

# ORGANIC CHEMISTRY

APPLIED TO

## PHYSIOLOGY AND PATHOLOGY.



I. IN the animal ovum, as well as in the seed of a plant, we recognize a certain remarkable force, the source of growth, or increase in the mass, and of reproduction, or of supply of the matter consumed; a force in a state of rest. By the action of external influences, by impregnation, by the presence of air and moisture, the condition of static equilibrium of this force is disturbed; entering into a state of motion or activity, it exhibits itself in the production of a series of forms, which, although occasionally bounded by right lines, are yet widely distinct from geometrical forms, such as we observe in crystallised minerals. This force is called the *vital force*, *vis vitæ* or *vitality*.

The increase of mass in a plant is determined by the occurrence of a decomposition which takes place in certain parts of the plant under the influence of light and heat.

In the vital process, as it goes on in vegetables, it is exclusively inorganic matter which undergoes this decomposition; and if, with the most distin-

gished mineralogists, we consider atmospherical air and certain other gases as minerals, it may be said that the vital process in vegetables accomplishes the transformation of mineral substances into an organism endued with life; that the mineral becomes part of an organ possessing vital force.

The increase of mass in a living plant implies that certain component parts of its nourishment become component parts of the plant; and a comparison of the chemical composition of the plant with that of its nourishment makes known to us, with positive certainty, which of the component parts of the latter have been assimilated, and which have been rejected.

The observations of vegetable physiologists and the researches of chemists have mutually contributed to establish the fact, that the growth and developement of vegetables depend on the elimination of oxygen, which is separated from the other component parts of their nourishment.

In contradistinction to vegetable life, the life of animals exhibits itself in the continual absorption of the oxygen of the air, and its combination with certain component parts of the animal body.

While no part of an organised being can serve as food to vegetables, until, by the processes of putrefaction and decay, it has assumed the form of inorganic matter, the animal organism requires, for its support and developement, highly organised atoms. The food of all animals, in all circumstances, consists of parts of organisms.

Animals are distinguished from vegetables by the faculty of locomotion, and, in general, by the possession of senses.

The existence and activity of these distinguishing faculties depend on certain instruments which are never found in vegetables. Comparative anatomy shews, that the phenomena of motion and sensation depend on certain kinds of apparatus, which have no other relation to each other than this, that they meet in a common centre. The substance of the spinal marrow, the nerves, and the brain, is in its composition, and in its chemical characters, essentially distinct from that of which cellular substance, membranes, muscles, and skin are composed.

Every thing in the animal organism, to which the name of *motion* can be applied, proceeds from the nervous apparatus. The phenomena of motion in vegetables, the circulation of the sap, for example, observed in many of the characeæ, and the closing of flowers and leaves, depend on physical and mechanical causes. A plant is destitute of nerves. Heat and light are the remote causes of motion in vegetables; but in animals we recognize in the nervous apparatus a source of power, capable of renewing itself at every moment of their existence.

While the assimilation of food in vegetables, and the whole process of their formation, are dependant on certain external influences which produce motion, the developement of the animal organism is, to a certain extent, independent of these external

influences, just because the animal body can produce within itself that source of motion which is indispensable to the vital process.

Assimilation, or the process of formation and growth—in other words, the passage of matter from a state of motion to that of rest—goes on in the same way in animals and in vegetables. In both, the same cause determines the increase of mass. This constitutes the true vegetative life, which is carried on without consciousness.

The activity of vegetative life manifests itself, in vegetables, with the aid of external influences; in animals, by means of influences produced within their organism. Digestion, circulation, secretion, are no doubt under the influence of the nervous system; but the force which gives to the germ, the leaf, and the radical fibres of the vegetable the same wonderful properties, is the same as that residing in the secreting membranes and glands of animals, and which enables every animal organ to perform its own proper function. It is only the source of motion that differs in the two great classes of organised beings.

While the organs of the vital motions are never wanting in the lowest orders of animals, as in the impregnated germ of the ovum, in which they are developed first of all, we find, in the higher orders of animals, peculiar organs of feeling and sensation, of consciousness and of a higher intellectual existence.

Pathology informs us that the true vegetative life

is in no way dependant on the presence of this apparatus; that the process of nutrition proceeds in those parts of the body where the nerves of sensation and voluntary motion are paralysed, exactly in the same way as in other parts where these nerves are in the normal condition; and, on the other hand, that the most energetic volition is incapable of exerting any influence on the contractions of the heart, on the motion of the intestines, or on the processes of secretion.

The higher phenomena of mental existence cannot, in the present state of science, be referred to their proximate, and still less to their ultimate causes. We only know of them, that they exist; we ascribe them to an immaterial agency, and that, in so far as its manifestations are connected with matter, an agency entirely distinct from the vital force, with which it has nothing in common.

It cannot be denied that this peculiar force exercises a certain influence on the activity of vegetative life, just as other immaterial agents, such as Light, Heat, Electricity, and Magnetism do; but this influence is not of a determinative kind, and manifests itself only as an acceleration, a retarding, or a disturbance of the process of vegetative life. In a manner exactly analogous, the vegetative life reacts on the conscious mental existence.

There are thus two forces which are found in activity together; but consciousness and intellect may be absent in animals as they are in living

vegetables, without their vitality being otherwise affected than by the want of a peculiar source of increased energy or of disturbance. Except in regard to this, all the vital chemical processes go on precisely in the same way in man and in the lower animals.

The efforts of philosophers, constantly renewed, to penetrate the relations of the soul to animal life, have all along retarded the progress of physiology. In this attempt men left the province of philosophical research for that of fancy; physiologists, carried away by imagination, were far from being acquainted with the laws of purely animal life. None of them had a clear conception of the process of development and nutrition, or of the true cause of death. They professed to explain the most obscure psychological phenomena, and yet they were unable to say what fever is, and in what way quinine acts in curing it.

For the purpose of investigating the laws of vital motion in the animal body, only one condition, namely, the knowledge of the apparatus which serves for its production, was ascertained; but the substance of the organs, the changes which food undergoes in the living body, its transformation into portions of organs, and its re-conversion into lifeless compounds, the share which the atmosphere takes in the processes of vitality; all these foundations for future conclusions were still wanting.

What has the soul, what have consciousness and

OF CONSCIOUSNESS AND INTELLECT. 7

intellect to do with the developement of the human foetus, or the foetus in a fowl's egg? not more, surely, than with the developement of the seeds of a plant. Let us first endeavour to refer to their ultimate causes those phenomena of life which are not psychological; and let us beware of drawing conclusions before we have a groundwork. We know exactly the mechanism of the eye; but neither anatomy nor chemistry will ever explain how the rays of light act on consciousness, so as to produce vision. Natural science has fixed limits which cannot be passed; and it must always be borne in mind that, with all our discoveries, we shall never know what light, electricity, and magnetism are in their essence, because, even of those things which are material, the human intellect has only conceptions. We can ascertain, however, the laws which regulate their motion and rest, because these are manifested in phenomena. In like manner, the laws of vitality, and of all that disturbs, promotes, or alters it, may certainly be discovered, although we shall never learn what life is. Thus the discovery of the laws of gravitation and of the planetary motions led to an entirely new conception of the cause of these phenomena. This conception could not have been formed in all its clearness without a knowledge of the phenomena out of which it was evolved; for, considered by itself, gravity, like light to one born blind, is a mere word, devoid of meaning.

The modern science of physiology has left the track of Aristotle. To the eternal advantage of science, and to the benefit of mankind, it no longer invents a *horror vacui*, a *quinta essentia*, in order to furnish credulous hearers with solutions and explanations of phenomena, whose true connection with others, whose ultimate cause is still unknown.

If we assume that all the phenomena exhibited by the organism of plants and animals are to be ascribed to a peculiar cause, different in its manifestations from all other causes which produce motion or change of condition; if, therefore, we regard the vital force as an independent force, then, in the phenomena of organic life, as in all other phenomena ascribed to the action of forces, we have the *statics*, that is, the state of equilibrium determined by a resistance, and the *dynamics*, of the vital force.

All the parts of the animal body are produced from a peculiar fluid, circulating in its organism, by virtue of an influence residing in every cell, in every organ, or part of an organ. Physiology teaches that all parts of the body were originally blood; or that at least they were brought to the growing organs by means of this fluid.

The most ordinary experience further shews, that at each moment of life, in the animal organism, a continued change of matter, more or less accelerated, is going on; that a part of the structure is transformed into unorganised matter, loses its



condition of life, and must be again renewed. Physiology has sufficiently decisive grounds for the opinion, that every motion, every manifestation of force, is the result of a transformation of the structure or of its substance; that every conception, every mental affection, is followed by changes in the chemical nature of the secreted fluids; that every thought, every sensation, is accompanied by a change in the composition of the substance of the brain.

In order to keep up the phenomena of life in animals, certain matters are required, parts of organisms, which we call nourishment. In consequence of a series of alterations, they serve either for the increase of the mass (*nutrition*), or for the supply of the matter consumed (*reproduction*), or, finally, for the production of force.

II. If the first condition of animal life be the assimilation of what is commonly called nourishment, the second is a continual absorption of oxygen from the atmosphere.

Viewed as an object of scientific research, animal life exhibits itself in a series of phenomena, the connection and recurrence of which are determined by the changes which the food and the oxygen absorbed from the atmosphere undergo in the organism under the influence of the vital force.

All vital activity arises from the mutual action of the oxygen of the atmosphere and the elements of the food.

## 10 NUTRITION AND REPRODUCTION

In the processes of nutrition and reproduction, we perceive the passage of matter from the state of motion to that of rest (static equilibrium); under the influence of the nervous system, this matter enters again into a state of motion. The ultimate causes of these different conditions of the vital force are chemical forces.

The cause of the state of rest is a resistance, determined by a force of attraction (combination), which acts between the smallest particles of matter, and is manifested only when these are in actual contact, or at infinitely small distances.

To this peculiar kind of attraction we may of course apply different names; but the chemist calls it *affinity*.

The cause of the state of motion is to be found in a series of changes which the food undergoes in the organism, and these are the results of processes of decomposition, to which either the food itself, or the structures formed from it, or parts of organs, are subjected.

The distinguishing character of vegetable life is a continued passage of matter from the state of motion to that of static equilibrium. While a plant lives, we cannot perceive any cessation in its growth; no part of an organ in the plant diminishes in size. If decomposition occur, it is the result of assimilation. A plant produces within itself no cause of motion; no part of its structure, from any influence residing in its organism, loses its state of vitality,