blood from arteries percolated through the flesh as water finds it way through bog, or any porous medium, though, of course, it is possible. The discoverer's own language on the subject is not satisfactory.

Leeuwenhock, an advanced histologist, at about the time of Harvey's death, was quite plain in his description of the passage of blood from arterioles to venous radicles. He says:

"I used every means I could devise to see the complete circulation of the blood—namely, that one of the smallest of those vessels which we call veins, arose from another which is called an artery, and afterward conveyed its contents to a large vein; but I found this to be impossible, for when I followed the course of the artery until it became so small as only to admit one or two globules to pass through it at a time, I then lost sight of it. However, I was at length more fortunate—leaving the wing of a bat, and observing the tail of a tadpole. Here a sight presented itself more delightful than any that my eyes had ever beheld; for here I discovered more than fifty circulations of the blood in different places. I saw not only the blood in many places was conveyed through exceedingly minute vessels, from the middle of the tail toward the edges, but that each of these vessels had a curve or turning, and carried the blood back toward the middle of the tail, in order to be conveyed to the heart. Hereby it appeared plainly to me that the blood-vessels I now saw in this animal, and which bear the names of arteries and veins, *are, in fact, one and the same*—that is to say, they are properly termed arteries as long as they convey the blood to the farthest extremities of the vessels, and veins when they bring it back toward the heart."

While the observations of Leeuwenhock are to be trusted in the main, the modern histologist does not entirely agree with him. A capillary is not an arterial nor venous radicle, but an intermediate vessel peculiarly constructed in its parieties for the endosmotic transmission of nutriment; it is the seat of assimilation. A capillary tube in a vascular sense, is not impervious like a pellicle of caoutchouc, nor is it a mere strainer, but the meshes of its walls are cellular and possess the power to convert nutriment into structure, the new material becoming like the original. For instance, muscle would have imparted to it by its capillaries such material as may prove nourishment for muscle; a gland would get such a substance as might increase gland structure; and brain obtains food for brain,—and the draft is made from one and the same kind of supplies, yet transmuted by the cellular capillary walls into just such structure as may be in need of nutritious supplies. Furthermore, the capillaries in the different animals impart to the flesh of each creature its peculiar odor, flavor, texture, etc. If a pig, or a dog, or a cat, eat for dinner just what a man does, the food is digested in much the same way in all, and carried into the general circulation through similar channels, yet in being distributed the capillaries will make of this nutriment man, pig, dog, and cat, whether it go to brain, gland, or muscle. Of course the digestive and elaborative processes would exert an influence, yet the capillaries impart the most potent influence.

There are several lapses in the Harveian discovery of the circulation of the blood, as far as at present understood. The capillary circulation as one, the uses of the pulmonary circulation as two, the causes of the venous circulation as three, and the connection of the lacteal and lymphatic vessels with the venous as four.

The lapse in the capillary system has just been described. That of the pulmonary circulation consists in the fact that Harvey did not understand the function of aeration. As has been said, he thought the blood went to the luugs to be cooled, when in fact that was only an accidental circumstance. The third lapse is difficult to fully and satisfactorily explain. It is known that the portal circulation is independent of the heart's action or of any other visible propelling cause. The capillaries of the portal vein gather the blood from the chyle-making viscera, and after uniting into one great venous trunk, pour it into the liver through branches where it is again distributed as by a heart and arteries, no display of force being perceptible in the collection or distribution. It may be easy to say that the work is done by "capillary attraction," yet that is not satisfactory to a logical mind. The circulation in a tree from rootlets to leaves, may be by kindred forces, yet it is not easy to state what they are. Dr. Draper's idea that the sap is thickened in the leaves, and then pushed along by the thinner fluid which is constantly advancing is not satisfactory.

The movement is not chemical nor mechanical, but it arises from vital peculiarities not well understood. Vitality is an attribute of organic matter, and too complex and subtle to be analyzed by the chemist. It is not satisfactory to say that the more limpid and oxygenated arterial blood chases denser venous blood through the capillaries into the veins, as the thin sap pushes along the thicker.

The heart throws the blood through the arteries to the capillaries, and there the cardiac impulse is lost. A new agency is now needed to take the blood through the capillaries into the venous radicles. Possibly the capillary walls possess a force which has never been demonstrated. Probably it is of a compound nature, like most vital operations. Many ingenious experiments have been performed, and plausible theories invented to explain the movement of the blood in the capillaries, yet here is still room for an important discovery. It is a promising field in which to prospect for scientific nuggets.

Nervous ganglia or isolated centers of nerve force, in the walls of the heart will maintain a throbbing motion even when no blood is present, and the pulsating organ is removed from the body. Even the hearts of birds after they have been removed, if preserved warm and moist, may be kept throbbing for many minutes. This force is essential to the vital continuance of inferior animals. It tides some creatures over the winter sleep, saving them from asphyxia and death. These separate and independent centers of nervous energy may move the capillary walls or the fluids within them. These ganglia are, as it were, the cells of a vital battery, which at length will cease to act after their source of supplies for generating activity are cut off or exhausted. The moving forces of a living organism are largely dependent upon one another. In the lower animals a tentacle may be lopped off without disturbing the creature much, and a new part may be reproduced. A hydra may be divided in the middle from rays to foot-stalk, and the halves will soon become converted into two individuals, each having a set of independent nerve centers which can not be discommoded by decapitation or dismemberment. In the lowest vertebrates, such as salamanders, the body may be cut into a dozen pieces, and for hours each segment will respond to irritation as if the entire living body were present. The circulation in such creatures is kept up to a certain extent in the various sections. No heart is needed, but the walls of the vessels, under the stimulation of isolated and independent nerve ganglia, will keep the blood moving, rather sluggishly, through the capillaries.

In the forming embryo chick a pulsating tube or sac is observed before a globule or red blood can be seen. A few nerve cells in the walls of the rudimentary heart are the stimulus of the pulsatory motion. Furthermore, oxygen is essential to activity in the nerve battery, for as soon as an incubated egg is varnished to exclude air from the yelk within, the cardiac pulsation ceases, and the embryo dies. This shows that aeration is an essential feature of life, or vital activity.

In regard to the lacteals and lymphatics, it may be said that they belong to the circulatory system, and pour their contents into the veins near the heart. The lacteals take up nutriment from the mucous surfaces of the intestinal track, and the lymphatics absorb such material in various parts of the body as is not wholly waste, and elaborate it into something which may be serviceable in another part of the organism. The lymphatics constitute an important part of the function of nutrition; and they work independently of the sanguineous system of vessels, of which they are collateral. Fluids move in them by the same forces that propel the blood in the capillaries.

BIOGRAPHICAL SKETCH OF MICHAEL ANGELO.

The subject of this sketch was born in Florence in 1474; and by his labors in art and architecture, became one of the most distinguished individuals of mediæval times. He sprang from honored stock, yet rose to eminence by personal effort. When he resolved to become an artist, he was thought to have lowered the dignity of his family; however, his ambition was to be worthy the companionship of princes, and during a long and eventful life he never fell below a lofty standard. His father designed that he should be fitted for the priestly office, but instead of studying theology the lad spent his time in making pencil sketches, in which he manifested more than ordinary talent and originality.

An incident in the student days of Michael Angelo may have done much to shape his destinies. Lorenzo de Medici, the then ruling representative of Tuscany, and an ardent lover of sculpture, established a "garden" in Florence and supplied it with antique statues, basso-relievos, and busts, to encourage amateurs to embrace a rare opportunity for sketching and modeling. To the Medici Garden young Angelo was admitted, and he made such progress that his patron paid him many compliments. He was invited to become a member of the princely household, and to use the magnificent libraries and extensive cabinets of gems, medals, and other art treasures; and the zeal manifested by the favored pupil delighted the heart of Lorenzo. While a student in the palace, he executed a basso-relievo in marble, representing the battle of Hercules with the Centaurs. The figures in this group are admirable, and even then the genius of a sculptor was recognized in them.

The rising artist's next work was a crucifix in wood. It was executed for the monastery of San Spirito, and with such skill that the Prior assigned him a dissecting room, and bodies for anatomical demonstrations.

Michael Angelo also studied anatomy with Realdo Colombo, an eminent physician and surgeon of the time, whose fame has been honorably associated with anatomical discoveries. While receiving instruction he made sketches which he intended to utilize in a book designed for sculptors and painters in the exhibition of the human form. To forward and enhance the work, a friend furnished him the body of a fine young Moor, from which he was expected to obtain some points in surface displays, and develop rules for outlining the human figure. Condivi says of Michael Angelo, that "his knowledge of human anatomy and of other animals was so correct that those who had studied it as a profession hardly understand the subject so well. I speak only of that department necessary to the arts of design, but not as to the minutiæ valuable to the surgeon." He studied the horse with the same care as the anatomy of man, and availed himself of the drawings of Leonardo da Vinci. Gonfaloniere Soderini was ambitious to engage the talent of the two anatomists to ornament the hall of the ducal palace at Florence, and commissioned them to make two grand paintings, each artist to choose his own subject. Leonardo da Vinci, whose knowledge of equine anatomy was of a high order, chose a cavalry battle, and Michael Angelo selected an historical event in the war between the Florentines and the Pisans. Vosari's account of the occasion and its treatment reads as follows: "The Florentine soldiers, bathing in the river Arno during the heat of the weather, became alarmed at an unexpected assault of the enemy. The hurry and confusion in getting out of the water, dressing themselves, and preparing for action, was the point of time chosen; and the principal group in the cartoon was descriptive of that scene. Some of the figures were employed in putting on their armor, buckling on the cuirass, and getting ready with precipitation to give assistance to their companions, whilst an infinite body of cavalry commenced the action with a terrific charge. Among other prominent figures was an old man seated on the ground, whose head was bound with a garland of ivy to shade his brows. In the tumult and confusion that surrounded him, he was represented drawing on a hose with difficulty, from the leg being wet; and with great muscular exertion and expression of countenance showed both energy and impatience. The actions and attitudes of figures were as contrasted as the circumstances might be supposed to create, and difficult foreshortenings characterized the deep knowledge of the artist, and his powers of execution. The figures are variously sketched: some in charcoal, others in lines drawn with a pen, and some stamped with black chalk; and the lights displayed with white, exhibited at once great versatility and professional skill. Such was the excellence of this work that some thought it absolute perfection,—not to be rivaled and even hopeless to approach. And certain credit is due to the opinion, as it was at once placed in the ducal hall to the honor of Michael Angelo and the glory of art, and was for many years constantly visited by both natives and foreigners who came to study the great work and to make copies of it in parts."

About this time (1503) Julius II. was elected to the papal throne, and being an admirer of art, and ambitious to glorify his reign, invited artists of repute to visit Rome. The first honored was Michael Angelo; and the invitation to come to the Vatican was accompanied with flattering compliments and a draft for a hundred ducats to pay traveling expenses. The Pontiff had determined to beautify Rome, and to make the city the center of art and the home of artists. A favorite observation of his was that "learning elevated the lowest orders of society, stamped the highest order on nobility, and to princes was the most splendid gem in the diadem of sovereignty."

Although Michael Angelo was gratified by this invitation from the Bishop of Rome, he was not inclined to relinquish his hold on citizenship in Florence, the city once torn by Guelph and Ghibeline, and by factions led by unwise rulers. After Lorenzo "the magnificent" died, his ill-starred son engaged in questionable enterprises, making war on adjacent governments and squandering revenues which were needed in the cultivation of peace and prosperity at home. This state of things led outside enemies to federate against the prince, and to plot the spoliation of "the gem of Italy." While a hostile foe was gathering up its cohorts, and menacing the Florentines with fire and sword, an effort was made on the part of the best citizens of Florence to preserve the country from invasion and the loss of liberty. While Michael Angelo was chiseling into shapely proportions the colossal statue of David, he was obliged to omit finishing touches by an order for every citizen to arm, and enter actively upon military duty. At that time all was not harmony in the ranks. The presence of several partisans was a weakness where a competent leader might have organized strength. The gates and walls of the city had been erected as a safe-guard against spearmen; and the invention of gunpowder and the use of cannon rendered them useless. In the pinch Michael Angelo was appointed military architect and master of ordnance. Hostile forces were pouring into Tuscany day by day with the avowed purpose of besieging its capital. While the advance of the enemy was threatening, Michael Angelo had fortifications erected on Monte San Miniato, a height commanding not only Florence but much of the surrounding country; and as subsequent events proved, the wisdom of the policy was apparent to all. In the first assault on the citidel the besiegers were easily repulsed. After months of delay on the part of the enemy they threw up a rampart to storm the bastion of San Miniato; but the plan was frustrated by the measures Michael Angelo had taken for its defense. Cannons were planted in the garden of the convent and two large guns were mounted on the bell tower commanding the intrenchments; and these so completely annoyed the enemy that the intention to storm the bastion was given up, and the artillery directed to demolish the tower. This scheme failed through means adopted to preserve the Citidel. Michael Angelo hung mattresses of wool on the sides exposed to attack; and by means of a projecting cornice a considerable space was left between the cushions and the wall. This simple expedient saved the tower from the damaging effects of cannon shots; and compelled the enemy to engage in a slow siege while treaties and treacheries were plied by those who can accomplish more to overthrow a city by diplomacy than through breaching assaults on fortifications. Emissaries from the Pope and traitors within the ranks of the besieged led to the city's capitulation. Michael Angelo escaped to Venice, and there engaged in artistic pursuits, for the time abandoning hope for the liberty and tranquillity of his country.

As has been stated, Michael Angelo was called to the Vatican by Julius II. in 1503; and he was taken into consultation with other artists as to the grandest thing to be done for the glory of the pontificate as well as the reputation of the ruling papal See. Julius II. was in favor of constructing a Mausoleum; and Michael Angelo set about a plan in comport with his master's conception—he designed a parallelogram to embrace the tombs, and a superstructure ornamented with forty colossal statues with an abundance of smaller figures, and all united in one stupenduous whole. The design met with the approbation of the Pope, but where was the structure to be erected? After many devices had been discussed, and their feasibility questioned, it was determined in council to rebuild St. Peter's on an enlarged scale, and the work was entered upon with zeal, though no one living ever expected to see the plan executed. The estimated cost of the structure was so astounding that at first even the ardor of Julius II. could not compass the methods which should raise the money. At length it was determined by him to sell "indulgences" to replenish a depleted treasury; and the abuse of the scheme incited a monk of Saxony to oppose the authority of the Church, hence the inauguration of the Reformation. Although the basilica of St. Peter's is the grandest display of architectural splendor in the Christian world, its magnificence can not atone for the schism its expenditures created in the Catholic fraternity. The builder of St. Peter's called a Luther into being.

As soon as the design of Michael Angelo was approved the great painter, sculptor and architect went to Carrara to procure the marble necessary for the undertaking, the Pope giving him an order upon a banker in Florence to pay for the material. That suitable blocks might be quarried successfully, Michael Angelo took up his residence for eight months in the immediate vicinity of the famous mountain of marble. He sent most of the blocks to Rome, yet enough to Florence to occupy his chisel during the heated season when the Vatican was considered unwholesome on account of the malaria of the Campagna. While Michael Angelo was at Carara he conceived the idea of erecting a pillar on the marble mount which should rival the leaning tower of Pisa, but no opportunity occurred for carrying the design into executon. His conception was to quarry a monolith of the finest marble, erect it on the mountain top, and then chisel the monumental shaft into human shape, so that its outline, and perhaps its features, might be seen from the sea as a mark for mariners.

After Michael Angelo returned to Rome the Pope held daily conversations with him, even making a covered bridge from the Vatican Palace to the sculptor's studio, that he might pass to and fro without being observed. "This honorable partiality," says a chronicler, "was too apparent not to excite jealousy in those who were dependents on the court; and as jealousy seeks not to partake, but to monopolize favors, he that has distinguished friends can seldom be without secret enemies." Not long after this intimacy, Julius II. began to spend time among other artists whose merits he had appreciated and thought deserving of attention. Michael Angelo being apprised of what he considered a growing neglect, seized an opportunity to abandon the Pope's enterprise and to return to his beloved Florence, leaving word on his departure which is reported as follows: "From this time forward, if his holiness wants me, he shall have to seek me in another place."

The Pope was no sooner informed of this hasty measure than he dispatched five couriers to arrest the fugitive and reconduct him to Rome; but they did not overtake him till he had reached a village of Tuscany, which was beyond the jurisdiction of the Pontiff. Although the Pope commanded Michael Angelo to "immediately return to Rome on peril of disgrace," the stubborn Florentine refused to go, and his obstinacy led to diplomacy. The Pope addressed the following letter to the government of Florence: "Health and Apostolic benediction to our dearly beloved. Michael Angelo, who has left us capriciously, and without any reason we have been able to learn, is now in Florence, and remains there in fear of our displeasure, but against whom we have nothing to allege, as we know the humor of men of his stamp. However, that we may lay aside all suspicion, we invite him with the same affection that you bear toward us; and, if he will return, promise on our part he shall be neither touched nor offended, and be reinstated in the same apostolic grace he enjoyed before he left us.

Rome, the 8th of July, 1506, III year of our pontificate."

This letter was followed by a second and a third, the latter threatening Florence; yet Michael Angelo entertained a purpose to enter the service of the Sultan, the proposition being to build a bridge from Constantinople to Pera. To conciliate matters the Florentine Government named Angelo as ambassador to Rome, the commission being, by the law of nations, inviolate. At this time the Pope, in a warlike expedition, entered Bologna, and there sought an interview with his esteemed artist; and, through the mediation of friends, a renewal of mutual admiration was restored, the Pope giving Michael Angelo his benediction, and an order to make a colossal statue of himself in bronze. The renowned sculptor completed the monument in sixteen months, and placed it in the facade of the church of St. Petronio; he then returned to Rome. Within three years Bologna was retaken, and the imposing statue of Julius II. was thrown down, dragged about the streets, and broken in pieces, the fragments going to a foundry to be recast into a canon—*sic transit gloria mundi.*

Upon his arrival at the Vatican, Michael Angelo was requested to ornament the Sistine Chapel on a grand scale, and to do the painting with his own hands. To this he objected on the ground that he was not a fresco painter, but a sculptor and architect. The Pope called attention to the high order of his earlier labors with the brush, and commanded that he engage in the work at once.

Raphael was then at work on his cartoons, which have since made famous the stanzas of the Vatican, and Bramante was the acknowledged architect of the contemplated St. Peter's; and a burning jealousy existed between these two rival artists. The Sistine Chapel had been built by Sixtus IV., uncle of Julius II., and ornamented with historical paintings of some merit. Those pictures were to be effaced, and the walls decorated with new designs. The scaffoldings were erected by Bramante, but were so objectionable in many respects that Michael Angelo ordered them removed, and in their place he built his own. The invention proved so satisfactory that it was afterward utilized in the construction of St. Peter's, and other monumental structures.

It took some time for Michael Angelo to prepare the walls to be ornamented, and to try his paints and colors, an occasional figure not drying out well. At length all obstacles of a physical nature were overcome, except a mistiness of vision in the artist produced by the dust of plaster, and through looking upward so much while prosecuting his work. The ceiling, which is coved, he painted in divisions, the flat space at the top having nine compartments, the spaces alternating with a subject from the Old Testament, and then one from a delphic, cumæan, sibyline, or other oracle. The mosaic account of creation is portrayed in inimitable grandeur; the breath of life entering Adam, the configuration of Eve, the presence of Cain and Abel, the Deluge, and other Biblical scenes contribute to the wonderful artistic display which to our time annually influences thousands to visit the Vatican. The visitor in Rome is nowhere more highly entertained than while viewing the works of Michael Angelo as displayed in the Sistine Chapel, or in trying to compass the dome of St. Peter's. While the famous Basilica was from year to year gradually exhibiting its magnificent proportions under the architectural designs of Michael Angelo, the brush of the great artist was giving form and color to the figures, human and divine, in the Last Judgment. And while these marvelous productions in juxtaposition continue to enchant the lover of art, it can not be forgotten that Rome embraces other attractions due to his skill and genius. His seated Moses in the Church of San Pietro in Vinculo will forever hold a high place. The novice in art may not admire the prophet's horns, but he can not avert the following of those piercing eyes, fitfully flashing the lightnings of Sinai. The statue has been pronounced alive by the timid, so lifelike is the expression of the face.

A criticism of the Last Judgment is, that the figures are not sufficiently ghostly. Biagio, master of ceremonies of the Pope, was asked what he thought of the figures, and replied that such a display of the nude was better suited to a bath establishment than to a chapel. Michael Angelo was wroth at this criticism on the part of a man who had no reason to be prudish; and out of sheer revenge painted a recognizable caricature of Biagio as Minos among the damned, the head bearing the ears of an ass. The travesty offended the feelings of the attendant to an extent that the Pontiff was asked to have the portrait effaced. "Where has the painter placed you?" asked the Pope. "In hell," was the answer. "If you were in purgatory, my prayers might have effect, but I have no power over the damned;" and his Holiness seems to have expressed a verity, for to this day Biagio remains as Minos, and the ears of an ass grace the sides of his head.

When Michael Angelo was 72 years of age, he was appointed chief architect of St. Peter's; and he accepted the dignified position on condition that he receive no salary, and that he be empowered to discharge many persons who were so much lumber about the great edifice. Besides, he was to have the privilege of making such alterations in the stupendous fabric, with the Pope's approbation, as his own model might suggest.

From this time forward the grand Basilica made active progress, notwithstanding its architect had under construction the Farnese Palace, and was engaged in building a senatorial mansion on the Capitoline hill. But such was the industry and capacity of Michael Angelo that he could accomplish more in a day than most worthy men would in a week. The great architect did not have all things his own way, for he would hardly get his plans in the course of execution before the Pope would die, and another of different tastes and peculiar whims would be elected to the papal throne. A change of rulers would always be attended with the fault findings of those who were ambitious to displace the architect in chief. At one of these grievance presentations the Pope asked Michael Angelo to exhibit his plans to those who were criticizing his work. The chief knew that the submission of his designs would be to expose them to attack, so he replied with warmth to the cardinal: "I am not, neither will I be ever obliged to tell your eminence, or any one else, what I ought or am disposed to do; it is your office to see that money be provided to take care of the thieves, and that you leave the building of St. Peters to me."

Michael Angelo was at this time invited by

Cosmo I., Grand Duke of Tuscany, to visit Florence and spend his days there in such vocations as he might elect. The old Florentine replied feelingly, recounting the love he bore for the city and its charming suburbs. He would once more enjoy bathing in the beautiful Arno, and again would he climb Miniato, and gaze on the many lovely landscapes the elevated view commands.

It was, however, impossible for him to leave St. Peters in the hands of incompetent architects, and retain the hope that his plans would be carried out; so he adhered to his purpose of standing by his cherished work. While engaged in forwarding the great labor of his life, though without the expectation of seeing it completed, Michael Angelo, at the advanced age of 89, after a short illness, succumbed to the inevitable. In the presence of his physician and a few friends he made the following nuncupative will: "My soul I resign to God; my body to the earth; and my worldly possessions to my nearest of kin." He died on the 17th of February, 1563. His remains were temporarily entombed in Rome, but afterward were buried in Florence, in a crypt of the church of St. Croce—the hallowed resting place being suitably inscribed and ornamented. There his remains are with those of Dante, Galileo, and other renowned Florentines.

Michael Angelo was rather delicate in his youth, but fairly athletic in early manhood, engaging eagerly in gymnastic sports. In a display of physical prowess he received an unlucky blow on the nose, which disfigured the organ for life. This nasal defect was ever a source of regret to him, and is alleged to have made him morose at times. His head was large, his shoulders broad, and his general physique erect, stately, and commanding; and his countenance was animated and expressive.

From youth Michael Angelo cultivated his mind in solitude, studying every branch of knowledge that might contribute to the advancement of his ambitious schemes.

He wrote creditable poetry, and in his sonnets religion and love are the prevailing subjects. In the accomplished Vittoria Colonna, Marchioness of Paschara, Michael Angelo recognized a genius and spirit in harmony with his own. When they first met she was a widow. Though past her youth, she was yet young in comparison with his age. She resided in a convent, and was occupied in doing good to the sick and needy. She died at the age of 56.

He did not amass immense wealth, but left to his relatives enough to make them comfortable. His old home in Florence is still in possession of the Buonarroti line, and many relics of the family are still exhibited at the family residence. Among these is a well worn copy of Dante. The author of *La Divina Comedia*, was born in Florence two hundred or more years before Michael Angelo saw the light; and the latter became a warm admirer of the great poet, and a thorough student of his dramatic creations. The "Demons" in Angelo's "Last Judgment" are not Scriptural, but the inventions of the ingenious Dante.

Although the compositions of Michael Angelo carry the freshness of originality along with them, not a few are suggestive of preceding thought. His poems bore a resemblance to the emanations of Petrarch; his sculpture, if not in style antique, is often classically Greek; and the conceptions in his pictures are predominantly Biblical or pagan.

When the talents of Michael Angelo are considered, the question arises whether he was greatest as painter, sculptor, or architect. But why measure the man in this way? Or why not take other eminent qualities into the estimate of personal characteristics? Michael Angelo was a patriot and a moralist; and his religious nature was deep and abiding. He so utterly detested shams and peculations in public affairs, that he labored an ordinary lifetime in molding St. Peter's into magnificent proportions, and would not accept pecuniary recompense. He always claimed that he worked for the glory of God and the elevation of mankind. His charities were bountiful, yet dispensed with discretion. He loved liberty and despised tyranny, as he honored truth and hated hypocrisy. His moral character was never assailed, yet it would have been, considering the wiles and jealousies of his time, if he had not lived an upright life. The precepts of Savonarola seemed indelibly stamped upon his heart. Taking Michael Angelo all in all, few distinguished in what constitutes individual greatness preceded him, and as few of equal greatness have succeeded him. A study of his character and talents ought to exert a beneficial influence upon the impressible.

A SKETCH OF SIR CHARLES BELL.

Art is so long, and time so short, that a man can accomplish only a moiety of what he may have contemplated in his more ambitious moments. Michael Angelo achieved more than the average of diligent men because he lived so long—to old age—and was able to work to the end. Raphael accomplished less because he died young. Wm. Hewson thoroughly investigated the lymphatic system, and wrote a work on the constituents and qualities of the blood, yet died at the age of thirty-five.

It is generally remarked that a man can not dip deep into any branch of science without progress being at the expense of other intellectual pursuits. In a measure this is true, but if kindred studies be pursued at the same time, points gained in one line of thought will assist in making progress in other departments of knowledge.

A prevailing notion among the ignorant is that an accidental endowment, called genius, enables the fortunate possessor to outstrip his fellow men at a bound, and without effort of a laborious nature. It is needless to state to intelligent readers that such a conception is wholly or principally erroneous. Those who have acquired much in this world have labored for what they possess. An individual may inherit a bent or inclination for a given pursuit, and make notable headway in that direction, yet not much worthy of comment will be achieved, unless a fair degree of energy be devoted to the acquisition. If a person indulge in the vision that he is a prodigy in his way, and may safely rest upon his oars, his bark will either dash upon rocks or drift to a strand.

The subject of this sketch was not an erratic individual thrown into view by chance or accident, or one fortuitously brought into notice by revolution, but he inherited respectability, and enjoyed comfortable surroundings; and by the display of fair talents, considerable energy, and much industry, he attained distinction.

Charles Bell was born in Edinburgh, in 1778, and was the youngest son of Rev. William Bell, a clergyman of the Episcopal Church of Scotland. The eldest of the sons, Robert, was an attorney, and the second son was the well known John Bell, anatomist and surgeon. Under the tutorship of the latter, Charles, after graduating with honor at the high school of Edinburgh, was educated in medicine. The young apprentice took to his studies with zeal, and was soon enabled to assist his fraternal instructor, who was lecturer on anatomy and surgery in the famous University of Edinburgh. He prepared the anatomical demonstrations with such care and scope that the Bells became distinguished as philosophical teachers. The younger of the two was skilled in the use of the pencil and brush before leaving the high school; and now he found a place to utilize these talents. He sketched a variety of anatomical preparations, and displayed them in water colors. These attracted attention and called forth such flattering comments that he was encouraged to have them published as *Plates of Dissections.*

He had at that time become a licentiate, and this exhibition of brilliant talents favored his election to the College of Surgeons, and afterward to the staff of the Royal Infirmary, the only hospital then in Edinburgh. . . . The older brother holding the highest position in Edinburgh as anatomist and surgeon, Charles could not rise in that city without coming in direct rivalry with him ; hence he left home in 1808, and sought a wider field of labor in London. In the great metropolis he knew that he would have to come in competition with Cline, Cooper, and Abernethy, yet he took the step without the thought of ignominious failure. He entertained lofty aspirations, and courted the opportunity to cross lances with brilliant knights in the lecture field. He did not engage in a rash experiment, for his fame had already reached the learned circles of London. His modest demeanor, gentlemanly bearing, and many accomplishments, proved a ready introduction to scientific clubs. He was early invited to join the Anatomical Society, where he became acquainted with many of the popular and eminent teachers in medical science ; and he soon entered a partnership with Mr. James Wilson in the Windmill street School of Anatomy and Surgery, where Hunter gained a share of his reputation in the scientific world.

Here young Bell's style of lecturing at once captivated listeners and drew crowds of students to his auditorium and laboratory. He was so courteous to his elders in teaching that he provoked no jealousy, but forced the concession on the part of competitors that they were more than rivaled—that they were excelled.

From this time there was no question as to the grade of talents possessed by Charles Bell, nor as to the position he was to occupy in scientific pursuits. His accomplishments were apparent in several departments of learning. His publication of a series of plates displaying the brain, with notes, showed that he was in advance of the old masters in neurological studies; and the compilation of his "Anatomical Demonstrations," placed him in the front rank of delineators. As a surgeon, he had few if any superiors; and as an author he stood among the best. Although he carried on his studies, experiments and instructions, concurrently, the leading labors of the scientist may be considered separately. Charles Bell first distinguished himself in anatomy, physiology and surgery; he then became eminent as a neurologist, making brilliant discoveries in regard to the nervous system; and thirdly, he attained a conspicuous place in art anatomy, becoming a master in the delineation of *expression.* His work on *The Anatomy and Philosophy of Expression, as connected with the Fine Arts*, is now the best known and the most valuable of his productions. A fourth edition of the work was published in 1851, by Henry G. Bohn, Covent Garden, London, and sells for about fifteen dollars. The illustrations are from the pencil of the author, and mostly from life or nature. They graphically represent the play of the passions, every grade being represented, from the winning smile, to the startling horror of the madhouse.

Upon the accession of William IV. to the throne of England, his illustrious ministry, in accordance with the suggestion and sanction of the sovereign, proposed to confer the distinction of knighthood—a Guelphic order—upon the meritorious of a limited number of the most eminent men of science then living, and than whom few greater have since obtained the honorable title. The persons selected to be the recipients of the dignity were Charles Bell, John Hershel, David Brewster, John Leslie, James Ivory and Mr. Baggage, the latter declining the honor for assigned reasons.

The publications of Sir Charles Bell show in brief the nature and extent of his literary, professional and scientific labors. His first publication was, *A System of Dissections, explaining the Anatomy of the Human Body, the Manner of Displaying the Parts and their Varieties in Disease.* The first volume—a folio—appeared in 1799, and the second in 1801. The plates are all from drawings made by the author, and give faithful representations of the different parts of the human body as they appear on dissection. The folio size was found to be inconvenient for student's use, therefore the letter-press form, with illustrations reduced, was issued in 1809.

The next book was dual in authorship. It is titled, *A System of Anatomy, by John and Charles Bell.* This, being out of print, is getting rare, and to be found only on the shelves of dealers in second-hand books. I advise the lover of old books to be on the look out for this production. "For happiness of expression, elegance of style, knowledge of the views of former anatomists and physiologists, and accuracy of description, I know of no work with which it can be compared." (Pettigrew.)

In 1807, Charles Bell published *A System of Operative Surgery, founded on the basis of Anatomy,* in two volumes. This surgical publication is a faithful representation of the surgery of the time, and is very happily illustrated by the author, who exhibited a wonderful facility for making himself known through the manipulations of the pencil-point.

In 1816, Mr. Bell commenced the publication of *Surgical Operations; being a Quarterly Report of Cases in Surgery treated in the Middlesex Hospital, in the Cancer Establishment and in Private Practice.* This series of annotations was never finished, but is valuable as far as it goes. The clinical details are illustrative and practical, being the product of a mind trained and accustomed to impart information most needed by the surgical student.

In 1819, Bell published an interesting *Essay on the Forces which Circulate the Blood; being an Examination of the Difference of the Motions of Fluids in Living and Dead Vessels.* The argument, carried on at some length, is that the heart alone does not propel the blood, but much is left to arterial tension, tortuosity, elasticity, capillary attraction, etc. There is some plausibility in the statements made, and additional force in the illustrations, yet I fail to see all points just as the author does. In 1810, Bell issued a small work depicting some cases of an instructive character for the operative surgeon. While we do many things much as they were done a century ago, it is not assuming to say that we have occasion to smile at a few of the methods once in vogue.

In 1824, Sir Charles Bell published *Observations on Injuries of the Spine and of the Thigh Bone.* This *brochure* is also controversial, being an attempt to support principles enunciated long ago, and to overthrow certain other doctrines set up by Sir Astley Cooper in regard to trephining in the event of fracture of the vertebræ; and in regard to the *pose* the leg and thigh should take after fracture of the femur.

A feature of Sir Charles Bell's surgical productions, is the careful demonstration of the anatomy of the parts involved in an operation. Both of the Bells were ever noted for the interest they threw into their demonstrations. If a muscle were described, not only its origin, insertion and function were called vividly to mind; but the importance of certain surgical points a given muscle bore upon, was cited and emphasized. The same practice of showing the relation of vessels and nerves to surgical operations was always followed.

Sir Charles Bell never omitted an opportunity to learn something of comparative anatomy, dissecting every variety of creature that could be obtained from any part of the earth. He always was at great expense in securing rare specimens. Whoever has read *The Hand, its Mechanism and Vital Endowment*, will at once see why the author of the production was selected to execute a work which should in part fulfill the bequest of the Earl of Bridgewater, who left £8,000 in trust to the President of the Royal Society of London, for the purpose of rewarding the writer of a dissertation "to exemplify the power, wisdom, and goodness of God, as manifested in the works of his Creation." The history of the execution of the celebrated bequest is somewhat interesting. The then President, Mr. Davies Gilbert, shrank from the responsibility of selecting the person best qualified to carry the object of the will into effect; and having associated with himself, in the discharge of this duty, the Archbishop of Canterbury and the Bishop of London, they determined to subdivide the sum left to their disposal amongst the writers of eight several essays, illustrative of the subject proposed. In his will, Lord Bridgewater had expressed a desire that the power and construction of the *human hand* should be embraced in the dissertation; and when Sir Charles Bell was made aware that he had been selected as one of the essayists, he, to the surprise of his colleagues in the enterprise, chose that as the subject of his essay.

The reader of *Bell's Hand* will say that he has ransacked the animal world to find arguments in comport with the desires of the reverend committee. The scales and fins of fishes, the feathers and wings of birds, and the belongings of quadrupeds, are arraigned as if the peculiarities of each were specialized by the Creator for the definite purposes manifested in the habits of the creature. By birth and education, Charles Bell was loyal to the prevailing theology of his day; hence he did not do injustice to his sentiments when he saw the wisdom and goodness of the Creator in every thorn that grew—in every poisonous tooth and claw—in even the deadly cobra's fang!

While Charles Bell lived in London, Napoleonic wars were disturbing the country, and making it necessary for him to study military surgery. After the sanguinary battle of Corunna, thousands of wounded were landed on the southern coast of England. To these at once Mr. Bell repaired, and devoted his time and ability in making the sufferers comfortable, gaining experience in the management of gun-shot wounds. After a few months of active service in camp, he prepared for publication an *Essay on Gun-shot Wounds*, and made it an *Appendix* to his *System of Operative Surgery*. The "Essay" was also published by itself, and became "authority" among army surgeons.

As soon as the battle of Waterloo was known in London, Mr. Bell started for Brussels, with the purpose of tendering assistance to the wounded, and that he might make sketches for his portfolio. The demand for surgical service was so pressing that he gave his entire time for weeks in caring for the disabled. As soon as leisure could be obtained, he used his pencil in making sketches. Some of these were afterward enlarged and colored, and now are regarded as valuable contributions to both surgery and art.

Before the time of John and Charles Bell, the functions of the nervous system were not well understood, though the anatomy of the brain and spinal cord had been demonstrated at Bologna and Padua—those mediæval seats of anatomical and physiological learning. Sommering and Meckel did good work in the way of giving rational views of the brain and nerves; and after them came Monro, of Edinburgh, and Gall, of Vienna. And about the time that considerable impulse had been given to studies of the brain by Spurzheim, and the labors of Reil had added to discoveries thus far made, Mesmer appeared as a magneto-neurologist, yet contributed little to what was already known in regard to the brain and nerves. By the combined labors of all investigators of the cerebro-spinal system, the brain had been thoroughly dissected and mapped, and the nerves were known to spring from the spinal cord in pairs. The ganglion on the posterior nerve had been observed and commented upon, and the functions of sensation and motion had also been considered, and even assured; yet, before Charles Bell entered the field as an original experimenter, it had not been demonstrated that sensory and motor nerves, in the same bundle, could be traced to separate parts of the spinal cord.

In a small essay, entitled *Idea of a New Anatomy of the Brain*, published in 1811, Sir Charles Bell contends "that the cerebrum and the cerebellum are different in function as in form; that the parts of the cerebrum have different functions; and that the nerves which we trace in the body are not single nerves, possessing various powers, but bundles of different nerves, whose filaments are united for the convenience of distribution, yet are distinct in office, as they are in origin from the brain."

In speaking of the nerves springing from the spinal cord, Mr. Bell says that the anterior column presides over the motor functions, and the posterior column sends out sensory nerves having ganglia upon them; and that often the two sets from one side of the cord have united in one bundle; both motor and sensory filaments can be traced to the periphery of the body, where they may be said to be distributed.

Before Bell's discoveries it was supposed that the nerves of special sense, as the optic, for instance, could bestow sensation or pain, or even motion, as well as vision. A careful dissection of the nerves of the face and head revealed the origin and distribution of sensory and motor filaments; and experiments upon animals clearly proved what was the function of any given nerve. Bell demonstrated that the sixth and ninth pairs of cranial nerves were exclusively motor—the one going to the external rectus of the eyeball, and the other to the deep parts of the tongue—to the muscles of the organ, and having nothing to do with the sense of taste. In studying the fifth pair—the trifacial—he found on each side of the median line two nerves, *one*, the larger, having a ganglion upon it, and the *other*, the smaller, without a knot, and like a motor nerve coming from the anterior columns of the cord. The large trunk, having a ganglion upon it, he found to be sensory, and to consist of three quite distinct branches. The upper branch endowed the forehead and region of the eye with sensibility; the middle branch gave sensation to the nose, upper lip, and middle parts of the face; and the lower branch expanded itself in the inferior maxilla, the lower lip, and upon the surface of the anterior half or two-thirds of the tongue. The filaments going to the papillæ of the tongue were called *gustatory*—taste being a modified sense of *feeling*—hence the sensory character of the nerve was demonstrated throughout. The part of the fifth nerve having no ganglion upon it, proved to be mostly motor in function, and endowed the muscles of mastication—the masseters, buccinator, temporal, and pterygoid.

Attempts have been made by Magendie, Longet, and other physiologists since Bell's time, to show that sensory nerves have motor power in some degree, and that motor nerves have manifested sensibility; but the general character of the nerve functions, as announced and demonstrated by Bell, have not been overthrown. The most that has been done goes to show that inosculation may give a bundle of motor nerves some sensibility, and *vice versa.* The portio dura of the seventh pair was once supposed to be both motor and sensory, but Bell demonstrated that the nerve is wholly given to movements of the muscles of the face; and that division of it resulted in paralysis of motion on that side, though sensation remained almost unimpaired.

The pneumogastric and glosso-pharyngeal nerves were ascertained to embrace both sensory and motor filaments, with fibrils of both so intertwined that it was with difficulty that the origin of each could be distinctly traced. Both nerves arise in the medulla oblongata, at a point which has been denominated the "vital knot," and the filaments of both preside over respiration. A division of either of these nerves results in partial or complete asphyxia. Bell called these mixed functions "excito-motory," to denote the distinctive character and reciprocal relations of the respiratory functions.

To the discoveries of Bell should be accredited the origin of sensory nerves in the *gray* matter of the cerebrum, of the medulla oblongata, and of the spinal cord; and the origin of motor nerves in *white* neurine. Bell ascertained that the "spinal accessory" nerve was motor in function, but did not announce that the pneumogastric derived all of its moving energy from that source. It required the experiments of Bischoff and Bernard to complete the discovery.

The sympathetic system of nerves was first made understandable by the investigations of Sir Charles Bell. Many years previously, John Hunter had delved in this field, and gained creditable headway, but had not made those nice distinctions in regard to the special functions of a nerve that were the *forte* of his successor. Hunter studied the ganglionic and visceral nerves in worms and the articulata generally, and saw motion and sensation manifested by the same bundles of nerves. Bell conjectured that the leading office of these parallel chains of knotted cords embraced functions in addition to those of locomotion and sensation, for he found them displayed along the viscera of the body, as if to exercise an influence over digestion, assimilation, and secretion. And he found, too, that sympathetic filaments inosculated with motor and sensory filaments coming from the cerebro-spinal system. This intimate relationship of the various systems of nerves led to the conjecture that the office of the ganglionic nerves was to harmonize the various workings of the animal body. Bell was the first to remark that the *gray* matter in the ganglia made the system of nerves *reflex* in its activities, and left it independent of the *will*, or voluntary effort. He found that filaments from the superior ganglia at the base of the brain exchanged fibrils with the pneumogastric and glosso-pharyngeal, and thus put respiration and deglutition beyond the dictation of mental operations. He mentions that a bolus of food, after it passes the isthmus of the fauces, is no longer under control of the will, but that it is involuntarily swallowed, whether pleasant or disagreeable. Through the influence of the sympathetic system the intestines are peristaltic, the glands secrete, and the blood-vessels and capillaries execute their functions. By the agency of the reproductive ganglia wonderful migrations in the animal world are executed. When the ovaries of the salmon become charged with spawn, a migration is made from the sea to the head waters of the rivers that the ova may be deposited in places favorable for the hatching and thriving of the fry; and as much may be said of a thousand other kinds of fishes. In the spring millions of wild fowl wing their way to the north, that their young may be reared in regions favorable for their safety and development. The females take the lead in these northern flights, and the males head the returning flocks.

Sir Charles Bell was gifted with many talents, and he buried none in the rubbish of life. He pursued his studies *con amore*, and became distinguished in all he undertook. His discoveries in the functions of the nervous system place him at the head of neurologists. His delineations in the *Anatomy and Philosophy of Expression* show that his investigations of the functions of the cerebro-spinal nerves had enabled him to depict emotions more strikingly than any artist before or since his time.

Sir Charles Bell cherished such an admiration for the fine arts, that he visited Italy and other art centers, to expand his conceptions of what an artist should be. He was always an advocate of what we call "life schools," and ridiculed studies in plaster casts.

In closing this succinct sketch of one of the ablest men that ever graced the medical profession, it is proper to say that he left London in 1836 to accept the chair of surgery in the old and famous University of Edinburgh. When his name was presented to the board of electors, he was unanimously chosen. Nothing could have been more flattering to him than this recognition of the esteem in which his reputation was held in the city of his birth after long years of absence. His many warm friends in London spoke with regret of his contemplated departure from the city of his adoption and many triumphs, but they could not swerve his ambition to return with honor to the place of his nativity. He lived several years to lend credit to the institution which owes not a little of its renown to the great surgeons, John and Charles Bell.

WHENCE THE ART OF ANCIENT, MEDIÆVAL, AND MODERN ROME?

The "Eternal City," as Rome is sometimes called, has many art attractions, but the visitor does not stop to pay more than a passing glance to handsome palaces of recent construction,—he hastens to gaze upon the magnificent "ruins" he has read about in school-books, and seen pictured in travelers' guides. He soon stumbles upon the Pantheon, and is amazed at the grand and classic appearance of the well-preserved pagan temple. He is astonished that a building over two thousand years old can be in such a fine state of preservation. After strolling a short distance, the tourist is confronted by a view of Trajan's Column, and scrutinizes the spiral relievos that extend from bottom to top. He can not make out all the meaning the artist has displayed, but he sees a thousand and more different figures wrought in the winding frieze of the shaft-like monument. With the pedestal and crowning statue, the pillar is one hundred and forty-seven feet in altitude.

Following the course of dilapidated structures, the visitor comes to the Capitol, and would stop to view its art treasures, but he sees the magnificent Arch of Septimius Severus, and must devote a passing inspection to the time-worn figures and inscriptions on the key-stones of the triple passage-ways. Hard by is the Colonnade of the Twelve Deities.

He can not stop to scrutinize the features and study the characters of the several gods, but bestows an inquiring look upon the Column of Phocas, then admires the "Ruin of the Three Columns," or remnant of the Temple of Vespasian. Now he beholds for the first time the grandeur of the *Forum Romanum.* A few years ago the complex ruin was buried in "cosmic dust" and the accumulated *debris* of centuries. Once it was the richest in architectural beauty of any place of the same size in the world. But after the Gauls had sacked the city, and overturned what they could not utterly destroy, the proud Forum became a herding ground for cattle, and a breeding place for bats and lizards. Sand drifted into the crevices and open spaces, until a mass of rubbish alone could be seen. The population of ancient Rome shrank from two millions to a few thousands; and each succeeding year added to the obscurity of the city's pristine splendor. Buried in forgetfulness was the *Cloaca Maxima,* lost to view was the beautiful Temple of Vesta, filled with river sediment was the *Carcer Mamertinus,* undiscoverable were the Temples of Saturn, of Castor and Pollux, and of Concord. The Arch of Titus was not to be seen, the Temple of Cæsar had disappeared, also that of Faustina. The Colosseum alone showed the top rows of the stupendous auditorium. Before the Christian Era, this amphitheater was capable of seating and sheltering a hundred thousand spectators. In the arena of this great playhouse were gladiatorial exhibitions, and fierce fights between wild beasts. In a famous exhibition which lasted a hundred days, it is said that five thousand wild animals were killed or disabled, and hundreds of gladiators bit the dust in contests with short swords.

Afterward this magnificent structure was used as a fortress, and later it was abandoned to birds of ill-omen. At length its walls were drawn upon for material to erect mediæval churches, and treated as a quarry from which building stone could be obtained easier than from distant ledges. Pilgrims of the eighth century looked upon the unequaled pile as a symbol of the lasting greatness of Rome, and repeatedly quoted the following lines:

> "While stands the Colosseum, Rome shall stand,
> When falls the Colosseum, Rome shall fall,
> And when Rome falls, with it shall fall the world."

At the north boundary of the *Forum Romanum* rises the Capitoline Hill, so called from its being the site of the Capitol. The approaches to the citadel are from the side opposite the *Forum*, the gateway being guarded by sculptured lions and grand statues of the Cæsars. In the center of the Piazza stands an equestrian statue of Marcus Aurelius. On the right and left are ponderous river gods, representing the Tiber and the Nile. From the windows of the Senate Chamber can be seen the multiple and magnificent ruins of the Forum, the Tarpeian Rock, and Mamertine prison where captive kings were incarcerated, and St. Peter caused a miraculous spring to flow that he might baptize his jailers. In this dungeon Jugurtha perished through lack of food, and Vercingetorix was kept for show-days. When taken from this underground jail, to be dragged at the chariot wheels of Cæsar, the unfortunate prisoner was reviled and jeered by a blood-thirsty and debased populace. These painful incidents show at what a low ebb were the public morals of the times.

Palaces, like wings to the Capitol, have been made receptacles of art treasures, exhumed within the walls of Rome or brought from villas outside the city. Among the thousands of priceless pieces of sculpture are a few famous specimens. Among the gods and demi-gods are heroic figures of Vulcan and three Cyclopes forging the Shield of Achilles. On the left of this group stands stately Minerva with the olive tree, ægis, and owl; and to her left is placed proud Juno with an oak tree, on which is perched a peacock, sacred to the goddess. Close by is the Infant Hercules with the lion's skin, club, and quiver, his left hand holding the apples of Hesperides. In a corridor are fragments of a colossal figure of Jupiter Tonans; the face—"the front of Jove"—exhibits figures that plainly suggest the wisdom and royal qualities of the ancient Thunderer.

In the Bronze room is a pleasing statue of a boy in the act of removing a thorn from his foot, and by a window is the *Capitoline Wolf* with the sucklings, Romulus and Remus.

In the Picture Gallery are some modern and mediæval paintings of great merit. The subjects are mostly Biblical; and among the artists are the names Raphael, Rubens, Tintoretto, Paul Veronese, Guido, and Bellini.

In one of the first rooms of the Capitoline Museum, is "the Dying Gladiator," a well known work of plastic art. It was unearthed three centuries ago, and long preserved in the Villa Ludovisi. It is Roman in conception, yet presumed to have been executed by a Greek sculptor. A broken defect in the arm and base was mended by Michael Angelo. In another room is an exquisite statue by Praxiteles,—

"the Marble Faun," of Hawthorne. The production is quite a copy of a Satyr chiseled at Athens. The sculptures of the Capitoline collection are largely of Grecian origin, some having been made in Rome by Greek sculptors, or secured from Athenian sources to adorn the gardens and villas of wealthy Romans living in the vicinity of Rome,—for instance, in Tivoli. The choicest statues have been found in the Villa of Hadrian, and the accomplished hand of Praxiteles is recognized in several of the products once the property of the luxurious ruler. One of the most charming pieces of sculpture found in Hadrian's Garden, is a row of doves on the rim of a basin beneath a fountain. As a work of art it is above criticism.

In an adjoining room to that of *The Doves*, is the celebrated *Capitoline Venus*, a work of Praxiteles—possibly a copy of the Aphrodite of Cnidus. It is generally regarded as the best outline of womanly charms the chisel has ever produced.

To appreciate the pagan and primitive art of Rome, the student must call to mind the fact that the early settlers of "classic Italy" were Trojans, who were closely allied to the Greeks; that the greater and lesser gods introduced into Roman every-day life were creations of poetic Homer or the more prosaic Hesiod. The Zeus of the Greeks became the *Jove* of the Latins.

An æsthetic race could not endure crude images to represent celestial rulers, hence they gave the deities the most attractive outlines, taking the best of human shapes for models. It is customary to think the gods created man after their own image, but the Greeks reversed the order of things, constructing deities in the likeness of human forms. Apollo was made as the representative of the best masculine shape, and Venus was the embodiment of grace in the female figure. Out of this kind of god-making has come the most attractive of art representations. Nearly all there is of pagan art has been developed in the creation of divinities, while the most of Christian art consists in the development of Biblical objects.

The Greeks were disposed to shelter their ods, hence the rage for architectural display in constructing deistical temples. With æsthetical people it was not becoming to house the ideal divinities in a cave or rock-shelter. The Parthenon of Athens was an abode of the gods, and so was the Pantheon of Rome. Every temple had an altar where incense was burned or sacrifices were made, hence the occasion for a priesthood to becomingly administer the sacred offices. In all religious things the Romans were servile imitators of the Greeks; and both peoples were pantheists. An outward form was the abode of a spirit which in its activities imparted feature to the physical envelope; and certain symbols were invented to emphasize inner qualities. Themis who impersonated justice, is represented as a noble and majestic woman, with blind-folded eyes, and as holding a balance in one hand and a sword in the other. The god of physical love is represented as a sturdy boy with plump cheeks and curling auburn locks,—he is winged, and armed with a bow and arrow.

Æsculapius, the god of medicine, was a celestial, being a son of Apollo. His ability to heal the sick and the wounded, rendered him popular among gods and men. In art he is represented with a staff which has a serpent entwined about it. The eldest daughter of Æsculapius was Hygeia. In the Capitoline Collection is a fine statue of the medicine god. It is accompanied by the goddess of Health and Prosperity.

One of the more stately of the superior deities is Neptune. With mystic trident "he makes the sleeping billows roll, and the rolling billows sleep." The handsomest fountain in Rome—the Trevi—is surmounted by a colossal figure of the sea-god, standing in a shell chariot drawn by winged horses whose tails and hind-parts are like those of dolphins. The splashing waters from three sources in the overhanging cliffs, in bounteous quantities fall upon the marble group, then dash into a broad basin below, making delightful cascades. The workmanship of this grand exhibit is Roman, but the attributes of the presiding deity are wholly Grecian. And so it seems to be every-where in Rome. The Greeks converted conceptions of mythological characters into beautiful statues, —they seem to have been the inventors of the best plastic art. The average Roman was warlike, and thirsted for conquest and plunder. It was easy to quarrel with a less martial people, and with the questionable right "to the victors belong the spoils," carry off what they had not the genius nor the disposition to make. The finest sculptures of Greece went to beautify Rome. Home talent was turned to the formation of invincible legions, with the view ultimately of extending the borders of empire. As soon as a few legions could be spared from protecting the home government, they were sent to conquer a neighboring province, and to despoil it. Every thing handsome and valuable was brought to Rome, hence the city became a vast store-house of art treasures. Then, again, the wealth and prosperity of the country attracted to it the best artists of foreign lands. Captive Jews and Greeks had to construct the aqueducts whose ruins, in segments of arches, stretch over the Campagna, even to the Alban hills. The Thermæ or baths of Rome were so extensive that they could accommodate 1500 bathers at once. The buildings were architecturally grand; and the halls and passage ways were filled with elegant statues and frescoes. The Farnese Bull, now at Naples, once ornamented the baths of Caracalla. The imposing ruins of the luxurious bathing establishment are still to be seen,—they are on the Appian Way, about a half mile from the Arch of Constantine.

Outside of what are denominated the Grand Galleries of Art in Rome, are many collections which embrace meritorious productions. In the Palazzo Rospigliosi of the Quirinal hill is an art hall that has its ceiling ornamented by Guido Reni. The mural painting in brilliant tints represents Aurora strewing flowers before the chariot of the sun-god Apollo. His deityship has his head adorned with an abundance of golden hair; and he is attended with a group of dancing nymphs clad in flowing robes of rainbow hues. The spirited horses are colored in accord with the tints of thin clouds in the background. The picture is one of surpassing beauty, and eminently fit to adorn a palatial ceiling.

In the center of the Piazza del Quirinal is a fountain, beside which stand two colossal horses in rearing attitudes; and giant statues of Castor and Pollux as tamers of the unbridled steeds.

The Piazza del Popolo, in the north part of the city, has an obelisk with Egyptian inscriptions to ornament a fountain. The monolith is placed between four spouting lionesses. This specimen of massive art was brought by Augustus from Heliopolis, in Egypt, and was originally dedicated to the Sun. The obelisk is now surmounted by a crucifix, placed there by Pontifical edict. Several structures of Rome have been bedecked with emblems of Christian worship. The column of Marcus Aurelius is crowned with the robed statue of a Pontiff.

In the Palazza adjoining the Basilica of San Giovanni in Laterano is quite an extensive museum ot ancient and mediæval art. This is about the only church in Rome which permits the presence of profane with Christian objects of art. The mosaics in the floors of one or two halls are marvelously ingenious and beautiful, gold and brilliants constituting the leading ingredients of the composition. The displays of mosaic in animal forms are exquisite. The picture gallery of the Christian Museum embraces illumined scenes from the Old and New Testaments by a high grade of mediæval painters. Before the erection of St. Peter's, San Giovanni in Laterano was the most important church in Rome. The octagonal Baptistry may have suggested a larger and handsomer structure of the kind at Pisa.

The Castle of St. Angelo on the north of the Tiber, and connected to the city by a bridge, with spans adorned with colossal angels, was designed to be the tomb of Hadrian, but the charming ruin is now a castle guarding an easy approach to the Vatican by this route. In the interior of the fort are several gloomy dungeons, in which were incarcerated Beatrice Cenci, Cellini, Cagliostro, and other distinguished prisoners not in favor with the "powers" then ruling.

A few minutes' walk by way of the Borgo Nuovo, takes the tourist from the bridge and castle of St.

Angelo to the Piazza di S. Pietro, or square directly in front of St. Peter's. A plain obelisk stands at the foot of the steps leading up to the portico of the church. Semicircular colonades extend to the right and left of the magnificent edifice, and add somewhat to the imposing grandeur of the front aspect of the historic structure. The ground occupied by the huge pile of buildings was once the circus of Nero, where St. Peter is said to have suffered martyrdom. The foundation of the present St. Peter's was laid in about the year 1500, by Bramante, but several architects were instrumental in raising the superstructure,—Michael Angelo planning the grandest feature of the edifice, *the dome.* The interior of St. Peter's is strikingly impressive, is awe-inspiring. The pillars, niches, statues, paintings, and the symmetry of all the proportions contribute to the whelming spectacle. Reaching from the substructure of the nave, are four pillars with Corinthian pilasters, and above these is a rich entablature which supports the arches extending from one pillar to another to the gorgeous vault above. By the fourth pillar is a sitting statue of St. Peter in bronze, a work of the fifth century, and brought from the monastery of Santo Martino. The feet of the saint are bare, and the great toe of the left foot projects a little beyond the pedestal. This is kissed by devotees, and the oft-repeated osculation has worn away a considerable portion of the digit. Probably the custom has given rise to the expression, "kissing the Pope's toe." The dome of the church rests on four huge buttresses which are so arranged that they do not seem to be specially designed to support the immense weight bearing upon them. In the vaulting of the dome are sixteen ribs so gilded and decorated that they do not appear to be supporting media. Between the ribs are mosaic displays of great brilliance. In the lowest intercostal space are tinted pictures of the Savior, the Virgin, and the Apostles; and in the upper space, on a level with the lantern, is God the Father. What is called the Canopy, over the High Altar, is an immense display of bronze. The metal in this weighs ninety tons, and was taken from the Pantheon—borrowed, and never to be returned. What was Pagan is now sanctified and Christianized.

To the left of St. Peter's is what is called the *Vatican.* This was once a palace and the dwelling place of the Popes. The home of the Pontiff is now in the handsome grounds in the rear of the Vatican Galleries. Here the Pope lives in voluntary seclusion, but walks and drives in the extensive inclosures which surround the Papal mansion.

On certain days in the week the galleries of art in the Vatican can be visited at a trifling expense. The collection of antiquities is thought to be the finest in the world. It was begun in Pope Julius the Second's time, and has been going on ever since. In the Greek Cross Hall is a *Venus*, with merit enough to have come from the hand of Praxiteles. In the Rotunda is a bust of Zeus, and the finest representation of "the front of Jove" extant. It is from the chisel of Phidias or Lysippus. The Hall of the Muses is filled with very attractive figures in Carrara marble. The Muses were found at Tivoli. In the Gallery of Statuary is *Sleeping Ariadne,* a voluptuous beauty once thought to represent Cleopatra. Near to the statue is a beautiful *Candelabrum* found in Hadrian's villa. It is adorned with the heads of Grecian gods, each being a masterpiece. In the Cortile del Belvedere are a few specimens of plastic art that will forever remain unsurpassed. The first of these to be mentioned is the *Laocoon* group. Offended Apollo commanded that the father and two sons be strangled by serpents; and this composite piece of Pentelic marble represents the execution of the relentless order. The group was unearthed in 1506, and pronounced "a marvel of art" by Michael Angelo. Not far from the location of *Laocoon* is *Apollo Belvedere*, a piece of sculpture highly esteemed by every art critic. In another corner of the corridor are the two pugilists, by Canova. There exists some diversity of opinion in regard to the "make-up" and *pose* of these athletes. The display of muscularity is good, but a lack of spirit is manifest in them. In a hall of the Quadrato Atrio stands the *Torso of Hercules*. The statue was executed at Athens B. C., and was found near the theater of Pompey in the 16th century. It is one of the boasted treasures of the Vatican. Plaster casts of the original are in every art gallery of Europe and America.

The paintings of the Vatican are numerous and wonderfully fine. They are largely scriptural, and mostly mediæval. The ceiling of the Sistine Chapel was embellished by Michael Angelo, several years being spent in the laborious work. In another part of the multiple gallery are the *Stanze* of Raphael; and it is difficult to tell in what respect the merits of one artist exceed those of the other. Michael Angelo loved sculpture and architecture, and painted as a pastime, or under compulsion. The ceiling work of the Sistine Chapel was forced upon the great artist against his will, though he took considerable satisfaction in the results of his unremitting labor with the brush. Raphael could create a lovelier Madonna than Angelo, but the latter could excel the former where physical and intellectual power is to be portrayed. The Jehovah of Michael Angelo would be too grand a theme for Raphael to display on a large scale. The angels constituted a fitter subject for the younger artist. It is not easy to give an outline of the Omnipresent Deity. Michael Angelo found it an unsatisfactory undertaking; and his efforts in that way are not above criticism. "The Spirit of God moving upon the Waters," is too ethereal and unsubstantial for even a fresco.

On the inclined part of the vaulting, Michael Angelo has given Prophets and Sibyls in alternate groups. Mingling mythological individuals with Biblical characters is fairly interesting, but hardly appropriate for a Pontifical chapel. However, the Sibyls are impersonated as devotees to study and philosophy, and perhaps to religion. The Last Judgment, painted on the altar-wall, and executed thirty years after the ornamentation of the ceiling, is a great and grand work, but in some respects an incongruous composition. The scene is crowded with figures, with Christ as Judge in conspicuous size and coloring. Devils, angels, and sinners, with here and there a saint, are present in profusion. Charon, who is a pagan god, is introduced with an over-crowded boat busily engaged in ferrying souls over the Styx.

The *Stanze* of Raphael embrace many mural paintings of frescoes which, so far as charm of form and delicacy of coloring may be concerned in pictures, challenge successful competition; they awaken wonder and admiration in the appreciative beholder. Grand personages in the world's history up to Raphael's time entered some one of the many compositions represented,—theology, poetry, philosophy, and justice constituting the leading topics in the illustrations. The chief characters are mythological or biblical, the latter taking the lead. A predominant feature of the paintings is to show the triumph of Christianity over paganism. The works of Raphael exhibit a fertility of invention, and a grace and delicacy of treatment, which characterize the genius and talents of the almost youthful artist.

In what passes as the Picture Gallery of the Vatican are displayed hundreds of fine paintings—the productions of such artists of mediæval and modern times as Bellini, Fra Angelico, Garofalo, Murillo, Titian, Perugino, Sacchi, Guido, Gorreggio, Poussin, and other painters of greater or less renown.

The Basilicæ in and about Rome are ornamented with paintings of great merit, the subjects mostly representing Bible scenes. Not infrequently the importance of a church depends largely upon the cost and character of its pictorial adornment. Almost every high altar is surmounted with "the Virgin," surrounded by angels and saints, and these paintings usually exhibit considerable artistic merit. The repetition of the subject is so frequent that the visitor becomes weary of it. The "Annunciation" constitutes a theme often seized upon by the painter of basilican pieces. The Madonna as Mater is usually presented with the infant Jesus in her arms; and the picture is quite pleasing to every body, to say nothing of the adoration bestowed upon it by the faithful.

The Catacombs of Rome are, by a law repeatedly re-enacted, outside of the walls of the city. Cremation became common among the Romans at an early date, but Egyptians and Christians were opposed to this manner of disposing of the dead, on the ground that it was contrary to their ideas of a resurrection of the body. The Catacombs of Callistus, now visited by tourists, are dismal underground excavations, which have been pillaged of jewels and objects of art. At one period it was common to rifle burial places. Many bones were carried away and sold as those of saints. Paintings of merit exposed in chapels adjacent to catacombs usually represent biblical traditions, most of them having reference to a future state.

ANATOMY—COMPARATIVE AND HUMAN.

The study of anatomy begins in the lower organisms and ends in the higher. I say the *lower*, for the lowest may not have been studied or contemplated. The microscope continues to reveal smaller and still smaller *phytes* and *zymes*, until the end seems to reach into infinity. The pathologist of to-day has a new microbe to "mount" before he be "done" with its novel predecessor. Numbers of these microscopic bodies have been differentiated as vegetable, and as many manifest the characteristics of animals. Not a few of both kinds do us mortal harm, and a certain other few have been utilized for the benefit of mankind. The ferments, so called, are mostly microscopic plants. Such organisms are too small to be dissected, and rarely admit of classification. They have been studied mostly as the producers of disease, as the sources of morbid action, as the living cause of disease, as pathological entities. At present it is a question whether microbes be the *cause* or *sequence* of morbid activity, the arguments *pro* and *con* being pretty equally divided. It is obvious from experimental tests that the majority of *infusoria*, as minute germs and spores have been denominated, are deleterious to mankind, yet a certain minority prove of more or less utility as peptics.

Plants and trees in a fossil state were the basis of our coal, petroleum, and "natural gas," hence a luxuriant flora overspread considerable portions of the earth before the higher animals were created. In the coal beds we find casts of huge *lycopods*, *ferns*, and *conifers*, and mammoth growths of the palm family. The ferns of the carboniferous age in geological nomenclature, which now grow to a height of four to five feet, then attained an altitude of sixty or eighty feet. The anatomy of these plants has to be studied in the barks, twigs, and leaves of carbonized specimens which have not suffered mutilation. Occasionally the trunk of a standing tree is offered for dissection and examination.

But before the carboniferous age were both plants and animals — not coal-making trees, nor creatures above mollusks and fishes, yet forming chapters in the earth's history which, through preserved fossils, can be read with distinctness of expression not to be surpassed by the electrotyped pages of a modern book. And away back of the carboniferous period—far back in the Devonian era—were stately trees, mosses, and marine plants, with a multitude of monstrous sharks, and fish enough for them to feed upon. And even anterior to the Devonian, was the Silurian age, noted for the absence of fishes, and famous for its infinitude of mollusks—for the predominance of algæ and invertebrate animals. Then there were no land animals —all life was in the sea. It corresponded with the Divine *fiat* at the commencement of the *fifth day*, according to the Mosaic account of creation: "Let the waters bring forth abundantly the moving creature that hath life."

Before the Silurian, in Archæan time, when, so far as the "records of the rocks go," there was no living thing on the earth, nor in the waters thereof; it was void of organic life. Dismal indeed must have been that period in the planet's history—and not so dreary either to contemplate in comparison with that of the Devonian and Carboniferous periods, when the smaller fishes were the legitimate prey of the larger—when the largest sharks consumed a school of fishes a day. Those were horrible feasts, and so are those held by smaller fishes to-day. The ten-pound pike has had a two-pound trout taken from its maw. "Game fish," so called, must have living food, and the appetite of such is almost insatiable. Survey their mouths, and be amazed at the dental display. Long and slender teeth are set so that no victim can escape—the way in is in one direction, and that is through barbed fauces, "*nulla vestigia retrorsum.*"

The shape of a handsome fish is admirable for swimming; the fins are perfect poisers and propellers; its tail is unequaled as an instrument of propulsion; its iridescent scales, laid on in artistic rows, constitute beautiful shields against injury, and an envelope to lessen friction in gliding through the water. The gills, with mobile covers, are charmingly adapted to aeration effected in a watery environment. The muscular force of fishes is immense; the ribs are exceedingly tough, and there is a layer of elastic cartilage between the vertebræ.

In a cursory consideration of comparative anatomy, the shell fishes—mollusca—must not be left unmentioned. The calcareous cover of the humble snail in the garden walk is highly ornamental in form and tints; and being a part of the creature, it is borne about with ease. The mollusk may be considered "at home" wheresoever it goes, but its latch string is not always out. Two shelled mollusks—oysters and clams—are famous for foods the world over. The muscular part of bivalves holds the shells so snugly in contact, that it requires the force of a lever—oyster knife—to pry them apart.

Among articulate animals is the lobster; its skeleton, like an armor, is on the outside; and in this respect it is quite the antithesis of vertebrates. This skeletal peculiarity renders the creature rather clumsy. The fossil trilobite was the lobster's tribal ancestor, but perished in Silurian seas.

The student of zoology is of necessity a lover of living things. The ugly toad has a jewel in its head, that is, it has something in its being which we may study with interest and profit. When the toad licks up a fly its tongue moves with the rapidity of lightning. In fact the act is accomplished in our presence and we do not observe the motion. The insect does not fly away, yet disappears; soon a motion of the toad's throat indicates that food is swallowed. A frog is fairly quick in its attempts to catch prey, but the tongue has little to do with the capture. If we could understand the activities of the lingual plexus of the toad, a step would be taken in the science of neurology. It is easy to comprehend how speed is derived in a serpent's head when the reptile inflicts a poisonous bite, for the recoiled head and neck, through a series of toggle-joints, can plunge forward a foot as quickly as an inch could be compassed. The anatomy and functions of a serpent's organization are marvels of adaptation of means to ends. That a limbless creature can attain the speed of a horse is quite astounding. If a snake be placed upon a polished floor, it may wriggle in serpentine curves, but no headway is made; but lay a brick here and there, and the worried reptile will take advantage of them as fulcra to display propulsive force.

In the contemplation of reptiles and birds, we perceive that they possess wide jaws. The peculiarity is to give these creatures faucial capacity; and if we give attention to skeletal parts, an extra bone will be found near the ear; this is the *os quadratum*—quadrate bone—placed at the base of the skull to receive the articulation of the under jaw. No mammal possesses such an arrangement to give width to the throat. Birds have the two clavicles joined in the median line near the keel of the breast-bone, and the two branches thus united constitute the furculum, or "wish-bone." Extending from the breast-bone upward and outward to the head of the scapula, in birds, is a strong bone not found in the mammal skeleton. This at first was a puzzle for comparative anatomists, but it is now as well understood and as rationally explained as any part of the skeleton. It is the *coracoid bone*—the coracoid process of the scapula *specialized*, or developed enormously for a particular purpose—that of forming a buttress for the support of the wing.

In making even a slight examination of the animal kingdom, it is easy to see that one species or order of animals grades or gradually shades into another; that there is a blending of features at more or less points in their organization. If it were not for the disposition to vary, the world would present a sameness that would be wearisome. However, in extreme variances it is not always easy to account for so much swerving from typical forms, unless something besides utility be gained in the extraordinary development of parts. The huge ears of an ass do not render the animal's sense of hearing more acute, and the auricular appendages are too long to be handsome. Possibly the display may be in mimicry of *horns*, to make the creature appear more formidable to carnivorous enemies. The widely branching horns of the elk and moose are quite an annoyance in thickly wooded countries, sometimes seriously impeding the animal's flight.

The tendency in the general evolution of plants and animals seems for the best. In some instances there is a wonderful provision made in the vegetable kingdom for the diffusion of seeds. The maple, for instance, has a winged seed, which in a high wind is made to sail off to the distance of miles. Each seed of the thistle has a feathery attachment which secures the widest dissemination. Insects with highly developed wings may cross a vast expanse of territory in a single day. The carrion fly goes with the velocity of a bullet; the humming-bird is a swift flyer; and the carrier-pigeon spans from sixty to eighty miles an hour. The shape of the pigeon's body is admirably adapted to cleave the air, and the long and slender wings, moved by powerful pectoral muscles, combine flying qualities which are unequaled. Gulls and other well known sea-birds can remain longer on the wing, but can not make headway at so high a rate of speed. The albatross has been reported as following a vessel in the Indian Ocean for two thousand miles, or for fifteen days, and not rest a wing during that time. Flocks of wild pigeons have been observed to fly for twelve hours at the rate of thirty miles an hour, covering a distance of three or four hundred miles without partaking of food or drink. The outline of the bird has been copied by the makers of ships; and advantages have been gained by a study of good models. A duck swims swiftly and with a moderate displacement of water. The propulsive power in the legs and feet is economically displayed. The penguin swims with the combined aid of flippers and feet, and overtakes a fleeing fish.

While the "lower animals," so called, possess mechanical principles in their make-up, and the most pronounced distinctive qualities, the higher types of life, including man, exhibit in a single individual, the most to admire. One of the strangest creatures amongst the mammalian group is the bat. It wings its way, while catching gnats at twilight, with the ease of a bird, though not with the steadiness of a feathered flyer. The vampire of the tropics is large and fierce, and feeds upon the blood of horses and oxen, unless such stock be corraled and covered with wire netting. In the caves of the West India Islands, there may be seen by day, suspended from the roofs of grottoes, thousands of bats as large as squabs.

In early geological times, there were flying dragons of reptilian characteristics; and smaller specimens may be found at present in islands of the Indian Ocean. The wing is a skinny parachute, stretched from one prominent point in the skeleton to another, and is used chiefly as a sail to enable the possessor to glide to quite a distance from higher to lower planes. Flying lemurs have not well developed pectoral wings, like those of bats, but an expanse of integument along the flanks, extending from the fore to the hind limbs. The loose skin is folded or contracted as soon as the aerial animal alights; then the "wings" disappear, till wanted again in a repeated flight. The extinct pterodactyle of the carboniferous age was not a bat, but a reptilian bird, yet it possessed a skinny parachute expanded upon a wonderfully prolonged digit. The *need* of an organ tends to its *development*, and the uselessness of an organ leads to atrophy and extinction. This would not have been well known were it not for archæological researches.

By fossil tooth and petrous track,
Is traced the creature story back.

It is interesting to know that animals kindred to those now living, yet larger and now extinct, preceded present races. In plain terms, the earth gave birth to gigantic creatures of certain types; then after an extended range of existence they were cut off to give place to smaller animals of the same kind. . . .

I have stated that gigantic animals of certain orders came first, and small ones afterward. But such is not the case with the equine family. The earliest possible horse was not larger than a sheep, and several larger and still larger introductions came along in the chain of evolution or development before the large and handsome animal of to-day stepped forth. In Myocene times, as companions of elephants and several varieties of the proboscidian family, the horse ranged over considerable portions of North and South America; but when this continent was discovered by Columbus not a horse was anywhere to be seen. Then, when re-introduced from Europe, the animal found a region suited to its purposes, and it has multiplied till, on the pampas of the LaPlata, vast herds run wild, while there are too few of the human race to break them to the bit. Some great catastrophe must have overtaken the early horses and elephants of this continent. Was it an overspreading of glacial ice from the north? Did the glacial avalanche overspread what is now Mexico, the Isthmus and tropical lands? Might not the elephant and the horse retreat before the encroaching cold? In Siberia the mammoth was so suddenly chilled that the stomach exhibits partly digested food; and its flesh, preserved in ice, is gnawed by wolves. There must have been a sudden overturning of mundane things! In places the blizzard may not have been so severe or fatal.

In a philosophical consideration of the largest animals now living, is it not probable that elephants, rhinoceroses, camels and whales, are the direct descendants of the earliest of their kind? Larger sharks existed in Eocene seas than now can be seen; yet as large crocodiles and gavials are met in Africa and South America as fossil remains of similar creatures indicate. The African ostrich is much smaller than the extinct moa and dinornis, yet there is reason to believe it is the prolongation of an original type. And there is testimony to prove that the gigantic forms cited are on their way out of existence; that the remainder of their career is comparatively short. The elephant will be slaughtered by ivory hunters, the ostrich for its plumes, and the whale for its oil. If it had not been for the discovery of petroleum, there would have been a hundred whale ships where one is now sent to the cetacean fishing grounds. No longer is the great beast harpooned, but a shell fired from a rifled cannon as surely hits and kills as a marksman scores a round at target practice.

Speaking of whales brings to mind the fact that the largest cetaceans are the biggest animals that ever lived in recent or past times. A whale one hundred feet long—and such are occasionally caught in Arctic and Antarctic seas—will weigh about one hundred tons. This Leviathan—this monster of the deep—is edentate ; it has no well developed teeth. Its food is jelly-fishes and minute mollusks caught by a balleen strainer. The gigantic mammalian travels with the speed of the swiftest express train, and even faster. If a whale eighty feet long should engage in a race with the Etruria, to cross the Atlantic, leaving New York at the same time, the cetacean would swim to Queenstown, back to New York, and then reach the vessel in the fogs of the Grand Banks. The whale moving at a moderate rate of speed, and hunting for jelly-fish, breathes once in three or four minutes, or once while making three or four miles. The pectoral fins or flippers are not used to effect headway, but to poise the body in the water; the tail as a propeller not moving in lateral strokes as does the tail of a fish, but striking the moving blows downward and upward. In Puget Sound I saw a whale scoop in a jelly-fish that would seemingly fill a hogshead. A square rod or more of the surface looked smooth as if oil had been poured upon the water. This the passing whale saw when its head was shoved above the surface to blow, and it then turned to swallow the food. In two minutes the cetacean rose to blow again at a distance of at least three miles away, and in the direction of Alaskan waters.

A strange group of undeveloped pelvic bones are found in the after part of the body. These are utterly useless, so far as can be estimated, and convey the idea that the creature was not an original creative conception, but a modification from something higher or lower. In organization the whale is nearest allied to the seal. Perhaps the sea-lion is the indirect descendant of a smaller species of whale. The seal's caudal feet move up and down as does the whale's tail. Seals give birth to their young and suckle them on land or on ice floes, but whales always stick to their native element. A fossil may yet be found to throw some light on the source of the whale's origin. The manatee, or sea-cow, is first cousin to the whale, and there may have been a nearer relationship between them. The stroke of the tail is the same in both creatures. The uncut teeth in the whale's under-jaw indicate that it may have been a *saltus* from the sea-cow, or from a great seal now extinct.

How the nostrils of the whale were placed away back on the head is not easy to explain, unless a *need* in the organic world is followed by a modification in its favor. While it rests or sleeps at the surface, the nasal apertures are above water, and the animal breathes like an ox, and does not spout. However, if the waves slop over the openings, the water is blown upward with considerable force. The holes are closed with sensitive valves which open to air, but close when touched by water. When the animal dives to the depth of a thousand feet, the pressure on the valves must be great, unless support—counter-pressure—come from elastic air in the lungs. In fin-backed whales we have a fishy feature in a mammal. We can not see how the slightly useful fin could come through inheritance. Several varieties of cetaceans get along without the dorsal fin. At best the appendage can do no more than help poise the trunk in a comfortable attitude. It does not seem that necessity was at the foundation of the dorsal fin. . . . Biology looks to heredity, adaptability, and utility, for alterations in structure and modifications of function. In seeking the cause of the variations observable in the organic world, we have to take into account food, climatic influences, local and general vicissitudes and necessities; and in the recognition of causes, we must admit that a certain degree of intelligence pervades the Universe. No one will attempt to deny that lack of use results in atrophy and absolute loss of structure; and is not the evidence just as strong that vigorous action tends to development? The organic change may be slow in its manifestations, yet in the infinity of time what is the necessity for haste? The ox while chewing the cud would suffer a dental clash, if the creature possessed upper incisors; the horse by a tilt of the jaws can cut a mouthful of grass with its upper and lower incisors, then use the grinders without having the incisors touch each other in mastication. The beaver can use its gnawing teeth all day without having its grinders clash; and then it may masticate its food without the incisors meeting each other. By an arrangement in the socket for the condyles of the lower jaw, one set of teeth can be used at a time, and the other be unemployed. Now, it is not difficult to conceive how these articular changes might be brought about in the course of time, if effort be put forth to accomplish the object. . . .

In the contemplation of human anatomy, there is much to be considered which is made philosophical by comparing and contrasting features in the lower animals, and by keeping in mind that man is a mammal, and embraces in his development many of the characteristics of the inferior animals. The lower animals are governed only by instincts, and are therefore responsible only to them. When a hawk swoops upon a chicken or small bird, it does a cruel act, yet the bird of prey obeys its instincts as unswervingly as the woodpecker does when it sends its attenuated and barbed tongue into a worm-hole and drags forth a grub to be swallowed as a delicious morsel. When we shoot birds for mere sport we are more to be blamed than the hawk or owl for taking life to satisfy the pangs of hunger. . . .

The comely athlete has developed his stalwart form and figure by manly sports or toughening acts. Those artistic arms and legs were not brought out in groveling pursuits—those fine muscles were trained into shape by methodical exercise. The gymnasts of our best schools for physical training were developed day by day in systematic efforts. The overworked rustic is neither an athlete nor a gymnast; he exercises his muscles, but not methodically—he is a slow molded drudge. A Grecian face and "a mold of form" are combinations almost never seen among common laborers, for such are not fed with care, and groomed by skilled hands. Even the prize-fighter is fed and handled with artistic skill for weeks before he enters the prize ring. The huge tragedian, as he stalks on the stage, displaying the arms of Vulcan and the calves of Milo, had to attain the gigantic development by several semesters in the best gymnastic schools.

There is a branch of anatomy studied and cultivated by painters and sculptors. It marks the outlines of men and animals, and embraces their features. The antique group, combining Amazon, horse, and an attacking feline, is an artistic display which commands the attention of the skilled and the untutored in æsthetics. . . . Leonardo da Vinci engaged in making human dissections when *anathema* was pronounced against those who were regarded as impious for desecrating the dead; and the great sketcher studied the skeletal and muscular parts of dogs, deer, horses, and wild boars, that he might represent these creatures faithfully in art. Poets are granted the license to overstate an incident; and artists enjoy the indulgence of the same liberal spirit. A piece of art may be a shade overdrawn, and the custom will not be criticised, but Leonardo da Vinci quite overstepped the margin of favor granted to those of his profession. His otherwise fine figures exhibit too much muscularity—appear crowded with anatomy. The partakers of the "Last Supper" are athletes, rather than the "meek in spirit." It was pardonable if not commendable in Rubens to give sturdy trunks and limbs to the stalwart men who lowered the body of Christ in "The Descent from the Cross."

The reason Grecian gods were so attractive, and goddesses so beautiful, is that they were copied in art from the shapeliest of human forms. Antique forms represented evil influences, hence their physiques were in keeping with their moral natures—were anatomical distortions.

The study of human anatomy is said to be dry, and so it may be in its restricted details; but when a free rein is given to the lover of the beautiful in nature, where can he find more to interest and instruct than in the contemplation of anatomical principles? The range of mobility in the human arm is permitted by sets of muscles which act on the short arms of skeletal levers, that the limb may be small, quick-moving, and graceful. The muscles of the leg are arranged with a view to support the body on one limb, and to walk on two feet. The upright attitude in man is a physiological necessity, inasmuch as the skeleton and motor powers are so arranged and displayed that the erect position is the easiest to maintain. But it is the educated brain of man which lends to him his conceded importance. The physique of a six-foot savage may challenge our admiration, but we more admire the intellectual powers of a Bismarck or a Gladstone. The rude men of primitive races were stalwart, yet through a lack of efficient weapons their numbers were kept down by the prowess and ferocity of wild beasts. Cultivated man, skilled in the arts, is more than a match for savages and ferocious animals. An ounce bullet is sent through the head or heart of the ponderous and powerful beasts, and the victims fall as impotent as a pheasant or a hare. And strangest of all is that we know very little about the brain which gives man his pronounced superiority over the creatures which perish by the touch of his hand. To know ourselves better and better, we must compare our cerebral development with the brains of those animals which preceded us. . . . . . .

BIOGRAPHICAL SKETCH OF BARON CUVIER.

(Read before the Cincinnati Society of Natural History, Sept., 1877.)

The study of zoology as a department of human knowledge was well begun by Aristotle; and if it had not been weighed down with ludicrous fables, it might have attained a substantial foundation in the Grecian schools. There is no evidence that Rome, during her rise, culmination, and decline, embraced an individual, except Pliny, who could claim to possess a smattering of zoological knowledge. The Greek and Roman churches forbade investigations of a scientific nature, and prohibited all dissections. For nearly fifteen centuries after the overthrow of the Roman empire, the best of Europe was in a state of semi-barbarism. Geometricians, mathematicians, and astronomers made some progress, yet under threats, difficulties, and dangers. Without civil liberty and religious tolerance how can progress be made in scientific pursuits? Egypt and India entertained transcendental notions regarding metempsychosis, yet such absurdities were scientific hindrances.

During the latter part of the last century John Hunter, by his indefatigable industry, collected a mass of facts to be used in establishing a system of zoology, but the great collector died before his scientific plans had taken shape. Oken, Lamarck, and Linnæus had done considerable toward the same grand object; and Goethe, Geffroy St. Hilaire, Blumenbach, and others worthy of mention, were working in a similar direction. Humboldt also furnished valuable facts and suggestions, and the brilliant talents of Buffon turned the popular mind to the cultivation of a taste for natural history.

While zoological studies were thus pursued in the great capitals of Europe, and by men of the highest order of intellect, he that was to be the greatest of naturalists was ushered into existence. George Cuvier was born in 1769, at Montbeliard, a town belonging then to Switzerland, but afterward to France. His parents were French protestants, who had been driven from their native land through religious persecution. The father of Cuvier was an officer in the French service; and his mother, an accomplished woman, became the instructress of her son. At the age of eight the lad came into possession of Gesner's History of Quadrupeds, and a beautifully illustrated copy of Buffon. These books kindled a desire in the youth to become a naturalist, and he pursued the object of his ambition at every leisure moment. His first efforts in the pursuit of art and science were in copying the pictures he had studied; and so faithful were the delineations that he attracted the attention of critics. He also made unparalleled progress in Greek, Latin, and mathematics, yet found time each day to make a new picture. The Duke of Wurtemburg heard of his wonderful talents, and sent him to Stuttgard to be educated free of expense.

Although at a military school, the young scientist pushed his studies in natural history with zeal, and at the end of two years the Duke conferred upon him the distinguished honor of *chevalierie.*

At the close of his academical career the young student became tutor to the son of Comte d'Héricy, and while thus engaged, utilized his leisure time in pursuing ichthyological studies. A neighbor who had a taste for the study of natural history, possessed an extensive collection of the fishes of the Mediterranean, and Cuvier soon had every interesting specimen carefully depicted. After studying two years, of fishes in general, he went to Paris, where he was very soon appointed a member of the Commission of Arts, and professor of the Central School of the Pantheon. While holding this situation he prepared for his pupils the "*Tableaux Elementaire de l'Histoire Naturelle des Animaux.*" This was his first literary and scientific production, yet it contained a grand division of the animal kingdom into *vertebrata*, *articulata*, *mollusca*, *and radiata*. He proposed that objects in natural history should bear double names—representing *genus* and *species*, as *felis leo*, the lion; *felis tigris*, the tiger; *canis lupus*, the wolf; *canis vulpes*, the fox; and when families were grouped together, a single term was employed, as *felidæ*, to represent all of the cat-kind; *canidæ* for all of the dog family, and so on, the terminal part of the word signifying that all species resembled, in some leading feature, the representative or typical form of the group.

The department of vertebrates was subdivided into four *classes*, as *mammals*, *birds*, *reptiles*, and *fishes*, before Cuvier's time, yet he so embodied it in his classification that it now appears as the part of a general whole. These classes were further subdivided into *orders*, as *carnivora*, *herbivora*, and *cetacea*, of the mammal class; perchers, climbers, waders, and swimmers, of the bird-class; lizards, snakes, turtles, and frogs, of the reptile class; and *ganoids*, *placoids*, *ctenoids*, and *cycloids*, among fishes. In the same manner Cuvier subdivided the articulates, the mollusks, and the radiates; and his tables, with some modifications, are now to be found in every school-room in Europe and America.

Microscopic animalcules and vegetable germs which abound in fluids, and are too minute for classification, were called *zoophytes.* Cuvier intended to have these investigated and brought within the rules applicable in the arrangement of the higher animals, but he made little progress with the work.

During the first year of his Parisian life, he was appointed assistant to the curator of comparative anatomy in the *Jardin des Plantes;* and upon the basis of five old skeletons he commenced the collection and scientific arrangement of one of the most extensive cabinets of zoological specimens in the world. The opportunities here enjoyed led him to commence a work on *Anatomie Comparee*, and also one on *Regne Animal*, which were only finished in the course of years. Napoleon, appreciating the brilliant talents of Cuvier, took pleasure in appointing him one of the Inspector Generals for establishing lyceums in thirty towns of France. Cuvier was instrumental in founding three of the most famous, which are now the universities of Marseilles, Nice and Bordeaux.

Cuvier afterward held other appointments under the government, some of which he filled during stirring periods of the French Revolution. His views were so moderate and conciliatory that the successful or succeeding ruler did not disturb the popular scientist. Although a man of pronounced opinions, and sometimes an active partisan in political movements, and a staunch Protestant, when parties in power were mostly Catholic or infidel, he was discreet enough to escape the wrath of extremists. His devotion to science made his presence pleasing to all parties. Then, again, Cuvier was uncommonly attractive in manners and address. He lifted his hat to princes and peasants with the same ease and grace. He bowed to every child that passed; and shook hands with those who seemed to need recognition and encouragement.

Cuvier married Madame Duvaucel, and became the father of four children, all of whom he survived. The last, an only daughter, a lovely character, and the idol of her father, died of consumption a few days before she was to be married. The sad event made such a deep impression upon the illustrious scientist that he never fully recovered from the shock.

As Secretary of the Institute, Cuvier became the biographer of the celebrated scientists of his day; and he performed the service with such generous sentiment and richness of language, that in this department of literature he undoubtedly achieved one of his most notable triumphs. He manifested a lively interest in the welfare of his pupils, and rarely administered a rebuke even when the provocation to do so was great. One day a student of medicine came to him, and ventured to say that he thought he had discovered something new in the nervous system while dissecting the viscera of a human subject. "Are you an entomologist?" asked Cuvier. "No," replied the student. "Well, then," returned the master, "go and dissect an insect, I care not which, then reconsider your observation, and if it appear to be correct, I will believe you on your word." The student followed the teacher's advice, and after dissecting specimens of several species, came back with the confession that he had begun too high with his studies—that the lower organic forms furnished stepping stones to a knowledge of the higher. Cuvier replied, "You are now on the right road, go on."

When Cuvier observed a student laboring hard yet unsuccessfully over a knotty point in zoology, and he was sure nothing but waste of time and discouragement could be the upshot of it, he would patiently contribute moments precious to him, in order to unravel the student's tangle.

His purse was ever open to the needy and unfortunate of all who came to Paris to gain an understanding of natural science. Young men quartered in garrets to save expense, or to eke out a scanty income, were frequently aroused from their studies and meditations by a gentle tap at the door and the entrance of their revered master. He would come as if entering the chamber of a peer, and with a respectful salutation offer the assistance he saw was so much needed. If sickness assailed them, no rest was known till he had procured medical advice and relief. Himself keenly alive to the slighest rudeness or neglect, and grateful for the smallest proof of affection, he knew how to give, not only with a liberal hand, but with a delicacy which never wounded the most sensitive temper.

Cuvier in his scientific labors did not take up a subject and pursue it until the topic was exhausted, but he kept one branch of study quite in advance of another, making the foremost contribute to the progress of the rest. He did not always follow the plans he laid down for others to pursue, but occasionally took a point in the midst of things and worked his way out as best he could; and in so doing he frequently arrived at the solution of a question which might have required more time if approached in a systematic manner. While he was generally successful in taking a leap he never advised others to depart from established methods of study.

The libraries of Cuvier were arranged with a view to facilitate business. He had a desk in each, and manuscript in course of preparation in every department. By systematizing his time and labor he was enabled to accomplish an astonishing amount of work. When he read a book he indexed the topics, marked passages, and made note of observations and reflections, so that afterward it required little time and trouble to utilize what might be needed; and his memory was so excellent that he generally was spared the labor of referring to notes previously taken.

As a legislator Cuvier exhibited such an understanding of law that he astounded the most experienced statesmen. As president of the Council he was obliged always to wait till a bill had been discussed by each member; then he summed up what had been said with a rapidity that surprised every listener; and his eloquence was so inspiring, and his generalizations so striking, that the measures he advocated rarely met with successful opposition. His determined resistance to the schemes of the Jesuits was a marked feature in his legislative services. He denied entertaining hostile feelings toward that body, but he believed their principles were inimical to the welfare of the country.

As a geologist, Cuvier ranked as high as the best educated men of his time. In his discourse upon the surface of the globe, he shows that he was familiar with leading geological facts. He stated that plants were the earliest organic forms to appear on the earth, and that animals made their appearance subsequently. He also remarked that the layers of the planetary crust bore evidence that low and simple forms thrived and became fossils before the higher orders were created. He was the first to demonstrate that extinct animals were organized on the same unity of plan or type that exists in living specimens. He did not think that there is a continuous or unbroken chain running back from recent to extinct species, but that there had always existed a co-relation of form in the animal kingdom, which could be shown in the creature's entirety or in any of its parts. He held that each bone of the skeleton must bear the characters of its class, order, genus, and even species. In this I believe that he went even further than facts would warrant. Who could take the femur of a zebra and be able to determine to what species of the equine family it belonged? Who would take any number of bones belonging to a large trout and a small salmon, and undertake to demonstrate to what species of the *salmonidæ* the osseous specimens belonged?

In the quarries of Montmatre were discovered the fossil bones of the elephant, the rhinosceros, the tiger, the hyena, and of other large animals which Cuvier's genius and industry helped to restore and to name. By labors in this new field of scientific inquiry, Cuvier established the department of palæontology. The discoveries were so new and startling that for a time more interest was centered in extinct than in living animals.

Cuvier was a careful yet firm supporter of the Mosaic account of creation, and was indisposed to admit doctrines that ran counter to the teachings in Genesis. He believed there had been several successive organic creations, and that all except the last had been destroyed by telluric convulsions. The last embraced man; and the early record of this was to be found in Genesis. He gathered evidence to prove that this later creation did not reach back more than six thousand years, and that the animals of this period had not perceptibly changed since the creation. In conversation, when biblical topics were under consideration, he supported the Bible's account of creation, and believed that Adam and Eve were the parents of the human race; and that variations of color and peculiarities generally have arisen from climatic and other influences.

He repeatedly states that species never change; and arraigned the monumental records of Egypt to show that the giraffe, the leopard, the antelope, the ibis, and the crocodile, faithfully depicted on stone 5600 years ago, were identical with those now inhabiting that country. Why could he not see on the gates of Thebes the pictures of negroes chained in gangs as slaves,—negroes as distinct in their features as they are to-day, yet they were not five hundred years from the creation? If the Coptic artists can be trusted for fidelity to nature, and the creation took place less than five hundred years before their time, the lower animals had not changed to an appreciable extent, yet striking varieties had occurred in the human race, let the primitive pair be white, black, or copper colored.

When assailed by those who disbelieved in special creations—by materialists, Cuvier would quote thus from Genesis: "Let the waters bring forth abundantly the moving creature that hath life. Let the earth bring forth the living creature," adding, "God has endowed the surface of the planet with power to bring forth."

In the classification of animals it was a rule of Cuvier that the skeleton alone need be consulted to ascertain the peculiarities of an animal. He declared that he could as easily point out the difference between the teeth and vertebræ of the dog and the wolf, as he could that which exists between the fox and the jackal, but when put to test by a contemporary of his, the distinction could not be made. At present, in the determination of species, more importance is placed upon features or external appearances than upon anatomical variations. In many instances, though not in enough to constitute a rule, the skeleton bears marks of external characters. The superior maxillary of the wart-hog, for instance, has an osseous protuberance just within each tusk, on which the warty excrescence rests. The ordinary pig has a prenasal bone on which the snout is placed. No other animal possesses such a bone, though the ant-eaters have something akin to it.

There has been so much dispute in regard to what constitutes "species" that the critic of Cuvier's classification should be charitable toward what may appear to be errors in his system. When differences amount to permanent variations, species exist, and not otherwise. Of course Cuvier was wrong when he placed the dugong among whales, but that error may be looked upon as accidental.

The enthusiastic admirers of Cuvier may be pardoned for some extravagant notions they entertained in regard to his skill in restoring the entire animal if he only possessed a scale, a bone, or a tooth. It is easy in some cases to give the outline of a fish by one of its scales. All the ganoids are covered with diamond shaped scutes, therefore if a fossil scale of that form be brought from a quarry of gypsum or other Miocene rock, the fish can readily be sketched on a blackboard, and the peculiarities of the creature be given. All of the salmon family have the teeth peculiarly set in the palate, therefore if a fossil jaw bearing that peculiar arrangement of teeth should be discovered in a Pliocene bed, the fact would be established that the salmonidæ existed in that geological period; and that the waters were cold enough for the fish to flourish in. Nor would it be difficult for the artist to depict the shape of the fish, with its fins and markings. But in other instances, where the animal has no prominent characteristic, the restoration is not so easy and reliable. Cuvier restored the anoplotherium, the palæotherium, and other large creatures from very scanty means, but it is now thought that improvement might be made upon some of them. A study of the various species of the tapir family has thrown some light upon the form and habits of the extinct palæotherium. If Cuvier, in coming across the teeth and pelvis of the orohippus, had attempted to construct a small horse in accordance with his anatomical formula, he would undoubtedly have made it a solidungulate, and not a beast with four toes.

The following words addressed to the Emperor in commendation of Napoleon's desire to make France great in science as well as military achievements, express Cuvier's appreciation of the arts of peace: "To lead the mind of man to its noble destination,—a knowledge of the truth,—to spread sound and wholesome ideas among the lowest classes of the people, to draw human beings from the empire of prejudices and passions, to make reason the arbitrator and supreme guide of public opinion; these are the essential objects of science. This is how she contributes to the advancement of civilization; this is why she merits the protection of those governments, who, desirous of erecting their power on the surest foundation, form their basis on the common good." In this address Cuvier briefly alludes to what makes a country truly great, yet studiously avoids any allusion to his own labors.

In the year 1819, Louis XVIII., as a mark of personal esteem, as well as to bestow an honor well deserved, created Cuvier a Baron of France. Paris embraced many scientific societies, and numbers of men engaged in the advancement of science. Cuvier was at the head of these, and by his efforts the interests of all were harmonized. While thus actively engaged in the promotion of peaceful pursuits he exercised a greater influence for the good of France than any other man in the Empire.

Wellington, Napoleon, and Cuvier were born during the same year, and all three became remarkable characters. The fate of two of these was decided on a battle-field,—the issue exalting one, and dethroning the other; Cuvier made himself master of the scientific field, and there won a more glorious fame than could be gained by the victor of Waterloo.

Cuvier died in May, 1832, aged 62 years, and was buried as he had requested in the Cemetery of Pere la Chaise. His funeral was attended by men of all classes and shades of opinion, and in every part of France his death was bewailed as a national calamity. Pasquier delivered an eulogium upon Cuvier in the Chamber of Peers; and this has been translated into English.

Besides, tradition could be trusted to herald his distinguished ability. A contemporary thus descants upon the qualities of the great savant: "His fine commanding features, and the grand expression of his whole head, united to one of the clearest and most melodious voices that ever issued from the mouth of an orator, riveted the attention of all within sight or hearing; he was extremely fluent, and so rapid and unembarrassed, that while speaking he would often turn to the large blackboard which hung behind him, and with a chalk crayon, illustrate his statement by the most forcible sketch, and without the slightest pause or interruption. In entering and departing from his lecture rooms, the audience pressed so closely upon him, and exhibited such demonstrations of pleasure, that he could scarcely make his way through the throng." Educated men in all parts of the world felt a pang of sorrow when they heard of his death. A master intellect had been stilled at a comparatively early age.

APPENDIX.

THE HOWE PLACE.

A few years ago Dr. Howe bought the old homestead in Paxton with the intention of eventually giving it to the town. This bequest was practically accomplished on the Fourth of July succeeding his death. In making the presentation to the citizens assembled for the purpose, there was read the following paper, notes evidently intended for the occasion, found in a fragmentary condition in Dr. Howe's desk:

Mr. Chairman, and Fellow-Citizens of the Town of Paxton:

By and through the purposes of Divine Providence, and the fortuitous circumstances of human affairs, we have met on this, our country's natal day, to exchange greetings; and if you be half as glad to see me as I am to confront you, there is for the present an amplitude of joy on the lawn of this rural mansion.

The occasion of this convocation of Paxtonians centers in the fact that a great great grandfather of mine, on the Howe side, bought this landed estate from a subject of King George the Third, and took a deed from an agent of the Crown of Great Britain, and long lived here under English rule. This land, according to the deed which I hold in my hand, was purchased of Stephen Newton for the sum of four hundred and twenty-five pounds sterling—an amount in ready money quite as large for the place without the buildings as the homestead is now worth. However, there were about two hundred acres in the original purchase—the Brewer place, so called, having been sold from it, there remain about one hundred and two at the present time.

John Howe, my great great grandfather, transferred his right and title in the piece of realty to his only son, Paul, and he in turn deeded it to his oldest son, John, who sold it to Uncle Paul and my father, Samuel H. Howe. Soon after the joint ownership, but not till after I was born, the property was sold and for a season passed out of the Howe family. I was about four years old when I left this ancestral estate; but I distinctly remember the departure of our family, and that my mother shed tears when we left the premises. . . . .

I have always held the place in sentimental esteem, and long entertained the resolve to become at length its owner. All through adolescence and early manhood instinctive impulses directed my feet to this beloved environment, where the brooks contained trout and the copses embraced wookcock and grouse. In winter, after a fleecy snow had freshly fallen, I visited these hills and glens to track the fox and hare, and often returned home at night with an empty game-bag and an emptier stomach. However, bad luck at fishing and shooting was not attended with regret. I had enjoyed feasting my eyes on scenes that had kindled pleasures in the hearts of my ancestors; I had endeavored to bag fish and birds descended from stock my forefathers had as eagerly hunted, yet failed to catch.

By the contemplation of ownership through hereditary descent, I felt as if all the fish and game in this vicinity belonged to me, and I now consign the slender heritage to your keeping. I trust you will pardon me for placing a fanciful valuation upon what assessors have not appraised very high. They do not regard emotional estimates. . . . .

Two years ago, while making these familiar scenes a rambling visit, I told Mr. Keep, the owner for the time, that whenever he wanted to dispose of the property he might consider me a bidder. To my pleasant snrprise, in a few weeks I received a letter from him announcing his readiness to sell. I inquired the price, and, as it seemed reasonable, I took it at his offer.

Now, as I have no children to inherit the property, I hereby give and deed the same to the inhabitants of the town of Paxton, to keep, to hold, and to enjoy its incomes forever; the conditions being that the farm lands and buildings shall be known in records and in common parlance as the "Howe Place," and that the estate, buildings, and lands shall never be used as a pauper establishment.

This transaction is in accord with the views of my wife, who has relinquished her contingent "thirds," and has authorized the act by placing her signature to the deed I now place in the hands of the Chairman of your Selectmen.

As long as I may live I know I shall take pleasure in feeling that I have done what I was so long desirous to be able to do.

A familiar couplet expresses my feeling on this occasion:

"O, after many, many years, how pleasant 't is to come
To the old farm-house where I was born, my first, my childhood home."