Physiological observations upon glandular structures, and their different secerning offices / by Sir Anthony Carlisle.

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PHYSIOLOGICAL OBSERVATIONS

UPON

GLANDULAR STRUCTURES,

AND

THEIR DIFFERENT SECERNING OFFICES.

BY

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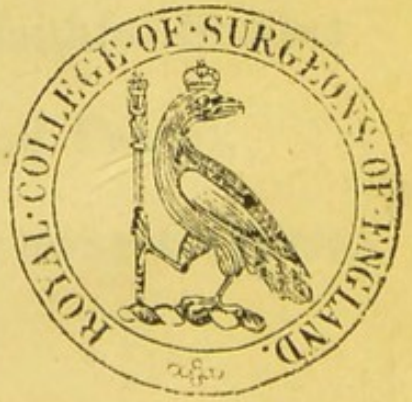
IN LONDON.



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TO

NICHOLAS CARLISLE, Esq.

K. H., K. I. C., D. C. L., F. R. S.,

&c. &c. &c.

SECRETARY OF THE SOCIETY OF ANTIQUARIES OF LONDON.

Very dear Brother,

I am happy to offer this tribute of affection to you, and to add my testimony to the universal feeling respecting your meritorious life.

Your faithful Brother

and Friend,

Anthony Carlisle.

Langham Place,
1st March, 1838.

PREFACE.

The following generalizations of facts which have occurred under the special observation of the Author during a long life, and the inductions which he has ventured to draw from them, may probably lead to improvements in Medical Philosophy,—for, although they may, in some instances, be defective in illustrative details, yet such brief notices have often proved to be fertile sources of more exact and more conclusive evidence.

The liberal and the scientific reader is, therefore, requested to receive this contribution, as an unfinished Memoir, which is intended to impart those thoughts on an important subject that are grounded upon experience, and which might possibly escape a less fortunate observer.

OBSERVATIONS, &c.

In the year 1829 I printed a Memoir under the title of "Alleged discovery of the use of the Spleen, and of the Thyroid Gland," assigning to each of them the manifest office of supplying heat for obvious purposes.

The period seems to have arrived for uniting anatomical evidences with the modern advances made in organic chemistry, since the knowledge of the remarkable changes occurring during life to the elementary materials of animals and vegetables demand a combination of those distinct researches.

Although some of the constituent materials of animals and vegetables are alike in their physical properties, and also in many instances in their chemical composition, yet the grosser fabrication of large animals and of large vegetables is dissimilar.

All bulky animals are designed for a life of long duration, and an especial mechanism, *the Heart*, is appointed for the propulsion of the fluid, called *Blood*, through tubular vessels which pervade their living structures.

The peculiar animal mechanism of a heart and blood-vessels is not, however, assigned to any of the most bulky and long lived species of vegetables, and yet their growths are as definite, and their configuration as diversified, as those of animals possessing a more complicated organization.

Animals also differ in another remarkable attribute from vegetables, the latter having no brain or nerves, nor any organs of sensation to represent the impressions of light, sounds, odours, taste or touch, indeed such sensations would be useless to non-locomotive creatures, while the welfare of a roving animal continually depends on the knowledge supplied by some of these sensations.

In the gradations of simply constructed animals and vegetables, smallness of bulk and a short duration of life are generally united; indeed, the continued restoration of the working apparatus of bulky creatures demands a more elaborate construction than that of small ephemeral creatures.

Hence many of the smaller and short lived creatures consist of simple uniform solids and of simple nutrient fluids, as in some of the *mollusca*, and their propagation is often effected by subdivision, or it may be gemmiparous.

A diminutive bulk is not however essential

or universal, for the *tremella nostoc* is apparently homogenous, and some of the larger *fungi* are of such uniform structure that it is difficult to assign distinct offices to any particular portion of their bodies,—while, on the contrary, several minute animals, such as microscopic animalcules, are of complicated structure.

Throughout both the animal and vegetable creations, nature has been frugal in bestowing superfluous parts; although, in some instances, subordinate insensible structures occur, as in the succession of deciduous leaves and the feathers of birds,—while in serpents, the whole epidermis is shed entire and at one time,—indeed it would have been irksome, if locomotive creatures had been permanently loaded with unnecessary parts.

In the whole range of nature there is a remarkable adaptation of parts to different uses, some of them for constant action, as the vital organs for breathing, and the heart for distributing the blood,—while other parts are passive, as the earth of bones, of teeth, and of crustaceous shells; or viscid fluids may be appointed for similar minor conveniences, such as for supplying the covering mucus of molluscous animals, and for the lubricating fluids of joints and of other parts subject to attrition.

The natural history of the animal œconomy, however, belongs more properly to zoology than to the series of facts and inductions of medical physiology.

If the following observations and suggestions should appear to demand more ample illustrations, it is respectfully submitted, that such variety and extent of detail would far exceed the limits of this Memoir.

Well considered hypothetical dissertations have from the commencement of the exact sciences, been prolific sources of ultimate conclusive theories, and the author having already submitted proofs of his careful researches in anatomy and in organic chemistry, is willing further to rest his pretensions to public approbation upon those claims.

The constituents of water, of atmospheric air, and the variable organic compounds in which *carbon* forms a part, may be severally regarded as the convertible elements of animal and vegetable substances,—and these elements are subjected to appropriate combinations: these mixtures are adapted to the transient existence of individual creatures, according to the destinies of each species: anatomical researches have explored many of the relations and continuities in organic nature, and modern chemistry has presented several illustrations of their composition, but neither the

tracings of continuity amongst organic solids, or the knowledge of the conversion of their fluids appear to have been carried as far into inductions as the evidences warrant.

The truly philosophic theory of DALTON cannot however be at this time applied to those gross unsettled mixtures of transmutable materials assigned for the continued changes of living organic bodies, but the better known elements of oxygen, hydrogen, nitrogen, and carbon, are nevertheless obedient to those laws, although obstacles to chemical union must arise from the continued motion of the gross temporary mixtures of living bodies, and the vicissitudes to which those transient mixtures are liable. The unquestionable instances of injecting from three to four quarts of water, containing a greater proportion of muriate of soda than sea water, into the veins of a living man without apparent injury, shows the extensive passive obedience of our animal nature; and also the better known custom of suddenly adding several quarts of fermented liquors to the circulating blood, which is often done with apparent impunity.

It is among these and similar examples of the intimate connexion between the peculiar transient compounds of living bodies, and the better known chemical combinations in purely

mineral bodies, that we may hope to discover the different workings of vital influences, mingled with those governed by physical laws; but the functions of animal and vegetable creatures are necessarily blended with the chemical laws of mineral substances, and *water*, the universal constituent of organic fluids, presents a striking example, while the limits of vascularity in animal structures, together with the contingent limitation of vitality and the general deficiency of tubular vessels in vegetables, form objections to any universal system of organic physiology.

It must ever continue difficult to define glandular organic structures and functions, because every living part of an animal or vegetable possesses the powers of reproduction by growth and of renovation, derived from one kind of gross liquid aliment, and hence a transmutation of blood, or some portion of it, or sap or some portion of it, necessarily implies a change in the properties of the restorative element; and all such changes, termed assimilation, are necessarily allied to glandular secretions.

Every animal and vegetable, whether of simple structure and composition or otherwise, must necessarily be endowed with the power to model it's special parts, and to assi-

milate or compound it's own peculiar materials, or the species of each kind would not be perpetuated.

These views of the order and disposal in the inheritance of a transitory succession of creatures, and every well assured advance of natural knowledge, whether by the tracings of anatomy or by chemical research, must approach us nearer to a better acquaintance with the demonstrable causes of living phenomena.

One of the most remarkable secretions is *bile;* it's especial organ, *the liver*, being the largest, and it's structure the most complicated of all the animal glands,—and yet, many vegetables secrete a liquid resembling animal bile without any such elaborate especial organization.

The bitter, green coloured, and purgative juices of aloes and of buckthorn possess nearly all the physical properties of bile,—in fact, the properties of bitterness and greenness are acquired locally in many vegetables from mere exposure to the sun's light : as in the exposed foliage of endive and lettuce, or in the parts of the tuber of a growing potatoe, when uncovered by earth.

The scent of the musk plant is so exactly similar to animal musk, that the best possible test, that of smell, afforded by an appointed

organ, does not distinguish the one from the other ; and the smell of some of the *stapelia* resembles putrid flesh so much, that the blue-bottle fly deposits it's eggs in the flower. In all these instances the agency of the sun's light proves sufficient to produce the stated changes or secretions, without the influence of nerves or of especially ordered tubular vessels ; and plants of entirely different classes form exactly similar essential oils.

Since men of Science have ventured to inquire into the physical phenomena of living bodies, metaphysical opinions about the mystical influences, termed *vitality*, have in many instances been superseded by the better understood evidences exhibited through experiments made upon inanimate matter. Thus it has been discovered, that sugar, oxalic acid, prussic acid, and ammonia, may all be compounded by chemical processes, although formerly thought to be organic products.

Another difficulty attaches to this subject, arising from the loose and unsettled way in which medical writers employ the terms, secreting, excreting and secerning ; but this want of precision may be avoided by a more discriminative division of the different organic structures, in which those changes take place. The most simple excretions appear to be the exudations, exhalations or extravasations of

pre-existing fluids, such as the serous moisture which facilitates the motions of cellular or reticular tissues, which form the distinct coating or covering of membranes within the abdomen, thorax, and skull. The moisture evaporated from the lungs of air-breathing animals, and the extravasation of dropsical fluids — another kind of convenient semi-fluid, termed *mucus*, is bestowed upon exposed surfaces, and some cavities, where evaporation or dry attrition would disturb the mechanical purposes and offices of parts. The readily vaporized respiratory fluid and perspiration contain water, and the salts of the blood, together with many unassimilated crude materials which are mingled with the blood, such as alcohol, the aroma of certain vegetables of the onion tribe, the peculiar rank smell of mutton, and sour vapours, all of which may be termed excrementitious.

Aqueous vapours are also freely perspired by vegetables, and diffuse their odorous peculiarities—these, in animals, pass out of the exhalent capillary vessels—in vegetables, they are exudations variously ordered by their cortical coverings.

Mucous secretions are different in their properties from watery, or serous fluids, in being adapted to retain a given viscidity, rendering them less subject to desiccate, and

they are all difficult of solution in watery fluids,—hence the pure mucus of the tonsils, which, although exposed to continued vicissitudes of dryness and moisture, still retains its appointed consistence,—and the mucous slime of an earth-worm, or snail, equally defends the creature against evaporation and drowning.

A mixture of *serum* and *mucus* is supplied to synovial surfaces, to the nostrils, the outer coat of the eye, to the articular cavities of the moveable joints, to the theca of tendons, and to bursæ.

It cannot be reasonably assumed, that the formation of pure *mucus*, is a necessary result of any especial organization of tubular vessels, because a similar substance exudes from many *fungi*, from the *mollusca nuda*, and from animals having a limited extent, or an absolute deficiency of tubular vessels, many of them being wholly incased in and protected by a covering of their own viscid mucus, — and the *entozoa* are doomed to abide, as parasites, in the mucus or serous fluids of other animals. The anatomical evidences of pure mucous structures are simple —their ordinary configuration being that of follicles, lacunæ or spongy tissues, having scanty supplies of red blood which is apparent in the tonsils. The follicles of the gall

bladder, of the prostate gland, the lacunæ of the urethra, of the skins of fishes, and in the outer covering of the slug, *(limax nuda.)*

The saponaceous exudation from the open pores of the Meibomian glands along the margins of the eye-lids appears to be designed to prevent the crusty desiccation of tears during sleep, which actually happens when those pores are closed by inflammation; and a similar subordinate provision occurs in the ceruminous glandules of the *meatus auditorius externus.*

It seems probable, that in all pure mucous structures the excretion or exudation includes mortuary portions of the structure from which the mucus issues, and that as these albuminogelatinous substances do not repass the vital boundary after being protruded, they then become extraneous and serve the uses of an extra-vital insensible protection like our epidermis, and other extra-vascular structures.

The vegetable creation presents abundant examples of remarkable secretions, which do not depend upon vascular structures or upon nervous influences,—neither do they in some instances, and during those secretions, retain a connexion with the living whole, from whence they were derived. A familiar instance occurs in China oranges when plucked from the tree before they are ripe,—

for, in this immature state, the rind or skin of the fruit is green and bitter, and the essential oil which affords the aroma, is not then formed,—but the ripening process, which includes the saccharine elaboration, keeps pace with the production of a yellow aromatic skin, and although detached from the parent influence, these secretory changes proceed, and are completed, which may be ascribed to a continued cohabitation among the elementary raw materials of the fruit, independent of the living influence of the tree. A similar occurrence happens in the growth of filbert-nuts, which at first present a juicy calyx, closely united with the growing nut. In this state the juicy calyx is strongly acid, the kernel and it's coverings possess neither oil nor farina, the nutshell being then pulpy,—in the progress of ripening the acidity of the calyx disappears, the cotyledon of the nut abounds in oil, and it presents a firm kernel, with a hard brittle shell.

All these successive changes may be reasonably assigned to organic chemistry actuated by light, heat, and atmospheric air, those agencies decomposing the elements of water and it's solutions of carbon into acid, sugar, oil, farina, and a confirmed hard woody structure. We cannot overlook the similitude between the fat oils of vegetable production,

and those of animal origin, although vegetable structures do not possess any tubular vessels like animals.

In ripened plum and peach fruits, the arillus contains prussic acid, which may be chemically accounted for. A philosophic consideration of these points cannot fail to elucidate some of the more simple processes of secretion, while a more exact acquaintance with the preparatory filtrations from the blood must reduce the complexity of the circumstances in all glandular functions. It is already notorious, that the vessels carrying red blood, do not enter into the gross structure of many glands, such as the pancreas, the lachrymal, the salivary, the lactiferous glands, and that the white brain-like parenchyma of these parts depends on the stoppage of the red gobules of the blood at the places where the returning branches of the anastomosing veins commence, by which arrangement the watery serosity of the blood is exclusively sent through smaller capillaries into the secretory parenchyma, the final issues of which are through the excretory ducts, after a designated change is effected. The definite size of the red globules of blood apears to determine the return of venous blood at the points, where the secerning capillaries begin. And some of the recent en-

gravings from MUELLER exhibit the continuation of the anastomosing arteries into the veins after a rounded turn of the communicating tubes; this corresponds with my own experience in prosecuting minute anatomical injections, and the recurving continuous tubes are well adapted to send off the terminal, secretory or exhalent capillaries, without disturbing the current of circulation.

The communicating branches which unite the pulmonary arteries with the pulmonary veins, permit the entire volume of red blood to be exposed to the respiratory function, which shows that these continuous capillary vessels are larger than the anastomoses between common arteries and veins,—where a returning current is established and terminal. More minute capillaries are assigned for the renovation or repair of parts, or for the exit of excretions or secretions.

The preliminary filtration of the blood and it's retarded progress after it passes into the ultimate secretory vessels have the manifest effect of exposing a selected portion of the blood to the nervous influence, to a greater extent than in the common routine of it's circulation; an extraordinary example of this appears in the *tubuli testis*, where long tortuous or convoluted small cylinders appear to be the ultimate secerning structure, al-

though it is evident that the capillary branches of the spermatic artery do not only enter these minute tubes at their ends, but also join or penetrate their sides along their course, otherwise the smallest damage done to one portion of these tubuli, would occasion inevitable impotence, the contrary being known to all experienced surgeons.

Some physiologists have assumed, that the tubular terminations of the capillary arteries do not embrace the ultimate secerning structures,—and it is affirmed, that the *vasa inferentia* of all such structures finally end in acinous cells, where the different respective changes are effected. But unquestionably this intervention of cells does not occur in the structure of the testicle, and throughout the vegetable creation it cannot happen, because of their total deficiency of tubular vessels.

The supposed existence of cells in the secerning blood vessels appears to be assumed in order to explain the necessity for a state of rest of the fluid about to be changed,—and although acinous arrangements are common to many glands, they are not universal. The cessation of the *vis a tergo* to the fluids in the especially detached capillaries of glands affords an obvious delay of the separated portion of the blood destined to undergo the nervous influence, without the aid of vesicles,

—and the continuity of these detached tubes into the excretory ducts, as in the testicle, the liver and kidney, supplies evidences of the sufficiency of continuous tubes without the intervention of cells. In the liver a singular retardation of the blood occurs by the double arborescent junctions of the *vena porta* with the *vena hepatica.*

If the mere rest of animal fluids were to conduce invariably to a change in their constituent elements, the stagnant fluid of local dropsies would not continue to be serous.

A series of elementary facts better suited for rational inductions are, however, presented by more enlarged anatomical views, since the extension of minute anatomical injections of the vessels which belong to different animal glands, have been traced to their ultimate attenuation; and medical philosophers are indebted to Dr. J. Mueller, and to Dr. Joseph Berres, above all modern anatomists, for their accurate, beautiful, and satisfactory illustrations lately published, on the minute structure of glands,—*viz.*, *de Glandularum secernentium structura peculiora* Dr. J. Mueller, *imp. Lipsiæ*, 1830; and, *Anatomia Partium Microscopicarum corporis Humani von* Dr. Joseph Berres, *Professor der Anatomiæ an der Wienen Universitat*, 1836.

In addressing scientific medical men, it would be superfluous to enumerate the details of anatomical and chemical facts on which the present observations and prospective hypothesis are founded; because the former are published in all the best modern books, and the latter appear to be justified by the researches of modern anatomists.

After collating these allied evidences, and making some cautious inductions, the intricate subject of organic secretion appears to the Writer to be further advanced toward a science, by simplifying the conditions and agencies by which the less concealed changes in the transitory materials of living organized bodies are effected. Unquestionably there is not in the cases of vegetables any connexion or dependance upon cerebral or nervous influence; whatever that may be.

Both the animal and the vegetable creation present equally simple and uniform constructions, which effect remarkably dissimilar secretions; and, in other instances, without possessing a similarity of organization, or being acted upon by apparently similar agencies, they produce similar compounds; nor is the subject elucidated by imputing them to the mysterious principle of life. The most remarkable and the most general of the phenomena which appertain to the living function

of secretion, are a state of quiescence, or a comparative degree of rest in the fluids where the secretory changes occur. For assuredly the mass of the rapidly circulating fluid of complicated animals is not intercepted in it's course toward distinct glands, but only the particular portion of the fluid to be changed, which is first diverted from it's ceaseless motion or continuous flow, and it is then designedly directed into extra circulatory channels before it is exposed to the secretory change, as it happens in the liver, the kidney, the lachrymal gland and the testicle. This comparative repose or rest of the fluid to be operated upon by glandular structures is therefore variously ordered in the glands, which are constructed for especial purposes; and, in some instances, there is a moral power or discretion bestowed on the sensorium to discharge more or less, as in the secretions of the lachrymal glands. In those complicated creatures which are invested with combined moral and physical attributes, the organization is varied according to the station assigned to each species and to their numerous subordinate parts, and although not of hourly service to the individual, they are essential for the intended duration of life, and for the assurance of a continuance of the species; since, if these minor provisions had

been omitted, the needful continuance of each species would have been uncertain, and thus the relations and the dependencies of the living creation would have been liable to derangement, and a chance medley of confusion be extended in some instances even to extermination, so as to supersede the inexorable system of perpetuity established under the primary laws of nature.

I have already ventured to deny the function of secretion to the spleen and thyroid gland, and the same objections may be applied to the lymphatic, lacteal or absorbent glands: for the continued sameness of the fluids absorbed by these especial vessels is manifested after their passage through those glands. Their structure is in all cases the same. Their peculiar cylindrical tubes on entering each gland, are divided into smaller branches, termed *vasa inferentia*, and these pass into a series of communicating *cells* which the fluid passes through to the opposite side of the gland, from whence tubes arise and lead into a second series of ramifying vessels, termed *vasa eferentia;* the parenchyma of these glands being moderately supplied with blood vessels. These facts are easily shown by quicksilver injections, and they constitute the whole of their known construction Absorbent glands are also sparingly supplied

with nerves, the contrary being common to secreting glands. The diseases of these organs seem however to indicate the principal, if not their only use, *viz.* that of stopping noxious substances from passing into the blood, and which is shown by inflammations obstructing the course of fluids through those glands, and often by consequent abscesses which discharge the offending noxious substance, as in buboes, and in mesenteric glandular diseases.

The temporary gland, termed *thymus*, largely possesses a medullary brain-like parenchyma resembling that of the pancreas, the salivary and lachrymal glands, and the element of the blood selected by each of them is serous, so that the production of a diluent watery liquid to supply some insufficiency of the milk diet in the fœtal stage may be its only and subordinate office. It being evident that the vascular structures as well as the parenchyma of the thymus glands in all animals are exactly similar to those of the pancreas and the lachrymal glands, and since the thymus gland has not any excretory or discharging ducts, it may be reasonably inferred that a change in the properties of the glandular blood actually occurs, resembling that exhibited in the excretions of the pancreas and the lachrymal glands although

returned to the heart by common veins, or, as some imagine, by absorbent vessels. Assuming, therefore, that such change happens in the thymus gland, the portion of gland-changed blood must necessarily pass into the right auricle, but whether to add a stimulus to the young heart, or to provide a more suitable venous blood for the first stages of infantile respiration, may in the present state of knowledge be doubtful. The parenchyma of the mammary glands is more firm and yellow than in the purer secretory glands of watery fluids; indeed the whole of the elements of blood, excepting the red globules, pass by their excretory ducts,—as the physical properties of milk satisfactorily show. One of the vital functions of the brain, and it's parts, may be regarded as glandular, which may either be a receptacle for electricity, or an apparatus to produce that subtle agent.—An additional instance of the influence of the brain upon glandular secretions, occurs during sleep; it being evident, that the saliva, tears, and other emunctory discharges, are greatly abated, if not altogether suspended, during the repose of the brain.—Also, in the fœtal state while it's passive functions are governed by the mother, the offices of the secreting glands, such as those of the liver, do not be-

gin until the approach of parturition, until which time the structure and control of the brain are incomplete.

The discovery of a discretionary electrical power in the *torpedo* and *gymnotus*, as well as the galvanic influences artificially made upon nerves and muscles, all conspire to support this suggestion.

The two remarkable gland-like structures belonging to the brain, called the *pituitary* and *pineal glands*, are intimately connected with it's great internal chambers, called *the ventricles*. The pituitary gland is guarded by a strong case of bone, the *cella turcica*, it is there immoveably fixed, and it consists of a *brain-like* parenchyma, having a tubular communication with the central ventricle, as if to exert some influence upon the composition of the ventricular fluid. The pineal gland exhibits less of cerebral matter in it's composition than the pituitary gland, and it contains cretaceous regularly figured granules, resembling in form the creeping bramble berry. The *pure* medullary composition of the peduncles which are united to the pineal gland are prolonged within the centre ventricle. Immediately after sudden deaths I have found alcohol, free acid, and the stench of garlic mixed with the fluid contained in the

ventricles of the brain,—and, in each case, those extraneous matters corresponded with the articles previously taken with food.

The organic construction of every species of creature is manifestly designed for two principal purposes,—the first, for individual self preservation during a limited time,—the second, for the maintenance of a perpetual succession,—and for each purpose, there are appointed accommodations of minor conveniences, not intended for the immediate necessities of the individual, but for the better assurance of it's assigned temporary existence.

The different agencies of electrity, of heat, and of light, obviously act upon the living fabrics of animals and vegetables, and induce various physical changes in their elementary constituent materials,—it may therefore be justly inquired, whether the potency of each of them is not variable by concentration or diffusion, as in the cases of electricity, heat, and light,—and, if that surmise should be proved, it may then be inquired, whether in the dispersed state of these agencies they may not act with equal potency when applied to detached molecules, as when their concentrated power is applied to similar materials in bulk.

But all such profound and momentous considerations belong exclusively to philosophic

minds,—and, if happily the prevalence of frivolous knowledge should permit, I venture to hope, that practical advances will be rapidly made in medical therapeutics sufficient to explain the mysterious uncertainties which yet remain, as to the modus operandi of drugs and the other therapeutical means employed by Physicians and Surgeons.

I should not have presumed to submit these imperfect hypothetical observations, in relation to the healing art, if extensive experience and daily communication with medical men, did not convince me of their lamentable backwardness, when compared with the followers of less important vocations,—among whom more enlarged views, and better established inductions, must contribute to more certainty and exactness.

Langham Place,
Jan. 19, 1837.

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