INTRODUCTORY LECTURE

TO THE COURSE ON THE

INSTITUTES OF MEDICINE,

DELIVERED IN THE

UNIVERSITY OF PENNSYLVANIA,

OCTOBER 16th, 1859.

BY

SAMUEL JACKSON, M.D.,

PROFESSOR OF THE INSTITUTES OF MEDICINE.

PUBLISHED BY THE CLASS.

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At a general meeting of the Medical Class of the University of Pennsylvania, held October 21st, for the purpose of publishing the Introductory Addresses of the Professors, Mr. Serapio Recio, of Cuba, was called to the chair, and Mr. Samuel J. Jones, of Pennsylvania, appointed secretary.

The following committee were appointed to carry out the desire of the Class:—

Thomas J. Savage, Alabama.
Thomas J. Reed, Arkansas.
James R. Todd, Barbadoes, W. I.
R. F. Q. Sutton, Buenos Ayres.
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A. H. Voorhees, Tennessee.
James H. Gaskins, Virginia.

CORRESPONDENCE.

University of Pennsylvania,
October 25th, 1859.

Professor Samuel Jackson, M. D.—

Dear Sir: We, the undersigned, have been appointed a special committee by the Medical Class of the University of Pennsylvania, to request a copy of your Introductory Address for publication.

Hoping that you will accede to this request of the Class, we are,

Very respectfully, yours,

Serapio Recio,
Samuel J. Jones,
Edward C. Franklin,
George H. Peets,
George W. Miller.

Philadelphia, October 31, 1859.

Gentlemen: My lecture, delivered at the commencement of the present session, is not an Introductory Lecture, as now generally understood in the medical schools.

It is the first of several preliminary discourses, forming the first section of my course, in which are discussed general principles I regard as essential to the understanding of the future scientific investigations, the immediate subjects of the Institutes of Medicine.

It was not intended for publication; but I cannot refuse to comply with the desire of the highly respectable Class of the University, communicated to me in your polite note of 25th inst.

Accept the assurance of my respect, and believe me,

Yours, truly,
SAMUEL JACKSON.

To Messrs. S. Recio, Geo. H. Peets, Ed. C. Franklin,
Samuel J. Jones, and Geo. W. Miller.

INTRODUCTORY LECTURE.

HUMAN knowledge is resolvable into two divisions; the one comprises the facts and ideas obtained from observation, experience, and experiment. The other consists of ideas formed by processes of reason—of generalizations of facts—termed laws and principles—discovered by the operations of the intellectual faculties.

The first forms the department of empirical art, practised from established rules, or methodical routine. The second constitutes science, which instructs in the nature, conditions, relations, connections, and laws of the phenomena, the subjects of knowledge; it guides the intellect in the path that leads to new discoveries, and to the revelation of truth.

The first division consists of primary ideas, formed by the intellect, directly from mental perceptions. The origin of these is the impressions or excitements produced in the different organs of sensibility—sight, hearing, touch, taste, and smell—by the bodies of the exterior world. These primary ideas are the representatives of the properties, movements, or other influences of external nature. These are brought to the apprehension of our consciousness through the avenues of our senses, and by the action of the perceptive faculties.

The different sensibilities are the agents intermediate between external existences and the mind. No direct action or communication between these last is possible. The mind is endowed with the cognizance of the varied modifications of the sensibilities produced by external impressions, corresponding to the properties, or other conditions of matter, inherent in itself, or communicated to it by the unknown causes named Forces.

From these data, it follows that all knowledge is derived from the phenomena or excitations of the special sensibilities. The human intelligence, by its rational faculties; by its instinctive logic of reason, investigates these phenomena, interprets them, arranges them in categories, and represents them in corresponding ideas of its own creation.

Our knowledge, consequently, is an ideal world, the mind has created from the impressions made on the senses; it is the representation, or a counterpart, of the external world, the bodies of which are incessantly in contact with, and acting on the, sentient organs. They are the normal excitors of sensibility; they impress and modify, in different modes, the state in which it exists. With each impression or excitation, there ensues a corresponding sensation, perception, and idea. The ideas thus obtained from each separate sense are primary, simple, and superficial; they do not penetrate beyond the surface. Each represents a single phenomena or property of an object. Alone, no one of them can communicate a complete idea of the exterior exciting body, of which it represents only a single property, quality, or action. Each sensation and perception proceeding from an exte-

rior body, is brought to the intelligence by a separate sense. It excites its accordant primary idea—a sound, a sight, a feel, &c. The mind, by its power of synthesis, combines them into an idea in our consciousness, which is the exact similitude, in thought, of the external body.

The higher animals, provided, like man, with perfect senses, are capable of forming this class of ideas. These ideas are compounds formed of the simple primary ideas. They represent single objects or individuals, and compose, in scientific classifications, the section of species. This class of ideas is the foundation of all knowledge.

The more gifted intellect of man, invested with supremacy in the dominion of thought, is not circumscribed within this narrow boundary of superficial and empirical experience. It is capable of penetrating deep into the phenomena of the external world. All nature is spread out before it, and is subjected to man's intellectual investigations. He can lay open her most secret operations; he detects the hidden laws that regulate and determines those operations, and thereby acquires the power to control and direct them for the accomplishment of numerous and varied objects, essential, important to his existence, and its multifarious objects.

A vast number of natural phenomena do not come within the cognition of the outward senses. They are subjective, seen only by the mind's eye, heard by the intellectual ear, and can be demonstrated alone by means, measures, and instruments devised and invented by the mind itself, without whose aid those phenomena

would otherwise remain unknown. With this higher advance in the discovery of new and recondite phenomena of nature, new classes of ideas, of corresponding character, are formed by the intellect, and stored up in the understanding. These ideas are of two kinds—complicated and complex. They are scientific ideas formed by the rational faculties, from the observation that numerous groups of phenomena have persistent relations, combinations, connections, and resemblances, indicative of law, order, system, and harmony. From these groups are formed, by the intellectual processes, the complex ideas of principles and law. In scientific classification, classes, orders, and genera, are the expressions and exemplifications of these ideas and principles.

The mind is capable of a yet higher range of thought, and of creating, by its rational faculties, ideas purely intellectual. No models, no examples of them exist in the exterior, material world. To this class belong abstract, or philosophical ideas. They require for their production strong powers of mental condensation, abstraction, and generalization, concentrated on a vast accumulation of knowledge, combined with a wide and intelligent survey of man's state in this world, and his numerous relations in and with nature. The number of individuals endowed with this extent of mental power and capacity is limited. Empirical intellects are infinite; scientific minds are numerous; philosophical are rare; they can be counted.

If the preceding statements are correct, and the facts are in strict accordance with nature, two deductions necessarily follow.

1st. That all our knowledge is phenomenal, and consists in ideas derived immediately from the phenomena of sensibility interpreted by the mind.

2d. That all scientific and philosophical ideas, laws, and principles, are theoretic interpretations by which the mind explains the causes of the complicated and complex phenomena of the external world, with which it becomes acquainted through the medium of the senses.

A few examples will best illustrate the subject. Day and night, light and darkness succeed each other, according as the sun appears above, or disappears below the horizon of any part of the earth. The sense of sight demonstrates the sun to rise in the east in the morning, to culminate in the meridian at noon, and to set in the west at evening. An individual may travel from 2 to 5000 miles on our continent, and his experience will prove to him that the earth is an extended plain, its surface roughened by the elevations of hills and mountains and depression of valleys, but without any appearance of rotundity. Every voyager on our inland seas, or the vast oceans, has presented to him the same testimony of the senses—they are extended plains of water.

This evidence of the senses has been the belief of the myriads of the human races from the earliest periods to this day; and even now, of the one thousand million, at which the inhabitants of our globe are computed, at least nine hundred million hold to the same opinion. If the vote of the majority was to decide the question, science and truth would be suppressed; error and falsity

would rule triumphant in this as in so many other matters of human belief. How then is it known that this almost universal belief, the direct evidence of sense and experience, has no foundation in reality? How are established the astronomical facts that the earth is an oblate sphere; that it rotates on its axis every twenty-four hours, causing the alternations of day and night, as successive portions of its surface rush into and as swiftly are whirled out of the sun's light; that the earth revolves round the sun in the period of a year; and that from its axis being oblique to the plane of its orbit, its path is ecliptic to the equator, whence results the annual changes of the seasons? These indubitable facts of astronomy are logical inductions or theories the mind has, by its reasoning faculties, framed from series of well observed and established phenomena. They are the ideal conceptions the mind has generated by the mental processes of analysis, comparison, synthesis, causality, judgment, and imagination, correcting the primary impressions and erroneous ideas derived from the senses. From these intellectually adjusted and established ideal facts, the mind has conceived and developed the science of astronomy, a perfect transcript of the celestial phenomena existing in nature, and whose original is the thought of the supreme intelligence of the Creator.

Many other instances might be cited of systematized ideas or knowledge having a purely intellectual origin. I will adduce the following: The idea of man as isolated, or an individual, is a compound, consisting of the idea of an animal existence and that of a rational and moral

nature united in one being. But in highly developed social and civilized states, attributes, offices, duties and powers are associated with man that are not elements of his nature, or essential to his existence. They have been created by the intellect, called forth by the necessities originating in the progressive advances from the simple life of the savage to the higher positions and complicated relations of the various civilizations of former periods and of our own time. Thus, passing by the ideas arising from his domestic and social relations and duties as a husband, parent, child, friend, neighbor and citizen, how complicated and complex are those evolved in devising ideal political systems, and in establishing civil polities for the government of peoples, communities, and nations?

All governments are mental conceptions or ideas of the modes or plans for effecting urban, city, State, and national organizations. They are most diversified and numerous. They are all artificial contrivances emanating from mental inventions. They are not copies or imitations of models existing in nature, discovered by the senses; they originate in man's thought.

In the complicated machinery of governments, men are invested with various degrees and kinds of authority and power, embracing ideas of complicated, complex, and abstract character, superadded to the primary idea of man. Such are an elective or hereditary legislator, senator, judge, noble, ruler, king, governor, or president. Each of these offices involves special ideas more or less complicated and complex. That of a king in former times was an abstraction, that invested the individual

with more than mortal attributes. Kings were hailed "as the anointed deputies of Heaven;" their power was deemed irrevocable—"not all the water in the rough rude sea can wash the balm from an anointed king," and it was assumed that "a divinity doth hedge a king." Even at this time nearly all the sovereigns of Europe claim their right to the throne and kingdom by the grace of God. In our great Republic the Presidency is a not less complex and abstract idea: though filled by an individual for a limited term, yet it may be truthfully asserted that the sovereign power of the people, like "a divinity doth hedge it in."

The above examples show that the social and political organizations of the ancients as well as those of the moderns, have been formed after ideal prototypes, devised by man's intelligence.

Appropriate examples demonstrating this law of the production of scientific ideas by the intellectual operations, may be found in almost every page of medical writings from the earliest period of the science. I will select one only; it is of interest as being of most common occurrence and respecting the nature of which, great differences of opinion and confusion of ideas prevail: I allude to fever.

When a patient is examined with the hand and the surface is hot, burning, and dry, immediately the existence of fever is asserted. On the contrary, should the surface be of natural heat, or be several degrees below it, imparting a sensation of coldness, the decision is equally positive that there is no fever. The primary

idea of fever derived from this investigation, it is evident is simply augmentation of the heat of the body. Like all the primary ideas, it is derived immediately from a sensation, in this instance a feeling imparted to the sense of touch.

This fact is still further demonstrated by the etymology of the word that designates fever in all languages. The Greek word *puretos*, fever, is derived from the root, *pur*, fire. The Latin, febris, fever, has for its origin ferveo, to be hot, and from this come the French word fièvre; the English, fever, the Spanish, fiebre, and the Italian febbre. In Spanish, the word calentura from calentar, hot, derived from caleo, to be hot, also signifies fever; the Italian has an analogous word, caldezza, fever, having a similar derivation and meaning.

I have endeavored to ascertain whether the word expressing fever in other original languages had a similar signification and origin to our modern terms. With this view, I applied to the Rev. Mr. Isaac Leeser, of this city, a thorough Hebrew scholar, who has lately edited a new version of the Hebrew Bible, for information on this subject. In a note with which he obligingly favored me, he states, " that the Hebrew word for fever is *Kaddacath*, derived from *Kadach*, to kindle, to burn. It is used in this sense in Deut. xxviii. 22."

Some years since I was fortunate in making the acquaintance of the late Rev. Mr. D. Abeel, an amiable and estimable gentleman, and truly pious Christian. He had resided several years in China, devoted to missionary labors, to the duties of which his health and

ultimately his life were sacrificed. The following is an extract from a letter in answer to my inquiry on this subject:—

"With regard to the Chinese word for fever, I find the two characters most in use, express the same general idea of heat. The one is pronounced in the court dialect *Shaou*, meaning to burn, to set fire to, to boil, to roast; the other *jé*, hot, as heated by fire, warm as weather, water, one's affections, or passions."

"The radical of the two characters which determines in a very general way their meaning is the same in both, though written differently. It means fire, heat, and many other things of a cognate kind." From Dr. S. W. Butler, of the Cherokee nation, I received the following statement while he was attending lectures. "The Cherokee word for fever signifies heat, or in a heat, the word, however, like our own term fever, being only applicable to animals."

It may be assumed from the above instances, that in all languages the word designated fever, expresses a simple fact or primary idea, represented by different, but synonymous words, all meaning heat, augmented temperature of the human body. As such it does not signify disease, it denotes a symptom only, common to numerous diseases, as inflammation, some local irritations and special affections, classed as and named fevers.

Now this term fever possessing, as has been shown, a limited and positive meaning, which signifies a single and simple fact and primary idea, has been employed to characterize highly diversified groups of complicated

morbid phenomena and most varied general and disturbed conditions of the animal organism.

In pathological speculations these groups have been made independent entities, and the term fever has been appropriated to designate them. Thus we have intermittent, remittent, bilious, yellow, typhus, typhoid, or enteric, pneumonic, and cerebral fevers. How utterly dissimilar are these affections. How much of complicated derangement is induced in all the actions, vital, nervous, and organic, of the animal economy, suffering under their attacks. Yet each is designated as a fever. The perversion of this term must have originated in the ignorance of the earlier observers of the internal pathology of those diseases, questions yet undetermined. The symptom, heat or pure fever, is an attendant on all of those affections, though not invariable; for it is often absent in the most malignant cases: as in Febris Algida of Galen, the cold plague of the South, and also in many of the worst cases of yellow and bilious fevers. Being, however, the most recognizable and best understood phenomena, while all the others were incomprehensible, it was construed to be the most essential character, and each disease was regarded as a special form of fever. The idea of fever in this new view, is complicated and complex; it is not a primary idea derived from the senses, but is a pure hypothesis.

Pathologists have gone further, and have formed in their speculations an abstract idea of fever as an essentiality capable of classification, according to specific characters. Thus fever was erected into a class, subdi-

vided into orders, genera, and species, to each of which was appropriated the name of a special fever.

A question was long since raised, which has a very important bearing on this subject. It has been doubted whether simple fever—augmented heat—is properly a pathological state necessarily a part of the disease, or whether it may not be a therapeutic operation of nature, defending and protecting the organism against the disturbing and destructive action of the morbific cause, or impression, which is the actual disease. I must pass this question at the present time; the limits of this discourse will not permit its discussion. Certain it is that every experienced practitioner knows that in the diseases called fevers, if there be not increase of animal heat, or fever, if the case be a feverless fever—"febris sine febre," the doom of that patient is inevitable—he must die.

In the foregoing discussion I have endeavored to demonstrate to you the origin and nature of knowledge and its division into art, or empirical practice, science, and philosophy. I regard this information as important in the commencement of your studies, for it will assist you to appreciate at its just value what you will be taught in lectures, and what you will read in books. The worth of knowledge consists in its truth: the false is always baneful, is a necessary consequence of ignorance, and the source of nearly all the evil that afflicts man and society.

The distinction I have attempted to draw, radically rooted in totally different classes of ideas, between art and science, is not generally understood, at least in a

clear manner; and in consequence confusion of thought frequently occurs in scientific discussions.

A very striking example was presented last August, at Paris, in a debate that took place at the "Académie de Médecine." M. Trousseau, one of the most celebrated Professors of Paris, denied that medicine, properly speaking, was a science; and M. Gibert, a highly respectable physician, boldly advocated pure empiricism in medicine, degrading anatomy, physiology and pathology, as of no value to the medical practitioner.

M. Gibert is not sufficiently known, at least out of Paris, to enable us to estimate the value of his opinion, or to give weight to his heretical notions. But, that M. Trousseau, who has won a position of so much eminence, who is regarded as a great authority in the practice, whose clinical lectures are models of scientific investigations, solid judgments and practical skill, should have advanced such an opinion in so dignified a body, cannot but excite surprise, regret, and mortification.

It cannot be supposed he was sporting opinions he did not entertain—the occasion and the place forbid the suggestion. He must be taken as serious, though at the expense of his consistency.

Surely M. Trousseau did not mean to assert that in every case of disease, the treatment of which he undertakes, he does not first seek to establish its nature or diagnosis, and its location, by all the signs, physiological, pathological, physical, chemical and rational, he can command, which he knows so well how to employ, and he daily calls into operation.

Nor will he overlook the influences of sex, age, con-

stitution, temperament, and the habits of the patient—as well also the seasons of the year and the particular prevailing endemic and epidemic constitutions. Neither is it to be presumed he blindly prescribes without first forming his indication of what ought to be done, whether and how it can be done, and why it ought to be done.

Now, in what does science consist, except in the knowledge indispensable to accomplish these objects, and the mental processes, the series of logical deductions, required for such an investigation? It would take more time than is now at my disposal, to prove this position by examples. I must content myself with its bare annunciation.

The delusion of M. Trousseau, for such I believe it to have been, may easily be explained. From his long and extensive experience in public and private practice, he has acquired an extensive stock of well-established pathological and therapeutic ideas and principles. He has been thoroughly trained in all the modern scientific methods of exploration and research. He has so frequently, in his long and enlarged experience, gone over this ground, he has so repeatedly solved pathological problems in the vast number of cases he has investigated, that it is seldom an absolutely new form of a disease presents itself to him, requiring a very close examination. His mental operations in his inductions and combinations are performed with so little labor, he is unconscious of effort, and he mistakes for simple art what is, in fact, the result of highly cultivated science.

Had Messrs. Trousseau and Gibert limited their assertions to the incompleteness of medicine as a science,

no objection could have been made to a truth admitted by every one.

But a science is not less science because it is imperfect, that it is still in progression. Chemistry was a science, though Priestley assumed hypothetically phlogiston to be an element; and it was equally a science, though Lavoysier supposed oxygen was exclusively the acidifying principle and the only supporter of combustion. His theory, founded on facts as they were then known, is still true as applicable to those facts; it failed in the generality of its application to other facts since discovered. Chemistry is still incomplete; it has not attained perfection, yet no one will deny its claims as a science, and medicine, possessing a vast amount of demonstrated facts and principles that have stood the test of time, is not less entitled to rank as a science.

The improvement and completion of art are dependent on the advancement of science; the perfection of its practical operations proceeds from acquired skill. The introduction of new arts and the great improvement in so many of the old, within the last half century, are the consequences of the rapid progress of scientific knowledge within that period. By the application of general scientific principles new ideas are formed, new conceptions are developed, improved instruments, mechanisms, and modes of operations, are invented and all the manipulative processes and rules for employing them are rendered clear, definite and certain. Art then becomes the incorporated reality of scientific ideas and thought, and can be practised by those uninstructed in science.

There is no art, even the simplest and most common, that will not sustain the correctness of this statement. I shall adduce that of navigation as illustrating most strikingly the dependency of art on the aid, not of a single science, but on the union of many sciences.

How great is the contrast between the navigation of the ancients and that of our time, at which it is pressing on with hastening steps to its highest perfection. In the Acts of the Apostles we possess a very interesting record and graphic account of a voyage made by Paul from Syria into Italy, at the commencement of our era. For the details, I refer you to your Testament; you will find that in this voyage, commenced in the autumn, the dangers of a winter passage made it necessary to find a commodious harbor in the island of Crete, at which to winter. This attempt was defeated by a storm which drove the ship from her course. For fourteen days and nights she was tossed at the mercy of the winds and waves, no one on board knowing where they were, or where they were driving to. At last the vessel was wrecked on the island of Melita, where they were detained three months, waiting for the sailing of the Castor and Pollux, an Alexandrian ship that had wintered in that island and was waiting for the propitious gales of the spring to resume her voyage. Embarked anew, after touching at Syracuse and making a compass, they arrived at Rhegium in Apulia, and in a day or two landed at Puteoli, the present Pozzuoli, near Naples. The length of the voyage must have been near five months. A steamer now sails weekly from Leghorn to Smyrna in five days. The voyage across the Atlantic

is often accomplished in ten to twelve days; and there is every probability will soon be effected in seven.

At this time a skilful navigator determines day by day, and marks on his chart the position and course of his vessel on the trackless ocean. So perfect are his calculations that he may guide his vessel direct to his port of destination without once seeing land. Captain Marryat relates that he sailed on board a ship from Valparaiso on the Pacific bound to Rio Janeiro, doubled Cape Horn, and the first land seen was the narrow mouth of the harbor, the port of their destination.

In what manner has navigation attained this state of perfection? By borrowing and appropriating to itself the ascertained facts and laws of other sciences and arts which are applicable to its purposes. Astronomy, geometry, hydraulics, mechanics, horology, and dynamics, have all been laid under contribution to so great an extent that navigation may be truly called a confederation of arts and sciences. The combination of astronomy and geometry by George Mercator, the compass, and the determination of its variations, have laid the foundation for modern navigation; and the substitution of steam for the uncertain and fitful energies of the winds have imparted to it almost certainty as to time, while the employment of iron in the place of wood in vessels of great magnitude promises to reduce greatly the many hazards that attend on ocean-travel.

Of all the arts, that of medicine is the most difficult to understand, uncertain as to the result intended, and dangerous often in its consequences from errors to which

it is liable. Of all the sciences, medicine is the most complicated in its phenomena, obscure in its laws, hidden in its operations, and most remote from its completion.

The great difficulty of medical art and science arises from the number, diversity, and obscurity of its phenomena. A very slight observation will demonstrate that the phenomena of living beings are very dissimilar, that though each is acting independently yet all occur to a common end. A further observation demonstrates that a large proportion of the phenomena of living organisms are identical with those of the collateral sciences, have a similar origin and are amenable to the same laws.

In constructing animal organisms nature has not provided a single organic and vital material for all the tissues and organs, or a single organic form or principle, but has drawn largely on other and exterior aids for her materials, and borrowed, if the term may be used, the forces and phenomena of the exterior world, which our finite intelligence compels us to separate into distinct sciences, though no such distinction exists in nature.

The obscurity of the vital phenomena is not in themselves, but in those who do not acquire a knowledge of the facts as nature has made them; of those who will obstinately regard all the living phenomena as identical and special in their nature, and as the immediate results of a vital principle: while in reality they are only accessories of different kinds, indispensable to the procuring and maintaining of the activity and reactions of the organizing or vital force, or principle. Such is the

intention of all the organic functions, and, in part, of the nervous functions.

The first lesson in the study of the phenomena of the living organism of man should be the knowledge of the different kinds of actions whose independent yet combined operations constitute his life.

For this purpose I will enumerate them, arranged in the appropriate classes to which they belong:—

Class I. *Organic or Life Actions—Nutritive and Formative Actions.*

By these actions are constructed the organism, a living mechanism, from a formless plastic matter, and daily is repaired by them the waste of the organic substance destroyed in the functional acts of life in all the tissues. They belong in varying degrees to every living structure, to every organized cell.

Class II. *Chemical Actions.*

These consist in molecular movements, changing the properties, and, generally, the forms and states of bodies. The kind of chemical action most frequent in the living organism is that known as catalysis, or action of presence.

In the organism they transform the crude albumen into the immediate organizable substance or plasm; they transform the organized substance into lower organic substances, forming the excretions; they transform or digest the alimentary matters, adapting them to be absorbed into the blood; they form the secretions from elements existing in the sanguine fluid, and generate animal heat.

CLASS III. *Physical Actions.*

These are numerous and diversified. Amongst them may be enumerated: 1. Endosmose and exosmose, a property of all organized tissues, introducing the product of digestion and other fluids into the circulation, carrying also oxygen into, and eliminating carbonic acid out of the blood; 2. Optical and acoustic phenomena, or those of vision and hearing. 3. Phonation, or production of voice; 4. Production of electricity; 5. Elasticity.

CLASS IV. *Mechanical Actions.*

Muscles are the organic mechanical instruments of life. The functions depending on mechanical actions and performed by muscles are: 1. Respiration, vocal sounds, speech, &c.; 2. Mastication, deglutition, peristaltic movements of stomach and intestines; 3. The circulation maintained by the forcing action of the heart, driving the blood through the hydraulic system of bloodvessels, distributing the organizable and vitalizing fluid to the ultimate molecules of every tissue; 4. Expulsion of feces, urine, mucus, the fœtus; 5. Movements of the body in locomotion, and in labor and exertions of various kinds.

CLASS V. *Dynamical Actions or Mechanical Forces.*

Every mechanism requires the expenditure of a force to produce its actions. The spinal axis is the dynamic apparatus generating the nervous motor force, the normal excitor of muscular action. The motor force is called into action by nervous excitor force, and the action produced is called excito-motory or reflex action. This

kind of action is automatic; it is unattended by consciousness or sensation; it is independent of the will or mind, and its object is to preside over the preservation of the organism.

The motor force may also be excited into action by the operation of the mind called the will, forming voluntary action; or it may be roused into action by the emotions and passions, giving rise to emotional actions.

There is very strong evidence to show that a vividly excited idea, or concentrated thought, may excite the spinal motor force, producing varied muscular movements independent of volition.

Class VI. *The Psychological or Mental Actions.*

The following is the arrangement I make of the faculties and actions included in this class: 1st. The moral faculties or instincts that govern man in his personal, domestic, and moral relations. 2d. The moral sentiments, antagonistic to the selfish tendencies of the moral instincts. They originate the higher, nobler, and more expanded motives that raise man to the highest elevations of humanity; that impart to him true piety, general benevolence, and all the virtues that dignify and adorn the characters of the great, the good, and the wise. 3d. The intellectual or rational faculties. By these man acquires the knowledge by which he is enabled to comprehend and interpret the great work of creation, the stereotyped signs expressing in the material forms of nature the divine ideas, in studying which he enjoys the exalted privilege of communing with his Creator.

Such are the varied phenomena and actions that con-

centre in man's organism and constitute his life. It is seen in this arrangement that four of the above classes are highly cultivated, whose principles are established and facts settled, an acquaintance with which will explain numerous vital phenomena that cannot otherwise be comprehended. Their intimate alliance with medicine must be soon accomplished; it can make no further material progress in any other manner. Like navigation, it must confederate with the collateral positive sciences, whose facts compose so large a portion of the so-called vital actions.

In all complicated sciences there is a radical phenomenon to which they are subservient. Gravity is the fundamental fact or law of astronomy, chemical affinity that of chemistry, polarity of electricity and magnetism, and so of others. The same general law prevails in medicine. Its radical phenomenon or general fact is the organic or life action, emanating from the reaction between the vital organic principle or force and the exterior world. Its normal reaction under its normal conditions is invariably the production of specific organic forms, instruments of life-organs constructed after types presided over and determined by germs, and a perfectly constituted organism.

This is the sole, the exclusively vital phenomenon and action, all the others acting after their special modes—chemical, physical, mechanical, dynamical—have for their final end the perpetuation of the organic, life, or formative action, innate in every living organized cell or particle, from which originate the whole organic world.

This proposition of the nature and limitation of the real organic or life-action, which I have advanced and advocated for the last twenty years, has received a demonstration in some recent series of observations communicated to the French Institute. One by M. Natalis Guillot, in December last; another in April, by M. Vulpian. The first of these consists in observations on the development of the jaws and teeth, in which observations were concurrently made on the development of the face. In the first periods of life, he states, no trace of the different tissues of the face of an adult can be discovered. The skin and mucous membranes are indicated as simple coverings of a homogeneous mass, consisting of molecules or of cells placed in linear arrangement.

In this homogeneous mass there are, as it were, at first, invisible foci, where the molecules are transformed, here to constitute the materials of bone, there to give birth to different fibres; in one place to produce tubes of ivory or of enamel, and in another to manifest the elements of the nervous tissue.

The observations of M. Vulpian are more demonstrative and interesting. They relate to the developments made in the tail of the tadpole after being separated from the body by a transverse section. The experiments were made in the laboratory of M. Flourens.

M. Vulpian had ascertained that the caudal extremity of the tadpole will continue to live from six to eight days, in one instance eighteen days, after being separated from the body of the animal.

I shall confine myself to a condensed statement of the general facts.

The cut surface soon cicatrizes; all the structure is rudimentary, neither nerves, vessels, nor blood exist. The general mass consists of cells filled with vitelline granulations. From these an epidermis is produced; the axis, at first very indistinct, becomes detached, forming a vertebral or median part, the lateral portions of which are formed by series of muscular bundles. In proportion as the muscles are developed contractility appears. Vessels also appear and continue to ramify more and more, and contain blood-globules; nerve and lymphatic elements, though obscure, give evidence of their existence. Certain movements are performed, partial subsultus of the muscles are seen.

These developments of structure occur equally in the separated tail as in that of the unmutilated animal.

When all the phenomena of development are in full activity, three or four days after the section, the separated tail exhibits all the phenomena of life. It is in some measure a true animal respiring by the skin, and nourished at the expense of the vitelline granulations, filling all the cells of which it consists. Reflex actions are manifested.

"All the vital phenomena, nutritive multiplication of anatomical elements, the simultaneous perfection of these elements and their physiological properties, are produced with an activity nearly equal to that of the animal in its sound state. It is the same with the most complex vital phenomena, such as the maintenance of the form of parts and the development in a determined

sense. All these different phenomena are clear evidences that the vital properties are inherent in the living molecules and tissues."

I cannot pass by the highly interesting and, on this subject, conclusive experiments of M. Ollier, communicated to the Académie des Sciences, December, 1858. They establish, 1st, that the tissue possesses an independent vitality; and 2d, that its mode of vital action is manifested in its function.

I shall select a single experiment, which is decisive and final on these points. He dissected strips of periosteum from bones, which he transplanted to the muscles of the back and other parts. The conditions of vital activity and nutritive development are here present. They are a definite temperature of 98°, and the plastic and oxygenated fluid that irrigates all living structures. The transplanted strips continued to live, to grow, and to develop true osseous tissue precisely as in its normal connection with bone.

In the ensuing course I shall be guided by the principles exhibited in this lecture, and endeavor to demonstrate the scientific elements and principles of medicine by all the means and appliances at my command.