The Hunterian oration, delivered at the Royal College of Surgeons, February 14, 1853 / by Bransby B. Cooper.

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Cooper, Bransby Blake, 1792-1853.
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Publication/Creation

London : John Churchill, 1853.

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THE

HUNTERIAN ORATION,

DELIVERED

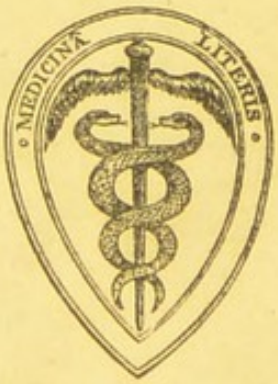
AT THE ROYAL COLLEGE OF SURGEONS,

FEBRUARY 14, 1853,

BY

BRANSBY B. COOPER, F.R.S.

SENIOR SURGEON TO GUY'S HOSPITAL.



LONDON:
JOHN CHURCHILL, PRINCES STREET, SOHO.
MDCCCLIII.

TO

CÆSAR HENRY HAWKINS, ESQ.

President of the Royal College of Surgeons,

THIS ORATION IS DEDICATED,

IN TESTIMONY OF SINCERE REGARD,

BY THE AUTHOR.

2, *New Street, Spring Gardens,*

Feb. 1853,

HUNTERIAN ORATION.

Mr. President,

To dilate upon the legitimate objects of the Hunterian Oration in the presence of such an auditory as on this occasion honour me with their presence, well acquainted as they are with the character and pursuits of Hunter, must, upon the first impression, appear a work of supererogation; nevertheless, it seems to me desirable to inquire into the intention of this annual meeting, and to duly consider the manner in which the delivery of the Hunterian Oration should be accomplished.

I believe, in establishing this memento of Hunter's immortal name, it was never intended that it should become a mere eulogium on that great man—a mere reiteration, year after year, of his personal laudation; but that it should have a much more extended object: namely, the elucidation of the rare qualities of his gigantic mind—a mind which, in the first instance, induced him to undertake, and ultimately enabled him to complete, a collection of preparations, which at

once embraces the exposition of every material essential to the study of Natural History.

The commemoration of the birth of the great founder of our Museum has given rise (as you well know, gentlemen,) on numerous occasions to addresses, the eloquence of which it is no part of my intention to emulate, even were the task an easy one; for, I confess, it appears to me that the design of this Oration would be more legitimately fulfilled by endeavouring to trace the just bearing of the labours of Hunter upon the sciences of Physiology and Surgery, than by merely repeating, with more or less oratorical effect, the unmeasured terms of praise with which these walls have so often resounded.

Not, sir, that I would advocate any penury of praise to Hunter's memory, but I cannot but feel, that the eulogium ought to take such a practical form, as may more clearly explain the circumstances and means by which Hunter rendered himself, as he has been so deservedly designated, the *Prophet of Surgery*. The sterling value and real utility of Hunter's labours are daily becoming more apparent; it would, indeed, seem as if the extension and improvement of surgical science, mainly advanced through his means, had so far enlightened his followers, as to have rendered them competent witnesses to that exalted merit which, during his lifetime, had not been duly appreciated, only because it had not been sufficiently understood.

To enter into any account of the early life of Hunter would be but a loss of time: his pursuits and education are subjects which have, over and over

again, been discussed, and may be considered as being disposed of; at the same time, there is a point connected with his life, to which I should wish briefly to advert: it is said, that beyond the most ordinary branches of learning, Hunter did not receive any education; even if this were so (and I believe it is not to be doubted), with his peculiar cast of mind, perhaps it is not altogether to be considered a matter of very deep regret. A mind well tutored and prepared by the training of the schools, although doubtless invigorated by their discipline, may come with less freshness and delight to a pursuit, entered upon, as the studies of anatomy and physiology were by Hunter, from the pure unbiassed love of the subject. He was naturally gifted with mental powers, which rendered him, to a certain extent, independent of the training required by capacities of a more ordinary character; and although it is possible that these powers might have been improved had they been subjected to a judicious scholastic discipline, it is yet doubtful whether, under the influence of a variety of pursuits, he would have been equally capable of devoting himself so exclusively to the subjects of his choice.

Untutored as he is said to have been, once started, his indomitable perseverance and enthusiastic love of scientific research enabled him to overcome all obstacles, and led him on by the most direct path to his ultimate professional eminence.

Between Hunter and his contemporaries a very striking difference may, I think, be justly shown to have existed: the great object of the former, in all his

working, seems to have been the establishment of broad principles; and in following the course of his labours, according to the order in which he had arranged the preparations of his museum, this at once becomes apparent. His mind was so comprehensive, that he grasped without difficulty the whole range of medical science; and it is equally remarkable and instructive to observe, with what slender means he contrived to push his investigations, and to arrive at such incontestable conclusions. His contemporaries principally occupied themselves in devising improvements in the method of performing surgical operations, in the invention of surgical appliances, and in the details of the art of surgery.

The philosophical character of Hunter's mind is probably nowhere more clearly illustrated than in his method of pursuing his researches; his great powers of observation and comparison, under proper control, were rendered subservient to one great end, which he seemed constantly to have had before him—the investigation of Nature's laws. To advance his views, he rejected no source of information; he evidently early perceived that all nature is created in perfect harmony and simplicity, and that to comprehend the organic system of the universe, it was necessary to begin at the very first link of the chain; he therefore commenced with the lowest types of life, he traced the analogies which may be found between the processes by which their existence is maintained, and the vital actions in organisms of a higher class; he showed that the repair of an injury in a vegetable, the renewal of

a broken shell, and the healing of a wound in man, were each subjected to a similar vital action for their reparation; and from this knowledge, he seems to have become impressed with the conviction, that to understand the conditions under which these actions occurred, he must first watch the phenomena which results from lesion, whether it be the effect of physical injury or disease.

But before we can duly appreciate the great undertaking of Hunter's master mind, we must contemplate the many difficulties which he had to surmount. At an early period of Hunter's career, it was considered by his contemporaries that a knowledge of anatomy alone constituted a sufficient foundation for the study of surgery, and the system of surgical treatment then employed consisted of little beyond the application of topical remedies to wounds, the adjustment of splints to fractures, without due consideration of the constitutional condition of the patient, as to its competency to complete the reparative process. In justice, however, to Mr. Pott, it should be mentioned that at this time he adopted a new style of practice at St. Bartholomew's Hospital in the treatment of his cases; and although it does not appear from his works that he had, like Hunter, devoted much time to the investigation of the laws by which the reparative action is established, still the natural acuteness of that great surgeon enabled him to perceive that the only rational system of surgical treatment is that which is the least likely to interfere with the curative efforts of nature; and he therefore relinquished the use of the

actual cautery and many other violent remedies which were then universally employed, and to which so many fell victims, and substituted in their stead means which were gentle in their influence, desiring as little as possible to interrupt nature's processes; although, as I have said before, he had not, like Hunter, watched the phenomena which were developed during the reparative action.

The first thought that would naturally occupy the mind of one, upon whom the honour of delivering this Oration had been conferred, would be the choice of the subject best suited to the fulfilment of the onerous duty he had undertaken; and I must confess that the contemplation of the method I should adopt, to do justice to the memory of Hunter, involved me in great perplexity. A retrospective glance showed me that the ground had been already ably occupied. I remembered that previous Orations had embraced almost every topic concerning John Hunter, either in a general or special point of view, as well as in connexion with the polemics of our profession. I remembered, too, how ably, for the last few years, the late Professor of Surgery had enriched his lectures on Pathology by the illustration of his views through the medium of the preparations of our Museum; and, indeed, in whatever direction I sought, I found the soil had been already broken, and had already rendered up a fruitful harvest.

To attempt to offer anything new in elucidation of Hunter's character and labours, I feel conscious, would prove but a vain effort, as far as any advan-

tage could be conferred upon those leading members of our profession which I have the gratification of seeing around me; but it must be remembered, that a great majority of my audience are not so well informed upon this subject; and, as I have observed, the chief object of this Oration ought to be, to bring before the minds of every aspirant to surgery, an appreciation of the value of Hunter's *unparalleled* services in improving this branch of science.

Hunter was no theorist; he founded all the opinions which he advanced upon the facts which, in the course of his researches, he elicited, and which, in most instances, he had been the very first to display: he stated truths as he saw them, and directly he had seen them, his unremitting industry, rather than his good fortune or his genius, was the key to his success in life. He possessed a tact in manipulation, and an ingenuity in contrivance, which, in addition to his natural aptitude, may in some measure be attributed to the scantiness of the implementary means at that period at the disposal of an experimenter, and it is possible that had the philosophical instruments now in use been at his command, much of his skill in adapting means to ends would have never been developed.

In an inquiry into the character and labours of Hunter it is difficult to know exactly in what light to regard him; and although we all must admit that he commands our gratitude, and that of succeeding ages, still I feel at a loss to point out where his merit chiefly lay, unless I draw your attention at once to this Museum. It is this rich collection of preparations,

sir, which marks the master mind of Hunter, and had he done no more than thus record the facts which he had observed in natural history, without drawing any deductions from what he had observed, he would have left behind him a mine of inexhaustible wealth. Hunter was not, however, satisfied with being thus a mere recorder of truths; all his investigations were conducted in the most systematic and consecutive manner, tending evidently towards the one great object of rendering Natural History, Comparative Anatomy, and Physiology subservient to the science and practice of Surgery.

It is in the very widest sense of the term that Hunter must be esteemed a naturalist. He did not confine himself to the study of any particular class of organized beings, but extended his observations throughout the whole range of animated nature. Even the characters of inorganic substances did not escape him,—not that he entered into any chemical investigation of their component parts, but he extended his inquiries in reference to their relation to the organic world. A little reflection will show that this study formed a very essential part of Hunter's plan; for it must be obvious to all who examine the contents of this great Museum, that it was his object to make it a complete picture of the created universe, not preserving merely the external appearances of the plants and animals which exist upon the earth's surface, but a picture of the system of Nature, illustrating the means by which she effects the operations necessary to the maintenance of living created beings.

It may be thought that the study of the mineral kingdom can have but little reference to the organization of living beings, and to the nature and character of their functions: such, however, is far from the truth; for it must be borne in mind that the elementary constituents of plants and animals are exactly the same as those of inorganic compounds; that there are, indeed, no elements peculiar to living organisms; but, in the words of Hunter, that "the man, the oak, and the mountain are but different modifications of the same elementary matter."

The constituents of the animal and vegetable world are derived solely from the inorganic part of the creation; that which to-day is a portion of the atmosphere or of the soil, to-morrow may constitute a part of a plant, into the tissues of which it has been absorbed and assimilated, by virtue of the vital action impressed upon the plant at the first moment of its springing into existence.

These considerations regarding the properties of inorganic matter in its relation to vegetable life, are really necessary to the proper comprehension of the manner in which the plant receives its nourishment, and this study necessarily precedes that of the physiology of plants.

We cannot, with any degree of reason, pass on at once from the study of inorganic to that of animal matter. In that case, we should be omitting a great and most essential link in the chain of nature; for the inorganic world ministers to the nutrition of animals exclusively through the medium of vegetables; and,

with regard to obtaining nourishment for the replenishment of their worn-out tissues, animals have no direct connexion with inorganic matter; this establishes a leading distinction between plants and animals, independently of any other, and points out indisputably the natural position of plants between the mineral and animal kingdoms. Hunter, no doubt, well considered this law, and therefore did not conduct us to the investigation of animal life, until he had pointed out the essential characters of inorganic matter and vegetable life.

The investigation of the nature of inorganic compounds will frequently tend to explain phenomena which result from the influence of the vital action on organic bodies; and it has occurred to me that there is no better instance of this fact than the power which plants possess of appropriating carbon from the carbonic acid which they absorb by their leaves and roots.

The decomposition of carbonic acid is a problem which the chemist can only solve by bringing into operation the most potent of his agents; it is one of the most difficult decompositions to effect, and yet it is a process carried on without intermission, during the daytime by the organs of plants, under the influence of that mysterious force, which we call *life*.

To return, however, to our reasoning upon Hunter's motives for commencing with the studies of the properties of common matter, proceeding afterwards to that of vegetable or animal life, it is evident that he had observed how these three steps in the scale of creation rise regularly above each other; the one

below ministering essentially, indeed indispensably, to the requirements of the one above.

Passing from the study of the inorganic matter of which all living bodies are constituted, he continued his researches into the structure of plants, and into the laws which govern nutrition, propagation, and repair of these low organisms: a task of no mean difficulty at the period when they were undertaken. It must be borne in mind when contemplating the difficulties with which he had to contend, that while these investigations were conducted, he was alone in the field, which as yet was but a barren waste. Natural History, in a truly scientific and connected sense, was almost unknown, especially in connexion with the phenomena of Life; and the collateral sciences of Physiology and Chemistry were in comparative darkness. Hunter could not, therefore, turn to the works of other investigators for assistance, but was compelled to rely entirely upon his own perseverance and innate acuteness to keep him in the path he had chosen. At the time when he commenced his inquiries into the sexual functions of plants and their general organization, Linnæus had not even made his classification of the vegetable world, and the microscope had not reached a sufficiently perfect construction to render it of much utility in the examination of very minute objects.

In studying nature, what could be more philosophical than the plan of thus commencing upon organic forms of the most primitive kind, in which the phenomena of Life were, in all probability, comparatively simple, and from which investigations

could be readily carried on to the higher forms of created beings, step by step.

Hunter soon discovered by thus comparing the vital actions of plants and animals, that a wonderful simplicity pervaded each: he watched the process of repair in injured plants, and discovered that their mode of reparation was precisely similar to that by which bone and other tissues were renewed in animals, and that the connexion between every class of organized beings remained, under all circumstances, unbroken.

Hunter tells us that "the most simple mode of investigating an animal body is, first, to consider the matter of which it is composed. In this inquiry, we shall find it more than probable that there is only one species of matter which is peculiar to animals, and I shall therefore call it 'animal matter.' The blood appears to be the most simple modification of this matter." Hunter, in applying himself to the study of Physiology, therefore, naturally commenced both with plants and animals, with their circulating fluids, the *sap*, and the *blood*—the pabula of life (Prep. 23 and 23*a*.);* and in the Hunterian Museum the earliest preparations are those which illustrate the tissues which enter into the composition of organic bodies, and which are all, from the blood upwards, modifications of common matter, and have been elaborated into their present condition by means of the organs of nutrition.

* The numbers affixed to the Preparations are those of the Hunterian Catalogue.

Hunter had, however, fallen into an error when he said, "there is only one species of matter peculiar to animals." Modern physiology and chemistry have shown that the proximate and elementary matter of plants and animals is precisely similar, and that the fibrin and albumen of plants are identical in composition with the fibrin and albumen of the blood; so that, in point of fact, the economy of vegetables and animals is very similar, and the distinction drawn by Hunter between the proximate elements of the two does not in reality exist.

It is well-known that Hunter held peculiar views with regard to the relation of the blood to the animal. He evidently more clearly recognised the great importance of this fluid than any physiologist who had preceded him, I mean in a truly scientific point of view. It is true the importance of the blood to the existence of the animal must have been thoroughly acknowledged from the very earliest time, but there is a wide difference between the mere knowledge of the fact that blood is essential to life, and the knowledge of the relationship of the blood to the different tissues, and of its renovating powers in health and disease.

His views with respect to the importance of the blood to the animal economy led him to the belief that the blood was endowed with a life of its own, more or less independent of the vitality of the animal in which it circulated.

How easy it is to imagine that Hunter, as an early experimental physiologist, should form such an opinion. The essential character of the blood while

circulating in the body, its power of self-coagulation when withdrawn from it, the influence induced over disease by its abstraction, all tend to encourage, or more properly to induce, such an opinion.

Hunter, moreover, believed that extravasated blood manifested a susceptibility to become converted at once into living organized tissue, a theory upon which he founded the dogma of Union by the first intention, believing that the blood resulting from the lesion of its vessels became organised, and healed up the wound without any subsequent effusion. That this is more or less erroneous, is now, I believe, generally admitted; it does sometimes happen that vessels conveying red blood pass into a mass of fibrin left from extravasated blood, but it is very doubtful if the mass itself really becomes organized. (Prep. 12).

There can be no doubt that Hunter was well acquainted with the constituents of the blood; he knew the tendency of the red particles to aggregate during coagulation, and he was acquainted with their microscopic character, but at the same time he seems to have been unacquainted with the change which the blood undergoes in the lungs, or the relation which that change bears to the rest of the body; at all events, his ideas upon this subject were not very definite, for he says, "before blood is capable of gaining life to support parts, it must have circulated through the lungs, where it undergoes an essential change, perhaps it there is first completed in its second state, or vivification," "and is then fitted to give life to every part of the body," for he says again,

"the blood is not only alive itself, but during its circulation it imparts life to every part of the body, thus being the living support to the whole fabric," "even the nerves themselves are supported by it, for they do not convey life to parts, but only direct their motion, and without the blood they would themselves become dead." "While alive the blood is always fluid, and if its life be not suddenly or violently taken away, it coagulates as it dies, and its component parts recede from one another."

All this seems to show that Hunter entertained some strong opinion as to the existence of a peculiar principle of life in the blood, and it shows at the same time what I mentioned before, that he was well aware of the great importance of this fluid; imbued with this conviction, he commenced his labours in forming the Hunterian Museum with what he considered most essential to organization—the sap and the blood. The blood, he says, "conveys to parts the means of nutrition and growth, so from blood new solids are formed, when, in consequence of disease or violence, there has been a loss of the part, or when there is a necessity for its production." The following experiments seem to have been instituted with the view of establishing the fact, that the blood of a living animal could, even under the stimulus induced by the introduction of the part of another animal into itself (by engrafting) nourish and support it, so as to convert it into a part of itself. Hunter transplanted a human tooth into the comb of a cock, where it not only became fixed, but actually became part of the organic

structure of the cock's comb; he proved this by injecting the cock's head, and, on dissection, blood vessels filled with the colouring matter of the injection were traced into the capillaries of the pulp of the tooth. (Prep. 48). The most striking instance of this incorporation of a foreign organic body with a living tissue is seen in this preparation, (Prep. 52), the spur of a cock has been removed from its leg and transferred to its comb, there it has adhered by a complete vascular connexion, and, as may be seen, the spur has not only continued to grow, but has acquired a far greater size than it ever acquires in its natural situation. The result of this experiment involves a very interesting physiological inquiry, as to how the capillaries which were destined by nature merely to furnish blood fitted for the elaboration of the tissues of the comb, should (under the *stimulus of necessity*) to use Hunter's own expression, be rendered competent to eliminate the horny matter of the spur, even to the extent of an hypertrophied condition.

Having treated of the sap and blood as the great source of the production, maintenance, and renovation of the various component parts, or proximate elements of vegetables and animals, Hunter next proceeds to illustrate, by preparations in his museum, those structures which relate to the motions of the individual members of these two kingdoms, and now we arrive at a point at which a most essential distinctive mark separates the two. There is, perhaps, some difficulty at first sight in perceiving that the motions of many

plants are not identical with those of some of the lower types of animals; motion in an organic body may either depend merely upon the physical properties of some of its structures, or upon vital contractile power inherent in some appropriate apparatus. Hunter has said, in speaking of motion, "The simplest organization is a certain arrangement of matter, so as to produce some action; this may be of two kinds—first, by such as may occur in any matter of which elasticity is one; and secondly, as is capable of producing a motion in itself." Now, the peculiar motions of plants seem to belong to that action which common matter may manifest from mere elasticity, but still so delicate is the construction of the apparatus, and so slight the causes necessary to induce its action, that it is almost impossible to distinguish it in certain plants from the motion induced by irritability; as yet, however, the microscope has not detected any structure resembling the muscular fibres of either the involuntary or voluntary muscles of animals.

The motions of animals are principally due to a peculiar property with which muscular fibre is endowed, whereby it is capable of contracting under the influence of certain forces resulting from some mysterious connexion with the volition of the being, so as to approximate parts distant from one another; thus, the motions of limbs, and indeed of the whole body in the act of locomotion, are performed by, and are wholly under the control of, the will of the individual.

But not so in reference to the motion of the hollow visceral organs, which perform functions most essen-

tial to life, wholly independently of the will, but still through the influence of contractile muscular fibres, which are termed involuntary muscles, and which are excited to action by the stimulus of the contents of the organs of which these involuntary fibres form a part. Hunter did not seem to be aware of the microscopic difference between the fibres of voluntary and those of involuntary muscles; but since his time, it has been discovered that the former are crossed by little transverse striæ, while those of the involuntary kind are peculiar, in having a frequent interlacement of their fibres, constituting a kind of membraneous arrangement. But animals are moreover furnished with elastic tissue, as well as with contractile muscular fibre; this is also the case in the vegetable kingdom, a fact of which Hunter was fully aware, and which he philosophically appreciated. He described the elastic tissue as being often substituted for muscle, as an admirable provision to economize the vital energy of the animal. "The action of the muscles," said he, "can only be continued through the exertion of the will of the animal, and not without more or less exhaustion, depending on the degree and duration of the action;" elastic tissue is therefore frequently substituted for muscular fibre, to sustain a part of the body of an animal in a long-continued position, or to assist in its recovery to a natural or habitual attitude. The operation of this power is very effectually employed, and is found to be fully developed in the neck of the giraffe, and indeed in all animals with long necks, and that carry their heads in an horizontal position from their body

It has been discovered by Professor Quekett that the fibres of this elastic tissue are crossed by transverse striæ in a similar manner as the fibres of the voluntary muscles, perhaps showing that this arrangement is inseparable from such tissues as are destined to become longitudinally shortened during the exercise of their functions, as no such provision is found in the involuntary muscles, which merely contract upon the parietes of hollow viscera. But as I have already said, we are as yet quite unacquainted with the nature of the motion of many plants which seem to be caused by the stimulus of the light and heat of the sun, or the contact of some foreign body with a structure susceptible to the impression, and resembling the kind of action which takes place in those parts of an animal which are furnished with involuntary muscles. A simple example of this motion is seen in the heliotropic plants, and in those which expand their flowers in the daytime and close them again at the approach of night, and yet no contractile structure in anywise resembling muscular fibre can be detected; there is, consequently, every reason to believe that this motion is strictly mechanical, and dependent upon an antagonistic arrangement of elastic springs.

The performance of the various vital functions essential to the existence of an animal is attended with a waste of its substance, and a replenishment is therefore necessary, or the animal would perish from inanition. The process by which this renewal of worn out parts is effected is *nutrition*, and is principally performed by means of a "bag," which, although

small in comparison to the bulk of the other parts, is perhaps the most important part of all. The stomach constitutes the principal distinction, according to Hunter, between animals and vegetables ; and he has even designated it the " primary animal," considering all other parts as superadded, according to the position the animal is destined to occupy in the scale of creation. The stomach, by means of its hidden powers, converts various substances into one common kind of matter, which is taken into the substance of the animal. Connected, more or less directly with the stomach, are various other organs appertaining to the process of nutrition, the preparations illustratrative of which form the next series of Hunter's Museum, and a great interest must necessarily be excited in the examination of these preparations, and in observing the difference in the form and structure of these organs, to adapt them to the variety of conditions under which various classes of animals obtain their food and convert it into their own proper substance.

It has been already shown that the presence of muscular fibre as one of the component parts of an animal, and its absence in the vegetable kingdom, form a great distinguishing mark between these two classes. But John Hunter has pointed out a still greater distinction—I allude to the means whereby living organic bodies obtain the nourishment from which their tissues are replenished. The principles of nutrition in animals and vegetables are strikingly similar, but the manner in which the materials for that nutrition are obtained is as strikingly dissimilar.

During the whole period of their existence, plants are fixed to one spot, and are entirely dependent for their support upon substances which are accidentally brought within the influence of their appropriating organs; but in adverting to locomotion, we perceive that the great purpose of this faculty in animals is to enable them to approach those substances which may serve as aliment. Through the medium of their senses most animals are competent either to make choice of that which is fitted for their nourishment, or to shun that which is pernicious; they thus possess a faculty which places them far above the position of the vegetable kingdom; but each alike must perish if from any cause they be shut out from a sufficient supply of nourishment. All this Hunter has taught us, and although perhaps the observations of others had extended to some distance along the same path, it was left to him to collect and establish an assemblage of consecutive facts which have served to shed light upon the progress of every subsequent inquirer.

From this stage of his investigations Hunter proceeded to the consideration of the variety of contrivances with which animals are furnished for the purpose of obtaining and seizing their food; and I believe I may safely aver, that not even the most cursory observer can examine the preparations referring to this subject without being struck with wonder at the infinite variety and complication of apparatus by which nature has rendered animals competent to obtain their food under the peculiar circumstances in which they are destined to exist.

It has always struck me, in reflecting upon this subject, that the design of nature in the organization of animals is in no instance more beautifully exemplified than in the adaptation of their organs for obtaining food; in many of the insect tribe, such as those for instance, which derive their nourishment from the juices of plants, a material always obtained in the liquid form, the apparatus employed is one entirely suitable to the office of sucking or imbibing these juices, powerful jaws and masticating instruments being in such a case quite unnecessary and inefficient to the object required; but in insects of a different class, those for example that feed upon solid matter, Hunter has shown the existence of jaws capable of triturating the hardest substances.

The means for obtaining food is, in some animals, accomplished by the most curious and cunning apparatus, of which an excellent example is furnished by the fishing-frog (*Lophius piscatorius*): this creature is furnished with a long flexible process, which arises from the upper and back part of its head, and curving forward, is drawn down sufficiently for its extremity to fall in front of its mouth; to this extremity an appendage is attached, which is suspended with a tremulous motion in the water, and a fish meeting it in its course, darts at it as a supposed prey, and is seized at once by the capacious and powerful jaws of its enemy. (Prep. 2055*b*). It would be fruitless for me to attempt to allude even to the many remarkable instances of wonderful prehensile apparatus, preserved in this museum, to illustrate the adaptation of

ways and means to suit animals to their various instinctive habits.

The structure of the teeth in different classes of animals appears next to have occupied Hunter's attention; and he seems, in fact, to have taken them in this order as a link between the prehensile organs and as the commencement of the digestive apparatus; for, although in some cases, serving only as instruments for seizing and destroying the prey, or for the defence of the animal, the teeth must, when viewed in a more general sense, be regarded as the commencement of the digestive system.

The first step in the process of digestion in most animals is performed by the teeth, and this process is of so much importance in the animal economy, that in cases in which the food is swallowed without mastication, a provision is made whereby another portion of the digestive apparatus performs the office of trituration and comminution.

The structure and arrangement of the teeth, as well as of the remainder of the organs of nutrition, is invariably found in complete accordance with the kind of food by which the animal is to be nourished, and with the circumstances under which the food is to be obtained; how unsuitable, for example, would the edged and cutting molars and long pointed cuspidate teeth of the tiger prove to an animal destined to feed upon vegetable matter; and no less inappropriate would be the flat-crowned grinders of the ox or sheep for holding a living prey, or for the tearing of flesh. The natural arrangement of the

teeth which fits each class of animal to its destined mode of feeding, seems to be unchangeable; but Hunter, in prosecuting his experiments on this subject, found that certain parts of the digestive organs are capable of becoming modified to meet, as it were, the contingencies to which an animal may be exposed, by which change the animal is rendered capable of existing, and even thriving, on a kind of food entirely of an opposite character to that originally intended by nature for its support and nourishment. Mr. Hunter fed a sea-gull (naturally a bird of prey) with grain, and after twelve months killed the bird: upon examination he found that its normally membraneous stomach had become much thickened, and so changed in character as to resemble the appearance of the gizzard of a graminivorous fowl rather than the stomach of a carnivorous bird. (Prep. 523).

Hardness, the natural physical property of the teeth, is not the only reason which renders them incapable of undergoing a change by the substitution of one kind of food for another; "for it is to be remembered," says Hunter, "that in many creatures the teeth perform no other office, as connected with the function of nutrition, than that of instruments to hold the food, having nothing to do in assisting the process of digestion."

Such is the case in those animals that swallow their food whole. Of such a character are the teeth of many fishes, and the bills of various kinds of birds, therefore the necessity for any change of such an apparatus is not implied, because the digestive organs

are impressed with the necessity for change of structure by the introduction of a new kind of food.

There is an apparatus identical in its use with teeth of this kind, the horny plates or "whalebone" which occupy the mouth of many kinds of whales. Of this substance, Hunter takes special notice in these words: "Some genera of this tribe have another mode of catching their food and retaining until swallowed, which is by means of the substance called whalebone —of this there are two kinds known. This whalebone, which is placed on the inside of the mouth, and attached to the upper jaw, is one of the most singular circumstances belonging to the species, as they have most other parts in common with quadrupeds. It is a substance, I believe, peculiar to the whale, and of the same nature as horn, nails, claws, and feathers, being wholly composed of animal substance, and is extremely elastic." In this preparation we see how this substance is arranged in the whale's mouth. (Prep. 323.) To this preparation I must also draw your attention, although not one of Mr. Hunter's; it consists of the Clio borealis, or whale's food, the small species of mollusca upon which the great whale feeds, and the apparatus described is for the purpose of collecting it. (Prep. 323*a*.)

In many kinds of fishes we have very curious examples of the existence of teeth as masticators—for example, the palate of the wolf-fish is covered with teeth, which are intended for the crushing of the shells of the mollusca upon which it feeds (Prep. 298); but in other fishes, where the teeth are employed

merely for the purpose of seizing the prey, the operation of trituration is performed wholly by the stomach, which resembles in its structure the gizzard of a bird. The gillaro of trout (the structure and physiology of which Hunter has most ably described) possesses such a gizzard-like stomach; this fish is also said to swallow pebbles, to aid the process of trituration. The common mullet manifests the same habits, and is possessed of a similar structure of stomach. (Prep. 502.)

Hunter, after having preserved the digestive apparatus of various classes of animals, to show how beautifully they are constructed to suit them for the preparation and digestion of the kind of aliment upon which they are destined to feed, and having searched even further, to prove that under circumstances of deprivation from their natural food they were rendered capable of assimilating into their own substance matters apparently quite unfitted for their habits, went still further, to show that nature possessed the power of modifying the digestive apparatus periodically during the progress of natural processes, and in this investigation he discovered that the crop of the pigeon during the period of hatching—although at all other times similar to that of other birds that live upon grain—then assumes a glandular character, which enables it, in addition to its ordinary function, to secrete a milky fluid, which is ejected, and affords nourishment for its young progeny, rendering the crop, in fact, a kind of mammary gland (Prep. 3740).

In birds and animals, as well as insects, a power of regurgitation of the food is not an uncommon provi-

sion, and a curious structure of stomach is provided for this purpose; it is found divided into two separate compartments, the distal part alone being, in point of fact, the true digestive stomach, the food passing into the first merely as into a kind of reservoir; small portions only pass into the second for the nourishment of the animal itself, while the chief mass is regurgitated, either to be stored as a future supply, or for the immediate maintenance of the young. The common bee affords a good example of this structure of stomach, "but it will be found," says Hunter, "that this still differs very much in its character from the stomachs of the ruminantia, in which ingesta are only returned into the mouth to be remasticated, to serve, however, wholly for the support of the animal itself."

With but very few exceptions, I have only hitherto referred to those preparations in the Museum which are intended to illustrate the mechanical apparatus concerned in the process of nutrition; for such, indeed, are the teeth and their substitutes, whether for the purpose of catching, or for tearing, grinding, and preparing food, and such also are, to a certain extent, the triturating stomachs of most birds, and, as I have mentioned, of certain kinds of fish. At this point, however, we must remember that these mechanical actions form but a very small part of the process of nutrition, although a very essential one as preparatory to digestion properly so called; for even in the course of grinding, the food experiences something more than mere comminution, inasmuch as it receives from the saliva an element which is probably necessary in

enabling the teeth to perform their function, and still more important in producing some chemical change in the food, preparing it for the future action of the solvents of the stomach. The saliva and the other fluids employed in digestion require a peculiar system of apparatus for the purpose of their secretion, together constituting a series of bodies termed glands, which pour out their fluids into the alimentary canal, so that they may come in contact with the comminuted food, producing a peculiar action, according to the particular requirements during the progress of digestion; each of these glands being furnished with ducts which convey their secretion to its proper recipient. The function performed by this secreting glandular system is of the greatest importance in effecting those changes on the ingesta which render them capable of being assimilated. Mr. Hunter was the first anatomist who ever demonstrated the ducts of these glands by injecting them with coloured wax. The function of digestion being completed by the conversion of the food into chyme and chyle, the imbibition of this truly nutrient matter is as essential for the replenishment of the blood as the process of digestion itself, and is performed by a system of vessels termed the absorbents. The real action of these vessels, and the limitation of their duty, does not seem to have been well understood before the investigations on this subject by Hunter; prior to that period, it was considered to be the office of the arteries to convey the whole mass of blood throughout the system for the replenishment of its worn-out tissues; while the por-

tion of the blood not so consumed was returned to the heart by the joint action of the veins and absorbents, into which vessels the arteries were supposed to terminate by open mouths, the former returning the colouring matter of the blood, and the latter merely the lymph, hence they were called the lymphatics; and it was believed that the veins and the lymphatics mutually performed the function of absorption. Mr. Hunter, however, from a series of admirably conducted experiments, deduced that the taking up of the nutriment eliminated from the food, and the absorption of the worn-out tissues which had been, by a vital action, resolved into their proximate elements, was wholly performed by absorbents; and that neither the arteries nor veins assisted directly in this function; and that it was only through their intervention that the nutriment entered the blood. He also discovered, by the same experiments, that the absorbents and the blood-vessels did not communicate by actual continuity, but that the fluids passed from one set of vessels to the other by transudation through their coats by an action which has, since Hunter's time, been termed Endosmosis and Exosmosis. Thus Hunter shadowed forth the discovery of the capillary system.

Mr. Hunter was also the first to demonstrate that the absorbent glands were made up of coils of absorbent vessels firmly connected by an areolar tissue, and that by injecting one of the vessels entering a gland, the whole of its tubular structure became filled with the injection. It seems clear from the nature of his

investigations that he perfectly comprehended the difference of the office performed by the lacteals and lymphatics.

In the brief sketch I have thus far been enabled to give of the labours of Hunter, as exemplified by the preparations of this Museum, I have confined my remarks to those actions in the animal economy which relate only to the preservation of the individuals of the different classes; having referred to those functions alone, which, excepting the case of some ephemeral insects, must be carried on in every perfect animal or plant to maintain its independent existence. I have yet to speak of that action through the agency of which it is provided that one series or generation of organic beings is invariably followed by another exactly resembling it, so that the species is perpetuated, every succeeding generation being in the likeness of its progenitors.

Mr. Hunter, as I have already shown, pointed out the distinctions which exist between the inorganic and organic world; but I think we may now observe, that there is NO distinction so striking as that which relates to the power of generation, which is entirely confined to organic life.

A mineral compound may consist of precisely the same ultimate elements as a vegetable or an animal, but not, like them, being endowed with vitality, it cannot produce or generate by any innate or spontaneous action other minerals like itself, but if decomposed by any chemical influence, the kind of compounds which are ultimately produced by the union

of its element, with other surrounding elements, depends entirely upon the circumstances under which the decomposition takes place. Such, however, is not the case with organized bodies, they possess, within themselves, a power impressed upon them at the very first moment of their existence, of producing other beings similar to themselves, and endowed with every organ necessary to the maintenance of their life, and to the production of their species without end.

This is the process of generation, and the organs employed in it are of the greatest importance in every kind of animal or plant—"propagation being, according to Hunter, one of the completest operations of either an animal or vegetable."

The preparations which Hunter has left us in connexion with this part of physiology, are as numerous and interesting as every other portion of his Museum; and, indeed, there are none which better prove his indefatigable industry and vast extent of knowledge in natural history, for every variety of plants, and the various types of animals are alike the subjects of his observation; and it may be justly said with regard to this part of the collection, that the student will require but little further information on the subject of propagation.

The function of procreation is distinct from those by which an animal is enabled to carry on the mere organic existence, the organs of digestion being wholly for the purpose of preserving the individual vitality; the stomach constitutes, in the words of Hunter, "the primary animal;" the more simple the

structure of an animal, the larger proportion does the stomach bear to the rest of its body.

Indeed, all the other organs which enter into the formation of the more complex animals are not to be considered as truly essential to their vitality, but are superadded for the purpose of adapting them to the various conditions under which they may be placed in the scale of creation; the organs of generation, and the organs of the senses equally come into this category. I have already shown, by referring to Hunter's preparations, that the digestive apparatus is always competent to convert foreign matter into the substance of the animal, and it is therefore subjected to great varieties in form and structure to enable it to assimilate every kind of food which the habits of the animal may lead it to require.

Upon examining the preparations of the generative organs preserved by Hunter, I think we shall at once perceive that the same law holds good with respect to them, and that the adaptation of means to ends is as conspicuous in the function of procreation as in that of digestion.

The generative apparatus is always exactly suited to the manner in which, and the circumstances under which, procreation is to be accomplished; for this function is performed under various conditions; with some animals it is quite independent of particular periods of copulative stimulus, and the organs are in a constant excitable aptitude; while, in others, the function can only be exercised periodically, and the

condition of the organs is in a corresponding state either of quiescence or activity.

In the preparations I now show you, Hunter has preserved one of the most striking examples of the change which the generative organs undergo to prepare them for their season of activity, and at the same time they are illustrative of the vital action induced as essential to a new functional office. These are preparations of the testicles of the common house-sparrow fully developed, as during their procreative season, and in their ordinary state and size during that period of the year in which there is an arrest of generative function. (Prep. 2457, 2461.)

In the higher classes of animals the nature of the generative function is as well understood, as that of any other function in the animal economy; and the preparations in the Museum afford ample evidence of Mr. Hunter's being thoroughly acquainted with all the phenomena attending the propagation of every species of the Animal Kingdom.

I have thus in a cursory, and, I fear, in but an imperfect manner, brought before your notice, sir, a sketch of that part of the great John Hunter's labours which relates to the process of digestion and to the function of generation, as explanatory of the means whereby animals are maintained in life and health individually, and are capable of constantly renewing and perpetuating their kind.

It has not been my object to make a critical commentary upon John Hunter's works; my only aim

has been, to show what vast resources the cultivators of surgery possess within these walls; and having done this, I have brought one portion of my task to a termination; but still I am conscious of having but inadequately fulfilled the important duty, as it requires something more than an ordinary mind to do justice to Hunter's memory. Nevertheless, I have endeavoured to perform my task sincerely and conscientiously, and it will afford me ample reward if I should hereafter ascertain that I had been the means of exalting, however slightly, in the minds of my hearers, that admiration and reverence for the name of John Hunter which ought to animate the breast of every lover of medical science.

The next portion of the duty that I have undertaken is one carrying with its fulfilment a very different feeling from that through which I have already passed, but which, nevertheless, custom has rendered indispensable on the part of him who stands in the position which I at present occupy. I need scarcely say, sir, that I speak of the melancholy obligation of referring to the busy work of death among our professional brethren. During the past twelve months the grave has, indeed, ingulfed many of our contemporaries, leaving a painfully long list of those that have departed from us, some of whom were cut off in the prime of life, and no small proportion while on the high road to the attainment of the greatest professional excellence.

I must be forgiven if I curtail this melancholy duty. I would not willingly or intentionally withhold the

tribute of respectful public mention from any name included among those that we have lost; but a want of personal knowledge of by far the greater part of them, entirely precludes me from doing justice to their particular intellectual and moral qualities, excepting in those general terms of regret and eulogy in which they have already been deservedly spoken of in the current periodical publications; indeed, the time allotted for the delivery of this Oration is quite incompatible with the lengthened mention even of the names of those that have been removed from this busy scene, and to select a limited number of them, to the exclusion of the rest, may appear in the light of an invidious distinction; at the same time, there are two or three individuals whose names I shall venture to separate from the long list to which I have alluded—these are the names of Vincent, Dalrymple, Pereira, Sir Charles Forbes, Sir John Webb, Mr. Lawrence, and Dr. Mantell—names, most of which have for many years occupied a prominent position in connexion with our profession. There is, I think, good reason why I should speak particularly of Mr. Vincent, for, during an unusually long period, he was one of the officers of this college. For more than half a century he continued in practice in this city, and, during a considerable portion of that time, was connected with the medical staff of St. Bartholomew's Hospital; no less than thirty years ago he was elected a member of the council of the College of Surgeons, and it is more than twenty years since he became one of our Board of Examiners. In the year 1829, he was the Hunterian

Orator, and he twice filled our presidential chair. The circumstance of his having been invested with these honours, marks the estimation in which he was held by his more immediate contemporaries, and I believe I may safely state, that his delicacy of feeling, gentleness of disposition, and integrity of conduct, endeared him equally to his professional brethren, and to his patients and friends. The peculiar character of his mind always prevented him from pushing himself obtrusively forward in life, and led him to shun every kind of publicity, and perhaps caused his eminently high professional knowledge to be less generally known than it deserved. He never seemed to desire popularity in any form, but was satisfied with that greatest of all rewards—the internal satisfaction and peace arising from a consciousness of the fulfilment of his duties, both in public and private life. He has left a name untainted by calumny, and revered, I believe, by all who knew him. Of the late Mr. Dalrymple, I shall speak as of a dear and highly-valued friend: his death has left a blank in the list of eminent surgeons that will be with difficulty filled up; and, to those who knew him in private life, his loss is almost irreparable. The position which he had attained for himself in his profession was entirely due to his own talents, industry, and integrity, and was, indeed, acquired under peculiar difficulties, arising from the delicacy of his constitution. Working as he was against that most discouraging and distressing of all obstacles to success, ill health, his moral courage and perseverance were undaunted, and, although the toil

was great and the progress slow, he failed not to reach, some years before his death, the goal of his ambition —the high opinion of his fellow-surgeons, and the confidence of the public. As a scientific man, both in his own profession and in the collateral sciences, he occupied a prominent position—and, indeed, it may be fairly considered, that he largely contributed towards placing the branch of surgery which he made his particular study upon a proper comparative footing with the other divisions of that science. Whether we consider him in a professional or social light, I think I am fully justified in saying, that among those who have been taken out of our ranks during the last few years, there has not been one whose loss created more universal sorrow and regret. The name of Mr. Dalrymple will long continue to live in the hearts of his friends, and the reputation which he has left with his professional brethren, is one to which any surgeon may be proud to aspire.

When I mention the name of Dr. Pereira among those whom death has lately snatched from amongst us, I feel convinced that it will be heard by all of those of our profession present with deep regret, and by his friends with unfeigned sorrow. The results of his arduous and long continued labours are too generally appreciated to render it necessary that I should comment upon them; but I think I may say medical science has experienced in his death the loss of one of the most talented and successful of its cultivators, and I know not where, in reference to the branch of medicine to which he particularly devoted himself, we

shall look for another to fill his place. Dr. Pereira may be justly said to have been one of the first (if not the very first) Pharmaceutists of the age, and his published works will doubtless long remain a noble monument of his zeal and industry.

In conclusion, it remains for me to say a few words in connexion with a subject of considerable interest to the members of the College of Surgeons. This is the first occasion upon which we have met together within the walls of this new theatre; and it strikes me as being peculiarly fit and proper that its inauguration should take place at the time when we are assembled to commemorate with all honour the name of him who was the originator and creator of the Museum, of which, as an Institution, the Royal College of Surgeons is so justly proud. It is almost unnecessary for me to say that the extensive additions and improvements which have taken place in this building will have the effect of increasing, to a very great extent, the general availability of the collection.

There is still one other point, which, although I have left to the last, I esteem of the very highest importance, and one upon which I cannot too highly felicitate the Members of our College; it is that the Government of the country, recognising with a liberal and discriminating spirit, the essential usefulness of the corporate medical and surgical bodies, has munificently granted a large sum of money towards the completion of our building; and, as I before remarked, it is a subject of great congratulation, and one which calls

for the sincere gratitude of every one of our members, that we have been thus enabled to increase the capabilities of this Institution, so that its resources may be progressively developed to a degree, the influence of which will, I trust, be beneficially felt by every branch of the medical profession.

THE END.