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A

TREATISE

ON

THE ANATOMY AND PHYSIOLOGY

OF THE

Mucous Membranes;

WITH

ILLUSTRATIVE PATHOLOGICAL OBSERVATIONS.

From the French

OF

XAVIER BICHAT.

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THE

TRANSLATOR'S PREFACE.

The works of no medical writer deserve a more attentive perusal than those of the illustrious BICHAT. Erudite, observant, and industrious, he, at an early age, reared a monument of science, which will perpetuate his name and matchless talents. From the rich treasures he has left, the Translator presumes to present this Treatise in an English costume. Where all is excellent it is difficult to make a satisfactory selection; yet this portion of the author's productions merits the [Pg iv] particular attention of medical students and practitioners in general, as it leads to the knowledge of the structure and economy of that part of the animal organization, which, more than any other, is subject to morbid affections.

The aim of the Translator has been faithfulness, clearness, and conciseness, rather than elegance: how he has fulfilled his intention he must leave to the decision of the candid Reader.

SAFFRON WALDEN,
JULY 1, 1821.

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A

TREATISE

ON

MUCOUS MEMBRANES.

SECTION I.

OF THE SITUATION AND NUMBER OF MUCOUS MEMBRANES.

1. The Mucous Membranes occupy the interior of those cavities, which, by various openings, communicate with the skin. Their number, at the first view, appears very considerable; for the organs within which they are reflected are numerous. The stomach, bladder, urethra, uterus, [2] ureters, the intestines, &c., borrow from these membranes a part of their structure: nevertheless, if it be considered, that they are continuous throughout, that everywhere they are observed to be extended from one organ to others, arising, as they did at first, from the skin, their number will appear to be singularly limited. In fact, in thus contemplating them, not as insulated in each part, but as continued over various organs, it will appear that they are reducible to two general surfaces.

2. The first of these two surfaces, entering by the mouth, nose, and anterior surface of the eye, (1) lines the first and second of these cavities: from the first it extends into the excretory ducts of the parotid and submaxillary glands; from the other it is continued into all the sinuses, it forms the tunica conjunctiva, descends by the puncta lacrymalia through the canal and lacrymal sac to [3] the nose. (2) It descends into the pharynx, and there furnishes the inner surface of the Eustachian tube, and thence it penetrates and lines the internal ear. (3) It sinks into the trachea, and spreads itself over all the air passages. (4) It enters the œsophagus and stomach. (5) It extends into the duodenum, where it furnishes two branches, one destined to the ductus communis choledochus, to the numerous rami of the hepatic duct, to the cystic duct and gall bladder; the other to the pancreatic duct and its various ramifications. (6) It is continued into the small and large intestines, and finally terminates at the anus, where it is identified with the skin.

3. The second general mucous membrane enters, in men, by the urethra, and thence spreads from one part through the bladder, ureters, pelves, calices, papillæ, and uriniferous tubes; from [4] the other it sinks into the excretory ducts of the prostate gland, into the ejaculatory ducts, the vesicula seminales, the vassa defferentia, and the infinitely convoluted branches from which they arise. In women, this membrane enters by the vulva, and from one part penetrates the urethra, and is distributed, as in men, through the urinary organs; from the other part it extends into the vagina, which it lines, as it also does the uterus and the fallopian tubes, and through the apertures at the extremities of these ducts it comes in contact with the peritoneum. This is the only example in the economy, of a communication between the mucous and serous surfaces.

4. This manner of describing the track of the mucous surfaces by saying that they extend, sink, penetrate, &c., from one cavity to another, is certainly not conformable to the march of nature, [5] which forms in each organ the membranes that belong to it, and does not thus extend them from one to the other; but our manner of conceiving is best accommodated by this language, of which the least reflection will rectify the sense.

5. In thus bringing all the mucous surfaces to two general membranes, I am supported, not only by anatomical inspection, but pathological observation also furnishes me with lines of demarcation between the two, and with points of contact between the different portions of the membranes of which each is the assemblage. In the various sketches of epidemic catarrhs made by authors, we frequently see one of these membranes has been affected throughout its extent, whilst the other, on the contrary, has remained untouched. It is not uncommon to observe a [6] general affection of the first, *viz.* that which extends from the mouth, nose, and anterior surface of the eye, into the alimentary canal and bronchi. The last epidemic observed at Paris, with which M. Pinel was himself affected, bore this character: that of 1761, described by Rayons, presented the same feature: that of 1732, described in the Memoirs of the Edinburgh Society, was remarkable for a like phenomenon. Now we do not see at the same time a corresponding affection in the mucous membrane which spreads over the organs of urine and of generation. Here is, therefore, (1) an analogy between the different portions of the first, by the uniformity of the affection; (2) a line of demarcation between them, by the healthy state of the one and the disease of the other.

6. We observe also, that irritation on any one point of these membranes frequently produces a [7] pain in another point of the same membrane, which is not irritated; thus a stone in the bladder causes a pain at the end of the glans, worms in the intestines produce an itching at the nose, &c. &c. Now in these phenomena, which are purely sympathetic, it is extremely rare that the partial irritation of one of these two membranes produces a painful affection in a part of the other.

7. We ought, therefore, from inspection and observation, to consider the mucous surface in general as formed by two grand membranes, spread over several organs, and having no communication with each other but by the skin, which is intermediate, and which, being continuous with both, thus concurs with them to form a general membrane, entire throughout, enveloping the exterior of the animal, and extending to the interior over most of its essential [8] parts. It should seem, that there exists important relations between the internal and external portions of this unique membrane, and this we shall soon be shown by ulterior researches.

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SECTION II.

OF THE EXTERIOR ORGANIZATION OF MUCOUS MEMBRANES.

8. Every mucous membrane presents two surfaces; the one adhering to the adjacent organs; the other free, beset with villosities, and always moist with a mucous fluid: each of them deserves a particular attention.

9. The adherent surface is attached to muscles almost throughout its extent. The mouth, the pharynx, the whole of the alimentary canal, the bladder, the vagina, the uterus, and part of the urethra, &c. present a muscular bed, embracing the exterior of their mucous coat. In animals [10] that have the panniculus carnosus, this disposition perfectly coincides with that of the skin, which, as we shall see, is in other respects analogous in structure to mucous membranes. In man the cutaneous organ presents here and there traces of this exterior muscle, as we observe in the platysma myoides, the palmaris brevis, the occipito frontalis, in most of the muscles of the face, &c. This disposition of mucous membranes places them under the influence of those habitual changes of contraction and dilatation, which are favourable to their secretion, and various other functions.

10. This muscular bed is not immediately inserted into the exterior surface of the mucous membranes, but rather, according to Albinus, into a dense layer of cellular tissue, which all the ancient authors have denominated, in the stomach, intestines, and bladder, the nervous coat; but [11] when well examined it presents no character analogous to that which the name indicates. The experiment of inflation, by which it is brought into its primitive state, is not so easy as Albinus and others have pretended; which led me to think that its nature might not be cellular, but that it was probably of a fibrous texture, formed by a web of extremely delicate and scarcely visible tendons, offering points of origin and insertion to all the fleshy fibres of the muscular bed, which, as we know, never describe entire circles, but rather different segments of that curve. I confess that this conjecture, though very likely, is not founded upon any decisive and rigorous experiment.

11. Whatever may be the nature of this intermediate membrane to the mucous and muscular coats, it evidently has a dense, close texture, which gives it a resistance very analogous to one of [12] the fibrous membranes. It is from this that the organ receives its form; it is this which maintains and controls its shape, as may be proved by the following experiment. Take a portion of intestine: remove in any part of the bowel a part of this membrane, with the serous and muscular membranes: having applied a ligature to the inferior end, inflate it, the air will produce in the denuded part an hernia of the mucous coat. Take another portion of intestine, turn it, dissect off a small part of the mucous membrane and of this coat: inflation will produce upon the serous and muscular coats the same phenomenon as in the preceding case it did in the mucous membrane. It is therefore to this intermediate tunic that the mucous membrane owes its power of resistance to [13] substances which distend it. This applies equally to the stomach, bladder, œsophagus, &c.

12. The free surface of mucous membranes, or that which is continually moistened by the fluid from which they borrow their name, presents two kinds of wrinkles or folds, the one inherent in their structure and which is constantly present, whatever may be their state of contraction or dilatation, such as the pylorus, the valvula conniventes, the valve of the colon, &c. These folds are formed, not merely by the mucous membranes, but also by the intermediate membrane mentioned above, and which in these parts takes a remarkable density and thickness.

13. The other folds may be called accidental, and are only observed during the contraction of the organ; such are those of the inner surface of the stomach, and of the large intestines, &c. In [14] most of the human subjects brought to our amphitheatres, these folds in the stomach, of which so much has been said, are not perceptible, because generally the subject has died of a disease which has impaired the vital powers, without preventing all the action of this viscus; so that, although it is frequently found empty, its fibres are not in the least contracted.

14. In experiments on living animals, on the contrary, these folds are very apparent; and observe how they may be demonstrated. Let a dog eat or drink copiously; open it immediately, and make an incision into the stomach the whole length of its greater curvature, no fold will then appear, but it soon contracts, its edges are drawn in, and the whole of the mucous surface is covered with numerous prominent plicæ in the form of circumvolutions. The same result may be observed in the stomach of a recently killed animal by distending it with air, and then opening it; [15] or, what is still better, by laying it open whilst empty, and stretching it, the folds will disappear, and when we cease to make the extension they immediately form again and are very apparent.

15. I would observe on the subject of inflating the stomach, that by distending it with oxygen gas the application of this fluid does not produce more prominent folds, and therefore no stronger contraction, than when carbonic acid gas is used for the same purpose. This experiment presents a result very similar to what I have observed when I have rendered animals emphysematous by different æriform fluids. Frogs and Guinea pigs (these are the two kinds I have chosen, the one being an animal of red and cold, and the other of red and warm blood) presented very little difference in their irritability, or their Galvanic susceptibility, whether [16]

inflated with oxygen gas or with carbonic acid gas. They live very well with this artificial emphysema, which gradually disappears. Inflation with nitrous gas is always mortal, and its contact appears to strike the muscles with atony. The stomach distended with it very soon loses its power of contracting, and its folds disappear. Here, as in all the experiments which have the vital powers for their object, we frequently obtain very variable results.

16. It follows, from what we have said respecting the folds of mucous membranes, that in the contraction of the hollow organs, which are lined by them, they suffer but a very trifling diminution of surface, they scarcely contract at all, but fold themselves within; so that in dissecting them upon their contracted organ, we have an extent of surface nearly equal to that [17] which they present during its dilatation. This assertion, which is true concerning the stomach, the œsophagus, and the intestines, is, perhaps, not quite so as respects the bladder, whose contraction does not show within such prominent folds, but they are sufficiently marked to bring the mucous membrane of this organ under the general law. It is, also, nearly the same with the gall bladder; yet we find here another cause; observed alternately, in a state of hunger and during digestion, it will be found to contain double the quantity of bile in the former case that it does in the latter, as I have had the opportunity of seeing in numerous instances, in experiments made with this object in view, or with other intentions. Now, when it has evacuated part of its contents it does not contract upon the remainder of the bile, with the energy of the stomach when it contains but little food, nor with the power of the bladder when it contains but a small [18] quantity of urine, but is then flaccid, so that its distention or nondistention has but very trifling influence upon the folds of its mucous membranes.

17. Moreover, in saying that the mucous membranes present with trifling variation the same extent of surface in the dilatations as during the contraction of their respective organs, I intend to speak of the ordinary state of the functions only, and not of those enormous dilatations which are frequently seen in the stomach and bladder, more rarely in the intestines. In such cases there is doubtless a real extension, which in the membrane coincides with that of the organ.

18. One remarkable observation that the free surface of mucous membranes affords us, and which I have already pointed out, is, that this face is everywhere in contact with bodies of a [19] different nature to that of the animal: these bodies are either introduced from without for its nourishment, and are not yet assimilated to its substance, as we see in the alimentary canal and in the trachea, or they are produced within, as we observe in the excretory ducts of the glands, which all open into cavities lined by mucous membranes, and discharge those particles, which, after having for some time formed a part of the composition of the solids, become heterogeneous to them, and are thrown off by that habitual action of decomposition, which takes place in living bodies. According to this observation we must consider the mucous membranes as defensive coats, placed between our organs and foreign bodies, and that they consequently serve the same purpose internally which the skin does externally, as respects bodies that are in contact with it.

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SECTION III.

OF THE INTERIOR ORGANIZATION OF MUCOUS MEMBRANES.

19. Between the mucous and other membranes, as respects their interior organization, there is this essential difference, that they are always formed by several thin fibrous layers; these layers or coats are, with the exception of the rete mucosum, the same as those which compose the skin with which these membranes have the most exact analogy. We are about to examine separately each of these layers, which are the epidermis, the corps papillaire, and the chorion, in their [21] general attributes; we shall afterwards consider the particular modifications which they undergo in the different parts of the mucous surfaces.

20. All authors have admitted the epidermis of mucous membranes: it appears, even, that the greatest part of them have believed that it is merely that portion of the skin which descends into the cavities to line them; Haller in particular is of this opinion; but the least inspection is sufficient to show, that here, as in the skin, it forms but a layer superficial to the corps papillaire and chorion; boiling water, which detaches it from the surface of the palate, the tongue, and even from the pharynx, leaves the two other coats denuded and apparent.

21. This epidermis is very distinct upon the glans, at the anus, at the orifice of the urethra, at the entrances of the nasal fossæ, and of the mouth, and in general wherever the mucous [22] membranes arise from the skin. It is demonstrated in these different places by the frequent excoriations which occur on them; it may be raised from the lips by a very fine lancet by the action of boiling water, a hot iron, or even by epispastics, as the method of the ancients proves, who employed them to produce a fresh raw surface for the cure of the hare lip.

22. But in proportion as we go into the depth of the mucous membranes, the existence of this coat becomes more difficult to be demonstrated; it cannot be raised by the finest instrument, nor

detached by boiling water, at least in the gall bladder, in the stomach, and intestines. I have made these experiments in fresh slain animals, and also in those where the natural heat had quite left them. But what our experiments cannot effect, inflammations will often produce. All the [23] authors, who have written on the affections of the organs which are lined by these membranes, mention instances in which flakes, more or less considerable, have been voided by the urethra, anus, mouth, nostrils, &c. Haller has collected a great number of similar observations. Without doubt the separation of the epidermis in these cases is produced nearly in the same way as we observe it in cutaneous inflammations. In many subjects that have died with symptoms of inflammation of the mucous membranes, and which I have already had the opportunity of dissecting, or of seeing dissected, I have not yet been able to observe this separation going on; that is to say, the epidermis separated at one point, and still remaining adherent at others, as in erysipelas. I have tried in vain to produce this effect by the application of an epispastic to the [24] inner surface of the intestines of a dog.

23. This epidermis is subject, like that of the skin, to become callous by pressure. Choppart cites a case of a shepherd, "dont le canal de l'urètre présentoit cette disposition, à la suite de l'introduction fréquemment répétée d'une petite baguette pour se procurer des jouissances voluptueuses." We know the density that this envelope takes in the stomachs of the gallinacea. In certain circumstances, where the mucous membranes are protruded from the body, as in prolapsus ani, inversion of the vagina, in the artificial anus, &c., sometimes the pressure of the dress produces in this epidermis a thickness evidently more considerable than is natural to it.

24. The epidermis is attached to the hair on the skin, although it does not afford its immediate origin; sometimes also piliform productions are observed in the mucous membranes. The bladder, [25] the stomach, the intestines, and the pituitary membrane have been in various instances the seat of these unnatural excrescences: Haller has cited various instances of them.

25. This envelope appears to have upon the mucous surfaces the same texture as on the skin, excepting in the delicacy of the laminæ from which it is produced. It is to this delicacy, which gives more exposure to the nerves, that we must doubtless refer the facility with which we excite various remarkable modifications in the sensibility, when by the Galvanic process we apply zinc to the mucous surface of the conjunctiva, the pituitary membrane, the internal membrane of the rectum, or of the gums, &c., and bring these several metal plates into mediate or immediate contact. The epidermis when removed is quickly reproduced; being destitute of all kinds of [26] sensibility, it in this respect serves the same purpose as the skin, by guarding the very sensible corps papillaire which is subjacent to it. To its presence over the mucous membranes we must attribute the ability they have of being exposed to the air, and even to the contact of foreign bodies, without excoriating or inflaming, as is seen in cases of artificial anus, prolapsus ani, &c., whilst serous and fibrous membranes never suffer such exposure with impunity. Hence there is no danger, in this respect, from opening the bladder: hence, on the contrary, that precept so justly recommended, not to open the cavity of the peritoneum, and to make the least possible incision into the synovial capsules. I would observe, that the existence of the epidermis upon mucous membranes is an important consideration, as respects the opinion of those who, like [27] Séguin, believing them to be without it, have said, that contagion is always received by the lungs, and not by the skin, which is, according to them, defended by this envelope.

26. In the organization of the skin, immediately under the epidermis is placed the corpus mucosum, particularly described by Malpighi, and generally considered as the seat of colour in the different varieties of the human species. It is described as a coat, pierced with holes by the passage of the nervous papillæ: M. Sabattier points out the manner of demonstrating it. Sömmering has, it is said, seen it separated from the epidermis and chorion on the scrotum of an Ethiopian. I confess that I have not yet been able to perceive it: M. Portal does not appear to have been more fortunate.

27. We distinguish only a kind of gelatinous juice intermediate to the corps papillaire and [28] epidermis, and most commonly it is not even apparent; I have never been able to observe more with certainty. In examining the skin of a Negro with attention, the epidermis being detached, I have seen the external surface of the chorion tinged with black, and that was all. Further, whatever this corpus mucosum may be, it certainly does not exist in mucous membranes, since they do not participate in the colour of the integuments. The heat of the sun, which darkens these in white people, does not appear to act upon the commencement of these membranes, which are equally exposed with them to its influence, as is seen in the red borders of the lips, &c. Nevertheless, I have many times remarked on the palates of dogs, which have been the subjects [29] of my experiments, similar spots to those which have marked their skin.

28. The sensibility of the skin is principally owing to the corps papillaire; that of the mucous membranes, exactly analogous to that of the skin, appears to me to arise from the same cause. The nervous papillæ of these membranes cannot be questioned: at their origin, where they dip into the cavities, even in the commencement of these cavities, as on the tongue, the palate, the internal surface of the alæ nasi, on the glans, in the fossa naviculare, on the inside of the lips, &c., inspection is sufficient to demonstrate them. But, we ask, do these papillæ exist also in those parts of mucous membranes which are more remote from the surface of the body? Analogy answers in the affirmative, since sensibility is the same there as at their origin; but inspection [30] proves it in a no less certain manner. I believe, that the villosities with which we see them everywhere thickly furnished are nothing else than these papillæ.

29. Very different notions have been entertained concerning the nature of these villosities: they have been considered, in the œsophagus and in the stomach, as destined to the exhalation of the gastric juice, in the intestines as serving for the absorption of chyle, &c. But (1) It is difficult to

conceive how an organ, so nearly similar throughout its extent, should fulfil, in different parts, such different functions; I say so nearly similar, because we know, that the villosities of the small are more prominent than those of the large intestines. (2) What would be the functions of the villosities of the pituitary membrane, of the internal coat of the urethra, and of the bladder, if they had no connection with the sensibility of these membranes. (3) The microscopic experiments [31] so boasted of by Leiberkuhn, on the erection of the intestinal villosities, have been contradicted by those of Hunter and Cruikshank, and, above all, by those of Hewson. I can assert, that I have never seen any thing of the kind on the surface of the small intestines during the absorption of chyle, and yet it appears to be a thing that cannot vary in different examinations. (4) It is true that these intestinal villosities are everywhere accompanied by a vascular web, which gives them a colour very different from that of the cutaneous papillæ; but the nonappearance of the cutaneous web is occasioned only by atmospherical pressure, by means of the contraction that it produces in the minute vessels: see, for instance, the newly-born infant; its cutaneous surface is as red as that of its mucous membranes, and if the papillæ were a little more elongated the skin [32] would exactly resemble the internal surface of the intestines: moreover, who does not know, that the vascular web surrounding the papillæ is rendered so apparent by fine injections as entirely to change the colour of the skin?

30. That in the stomach this vascular web exhales the gastric juice, and in the intestines it is interlaced with the origin of the absorbents, so that they embrace the villosities, are facts that we must admit, after the experiments and observations of the anatomists, who in these times have been engaged with the lymphatic system: but that does not contradict the assertion, that the bases of these villosities are nervous, and perform the same functions only on the mucous membrane as the papillæ do on the cutaneous organ. This view of them, by explaining their existence as observed generally over all the mucous surfaces, appears to me much more [33] conformable to the plan of nature than to suppose that they perform, in their different parts, diverse and frequently opposite functions.

31. However, it is difficult to decide the question by ocular observation; the tenuity of these prolongations conceals their structure even from our microscopic instruments, a kind of agents by which physiology and anatomy do not appear to me in other respects ever to have obtained great assistance, because when parts are so viewed each person sees in his own way, and is impressed accordingly. It is therefore the observing of the vital functions that should above all guide us. Now by judging of the villosities in this way it appears evident, that they have the nature which I have attributed to them. The following experiment will serve to demonstrate the influence of the corps papillaire upon the cutaneous sensibility: it succeeds also with mucous [34] membranes. If we remove any part of the epidermis, and irritate the corps papillaire with a pointed instrument, the animal writhes, cries, and gives signs of acute pain. If afterwards the cutis be pierced, and with the instrument the internal surface of the chorion be irritated, the animal will not appear to suffer pain, unless by accident some nervous filaments should be touched. Thence it follows very evidently, that the sensibility of the skin resides in its external surface, that the nerves pass through the chorion without being interwoven with its texture, and that their diffusion only takes place on the corps papillaire. It is the same in mucous surfaces.

32. The length and form of the villosities vary in the different mucous surfaces. Their appearance is not the same in the stomach, the intestines, the bladder, the gall bladder, on the [35] glans, &c.; which variation exactly coincides with the sensibility peculiar to each organ, a sensibility proved by numerous observations since Bordeu, who was the first to direct the attention of physiologists to the particular modifications that this property undergoes in the different parts.

33. Like the skin, the mucous membranes have their chorion: it is thick on the palate, gums, and pituitary membrane, delicate in the stomach and intestines, not very distinct in the bladder, gall bladder, and excretory ducts. It appears to be formed of condensed cellular strata, strongly united, as in the skin. Maceration develops this texture in a very sensible manner. There is nevertheless this difference, that in dropsy the cutaneous chorion rises and resolves itself into distinct cellules, that become filled with water, whilst no such change takes place in the mucous [36] chorion under similar circumstances. Does this difference in the morbid state suppose a dissimilarity of structure? Certainly not; for the synovial membrane is evidently of the same nature as the serous membranes; and nevertheless it does not participate in the hydropic diathesis which often affects them universally. It would be curious to expose mucous membranes to the action of tan, to see if they would present the same phenomena as the skin.

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SECTION IV.

OF THE GLANDS OF MUCOUS MEMBRANES.

34. Besides the three strata, which we have just mentioned, the mucous membranes present in

their structure a great number of glands and blood vessels. The mucous glands exist in all membranes which bear that appellation: they are situate under their chorion, and even in its substance: they continually discharge, through imperceptible orifices, a mucilaginous fluid, which lubricates their free surface, and defends it from the impression of the bodies with which it is in contact, at the same time that it facilitates the passage of those substances.

35. These glands, which are very apparent in the bronchi, palate, œsophagus, and intestines, [38] where they take the name of the anatomists who have particularly described them, are less obvious in the bladder, the gall bladder, uterus, vesiculæ seminales, &c.; but the mucus which moistens the membranes unequivocally demonstrates their existence. In fact, since this fluid is nearly of the same nature on all the mucous surfaces, and, in those where the glands are apparent, is evidently furnished by them, it must be secreted in the same manner in those where they are less evident. The identity of secreted fluids, certainly, supposes the identity of the secreting organs. It should seem, that in situations where these glands escape our observation, nature makes up for their tenuity by increasing their number. In the lower animals, particularly in the intestines, they form by their number a kind of new layer, in addition to those we have [39] described. The same may be observed in the palate, velum, &c. in man.

36. There is therefore this great difference between mucous and serous membranes; that the fluid which lubricates the former is furnished by secretion, whilst that which moistens the latter is produced by exhalation. We know but little of the composition of mucous fluids, because in the natural state it is difficult to collect them, and in the morbid state, where their quantity increases, as for instance in catarrhs, their composition probably undergoes some alteration: but their functions in the animal economy are well ascertained.

37. The first of these functions is to defend the mucous membranes from the impressions of the bodies with which they are in contact, and which, as we have observed, are all heterogeneous to [40] the animal. Here, without doubt, we see the reason why the mucous fluids are more abundant in the cavities where these bodies remain for some time, as in the bladder, at the extremity of the rectum, &c., than in those organs through which they merely pass, as in the ureters, and in general in all the excretory ducts. Observe again, why, when the impression of these bodies might be hurtful, these fluids are poured out upon their surfaces in a much greater quantity. The sound which is introduced into the urethra, and is allowed to remain there; the instrument that is left in the vagina to secure a polypus; that which, with a similar intention, remains some time in the nasal fossæ; the canula, fixed in the lacrymal sac, to remove the obstruction; and the tube that is introduced into the œsophagus, when deglutition is interrupted, always determine a more [41] plentiful secretion upon the corresponding mucous surface. This is one of the principal causes why it is so difficult to retain elastic tubes in the trachea; the abundance of mucous fluid, which is then separated, chokes up the apertures of the instrument, and renders its frequent removal necessary, and may even threaten the patient with suffocation, as Desault has himself observed, although he has nevertheless many times succeeded with that operation.

38. It therefore appears, that every acute excitement of mucous surfaces determines, in the corresponding glands, a remarkable augmentation of action. But how can this excitement, which does not take place immediately upon the glands, have so great an influence over them? For, as we have said, these glands are always subjacent to the membrane, and are consequently [42] separated by it from the irritating bodies. It appears that the above fact belongs to a general modification of the glandular sensibility, which is susceptible of being put into action by every irritation upon the extremities of the excretory ducts, which will be proved by the following considerations: (1) The presence of food in the mouth produces a more abundant flow of saliva. (2) The catheter fixed in the bladder, and irritating the ureters, or their vicinity, increases the flow of urine. (3) The introduction of a bougie, but half way up the urethra, will often be sufficient to occasion the bladder to contract with a power equal to force the urine through the passage, and so to overcome an obstruction in the canal. (4) The irritation of the glans, and of the extremity of the urethra, sub coitu, determines the contraction of the vesiculæ seminales, and [43] augments the secretory action of the testes. (5) The action of an irritating fluid on the tunica conjunctiva occasions an abundant flow of tears. (6) In making experiments upon the state of the abdominal viscera during digestion, and under the influence of hunger, I have observed, that whilst the food is only in the stomach there is very little flow of bile; but it increases when the aliment passes into the duodenum, so that then there is a considerable quantity in the intestines. During hunger the gall bladder is distended, and but little bile flows into the intestines. At the end of digestion, and even when that process is half finished, the gall bladder contains but half of its full quantity; yet it might be expected to empty itself more easily during abstinence, for then the bile it contains is of a deep green colour, very bitter, very acrid, and likely to irritate the organ which encloses it. On the contrary, during, or immediately after digestion, it is more clear, [44] mild, and less irritating; there must, therefore, be, during digestion, another stimulus: now this stimulus is the aliment passing over the mouth of the ductus communis choledochus[A].

39. Let us conclude, from these numerous considerations, that one of the principal means that [46] nature employs to augment the action of the glands, and to excite that of their excretory ducts, is [47] irritation upon the extremities of these ducts. We must refer to that cause the abundant secretion and excretion of mucous fluids in the cases above stated. It is also to this susceptibility of the mucous glands, to be excited by irritation at the extremities of their excretory ducts, that we must attribute the artificial catarrhs which are occasioned by the respiration of chlorine gas; the flow of mucus which attends a polypus, any tumour in the vagina, stone in the bladder, &c. The frequent occurrence of leuchorrhea in women who use coition immoderately, the abundant flow [48] of mucus from the noses of those persons who take snuff, in all these cases there is evidently an

irritation of the mouths of the mucous ducts.

40. The mucous membranes, by the continual secretion of which they are the seat, perform a principal part in the animal economy. They are to be regarded as one of the grand emunctories, by which the residue of the nutriment constantly escapes from the body; and consequently as one of the principal agents of that habitual decomposition which carries away from living bodies the particles which for some time formed part of the solids, but have at length become heterogeneous to them.

41. Remark the fact, that none of the mucous fluids enter into the circulation, but are thrown out externally; that of the bladder, ureters, and urethra, with the urine; that of the vesiculæ seminales and of the vassa defferentia with the semen; that of the nostrils by the action of [49] blowing the nose; that of the mouth partly by evaporation, and partly by the anus with the excrements; that of the bronchi by the pulmonary exhalation, which is effected principally by the solution of this mucous fluid in the air of respiration; those of the œsophagus, of the stomach, of the intestines, of the gall bladder, &c., with the excrements of which they frequently form, in the ordinary state, a part nearly equal to the residue of the aliment; and they even compose almost the whole of the matter voided in certain dysenteries and fevers, where the quantity is evidently disproportionate to the food that has been taken. Let us observe on this subject, that in the analysis of the fluids, in contact with the membranes of which we speak, as the urine, bile, gastric juice, &c., there are always some errors, because it is very difficult, impossible even, to [50] separate them from the mucous fluids.

42. If we call to mind what has been said above, upon the extent of the two general mucous surfaces, that they are equal and even superior to the extent of the cutaneous organ; if we afterwards contemplate these two grand surfaces, constantly throwing off the mucous fluids, we shall see of what importance this evacuation must be in the economy, and of what derangements its lesion may become the source. It is doubtless to this law of nature, which ordains that every mucous fluid shall be rejected externally, that in the fœtus we must attribute the presence of the unctuous fluid, of which the gall bladder is full, and of the meconium choking up the intestines, &c., kinds of fluids which appear to be only a collection of mucous juices, which, as they cannot be evacuated, remain, until birth, upon the organs where they have been secreted. [51]

43. It is not the mucous fluids only that are rejected externally; almost all the fluids, separated from the mass of blood by the means of secretion, have the same destiny: this is evident in the most considerable part of the bile. It is very probable, also, that the saliva, the pancreatic juice, and the tears, are discharged with the fæces, and that it is their want of colour alone that prevents them from being distinguished like the bile. I do not know even if, in reflecting on a crowd of phenomena, one would not be tempted to establish, as a general principle, that no fluid, separated by secretion, returns into the circulation; that this destination belongs only to fluids separated by exhalation, as those of the serous cavities, of the articulations, of the medullary organ, &c.; that all the fluids are thus excremental or recremental, and that there is no [52] recremental excrement, as the common division points out[B].

44. What is certain, at least, is, (1) that I have never been able to effect the absorption of bile or saliva by the lymphatics. When I have injected them into the cellular tissue of an animal they have always produced inflammation and suppuration. (2) We know that the urine, when infiltrated, does not become absorbed, and that it strikes with death every part that it touches; whilst the infiltrations of lymph, or of blood, are readily absorbed. (3) There is an essential [53] difference between the blood and the secreted fluids as concerns their decomposition, whilst exhaled fluids and serum, &c., are in that respect very similar.

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[54]

SECTION V.

OF THE VASCULAR SYSTEM OF MUCOUS MEMBRANES.

45. The mucous membranes receive a great number of vessels: the remarkable redness which distinguishes them would be sufficient to prove it to us, if it could not be demonstrated by injections. This redness is not everywhere uniform; it is less in the bladder, large intestines, and frontal sinuses; very marked in the stomach, small intestines, and vagina, &c. It is produced by a web of very numerous vessels, whose supplying branches, after having passed through the chorion, finish on its surface by an infinite division, embracing the corps papillaire, and is [55] covered only by the epidermis.

46. It is the superficial position of these vessels that frequently exposes them to hæmorrhages, as we remark principally in the nose, and as is seen in hæmoptysis, hæmatemæsis, hæmaturia, in certain dysenteries, where the blood escapes from the parieties of the intestines, in uterine hæmorrhages, &c.; so that those spontaneous hæmorrhages, which are independent of any external violence applied to the open vessels, appear to be special affections of the mucous membranes; they are seldom observed but in these organs, and they form at least one of the grand characteristics which distinguishes them from all the other membranes.

47. It is also the superficial situation of the vascular system of mucous membranes that renders their visible portions, as on the lips, the glans, &c.; serviceable in showing us the state of the [56] circulation. Thus, in various kinds of asphyxia, in submersion, strangulation, &c., these parts present a remarkable lividity; the effect of the difficulty that the venous blood finds in passing through the lungs, and of its reflux towards the surfaces where the venous system arises from that of the arteries.

48. I have already observed in the fœtus, and newly born infant, that the vascular system is as apparent in the cutaneous organ as in the mucous membranes; that the redness is there the same; it is even in that part more marked in the earlier periods of conception; but soon after birth all the redness of the skin seems to concentrate itself upon the mucous membranes, which before, being inactive, had no need of so considerable a circulation, but which, becoming all at [57] once the principal seat of the phenomena of digestion, of the excretion of the bile, of the urine, of the saliva, &c., demand a larger quantity of blood. The long continued exposure of mucous membranes to the air frequently occasions them to lose their characteristic redness, and they then assume the colour of the skin (as M. Sabattier has well observed in treating on prolapses of the uterus and vagina). By this circumstance some have been deceived in believing such instances to be cases of Hermaphrodism.

49. An important question in the history of the vascular system of the mucous membranes presents itself, which is, does this system admit more or less blood, according to its various circumstances? As the organs within which this sort of membrane is spread are nearly all of them susceptible of contraction and dilatation, as is observable in the stomach, intestines, bladder, [58] &c., it has been believed, that during their dilatation the vessels, being more spread out, received more blood, and that during their contraction, on the contrary, being folded on themselves, and as it were strangulated, they admitted but a small portion of this fluid, which then flows back into the adjacent organs. M. Chaussier has applied these principles to the stomach, the circulation of which he has considered as being alternately the inverse of that of the omentum, which receives, during the vacuity of that organ, the blood which it, being in a state of contraction, cannot admit. Since M. Lieutaud, an analogous use has been attributed to the spleen. Observe what I have ascertained on this subject from the inspection of animals opened during abstinence, and in the various periods of digestion.

50. (1) Whilst the stomach is in a state of repletion its vessels are more apparent on its exterior [59] surface than during its vacuity; its mucous surface at this time has no higher degree of redness, but it has sometimes appeared to me to be less red than when the viscus was empty. (2) The omentum, being less extended during the plenitude of the stomach, presents nearly the same number of apparent vessels, equal in length, but more folded upon themselves than during the vacuity of that organ[C]. If they are then less loaded with blood the difference is scarcely [60] perceptible. I would here observe, that great care is requisite in opening the animal, or the blood will fall upon the omentum, and prevent us from ascertaining its real state. (3) I am confident that there is no such constant relation between the volume of the spleen and the stomach in its different states of vacuity or plenitude; and if that organ increases and diminishes under various circumstances, it is not always in the inverse ratio of the state of the stomach. Like Lieutaud, I at first made experiments on dogs, in order to satisfy myself respecting the facts just stated; but the inequality in the size and age of those which were brought to me leading me to fear that I might [61] not be able to compare their spleens correctly, I repeated them on Guinea pigs, whose size and condition corresponded, and examined, at the same time, some whilst the stomach was empty, and others whilst it was full. I have almost always found the volume of the spleen nearly equal, or at least the difference has not been very perceptible. Nevertheless, in other experiments I have seen the spleen, under various circumstances, to show variations in its volume, but more particularly in weight; and this was the same during digestion as after that process was finished.

From what has been said it appears, that if, whilst the stomach is empty, there is a reflux of blood to the omentum and spleen, it is less than has been commonly asserted. Moreover, during this state of vacuity, the numerous folds of the mucous membrane of this viscus leaving it, as we have [62] before said, almost as much extent of surface, and consequently of vessels, as during its plenitude, the blood must circulate there nearly as freely as when the viscus is in a contrary state; it has therefore no real obstacles; the only impediment is in consequence of the tortuous direction the vessels are then thrown into. Now this obstacle is easily surmounted, since the vessels suffer no constriction or diminution of calibre by the contraction of the stomach.

51. As respects the other hollow organs, it is difficult to examine the circulation of their adjacent viscera during their plenitude or vacuity; for their vessels are not superficial, as in the omentum, or insulated, as in the spleen; therefore, to decide this question concerning them, we can only observe the state of the mucous membranes upon their internal surface. Now they have always appeared to me as red during the contraction as during the dilatation of the organs. [63] Finally, I give this only as a fact, without pretending to draw any inference from it opposed to the common opinion. It is, in fact, possible, that though the quantity of blood be always nearly the same, the rapidity of the circulation may increase; and consequently, in a given time, more of this fluid will be sent there during the plenitude of the viscera. This appears to be necessary for the secretion of the mucous fluids, which are then more abundant.

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SECTION VI.

OF THE VARIATIONS IN THE ORGANIZATION OF MUCOUS MEMBRANES IN DIFFERENT REGIONS.

52. The assemblage of the epidermis, corps papillaire, chorion, glands, and vessels, constitutes in the mucous membranes their intimate organization, which presents very considerable variations in the different regions in which they are examined. I shall point out only the principal of them; for in no different parts do these membranes present the same appearance, and in order to describe all their differences they should all be examined.

53. One of these variations is that which the aspect of mucous membranes presents at their [65] origin, when compared with their appearance in the more remote parts of the organs. Compare, for instance, the surface of the glans, the inner surface of the lips, the orifice of the urethra, &c., with any portion of the inner surfaces of the stomach, intestines, &c. In the first the corps papillaire will be seen slightly marked, and offering no villous character, the epidermis thick, very distinct, and easily separated, the chorion very evident, the vessels rather less superficial, the mucous glands numerous and very large, more especially in the mouth; in the other characters almost opposite will be observed; we should say, that the mucous membranes have at their origin a structure of a middle kind between the skin and their deeper portions.

54. Another variation of structure, not less striking, is that which is met with in that portion of [66] mucous surface which lines the sinuses. Here it has more redness, and an extreme tenuity; the three layers cannot be distinguished; and although there is a considerable secretion of mucous fluids, there are no perceptible mucous glands. Such are the characters of those portions of the pituitary membrane, which are considered as adapted to augment the sensation of smell, but which do not perform that function in the manner generally understood. In fact, the instant when an odour enters the nose, having the air for its vehicle, it cannot at once pass into the sinuses, because the orifices by which these cavities communicate with the nose are very small; but it enters gradually, impregnates all the air which they contain, and not being able to escape readily, for the same reason that rendered its entrance difficult, the sensation is prolonged, which on the [67] general pituitary membrane is soon dissipated by the action of the fresh air. Thus therefore the pituitary membrane is destined to receive the impressions of odours, and its extensions into the cavities of the sinuses to retain them.

55. With regard to the particular structure of that portion of mucous membrane which lines the sinuses I remark, that it is absolutely the same as of that which is spread over the surface of the internal ear, with the exception of a still more delicate tissue. All anatomists call this membrane the periosteum of the bony covering of the internal ear. The following considerations prove that it is not a fibrous membrane, analogous to that which covers the bones, but a mucous layer, like that of the sinuses. (1) It is evidently seen to be a continuation of the pituitary membrane by the medium of the Eustachian tube. (2) It is found to be habitually moist with a mucous fluid, which is [68] discharged through that tube, a property foreign to fibrous membranes, both of whose surfaces are always attached to some parts of the animal structure. (3) No fibre can be distinguished in it. (4) Its spongy appearance, though whitish, its softness, the readiness with which it gives way to the least agent directed against it, with a view to tear it, form a character not to be found in any part of the periosteum.

56. I pass over the other variations of structure in mucous membranes in their different regions; in all they have real differences. I observe only, (1) That these variations distinguish them from serous membranes, whose aspect is everywhere the same, as may be seen by comparing the pericardium with the peritoneum, &c. (2) The sensibility of mucous membranes varies in a very peculiar manner in their different portions: thus an emetic irritates the stomach, [69] but not the conjunctiva; the pituitary membrane perceives only odours; the mucous surface of the tongue flavours, &c. On the contrary, the contact of all kinds of bodies with the naked serous membranes produces phenomena exactly analogous.

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SECTION VII.

OF THE VITAL POWERS OF THE MUCOUS MEMBRANES.

57. The sensibility of mucous membranes is one of the principal characteristics that distinguishes them from other analogous organs. This power, which belongs to organic bodies, is variable in every part, prompt to develop itself in some parts, under the influence of the least excitement, roused with difficulty in others, present in every part, liable to proceed by means of inflammation from the most obscure state to the last degree of intensity—this power is here remarkable for features very analogous to those which it presents in the cutaneous surface (to [71] which, as we have stated, the mucous surface has great traits of resemblance) as respects its structure. It is to this analogy of sensibility that we must refer a crowd of phenomena, which are alternately exhibited in an inverse order upon both surfaces. I shall now point out some of these phenomena in succession.

58. (1) When the temperature of the surrounding air deadens the sensibility of the cutaneous organ, by contracting its tissue, the sensibility of the mucous surface receives a remarkable increase of energy. Observe why in winter, and in cold climates, where the functions of the skin are singularly limited, all those of the mucous membranes are in proportion augmented; thence arises a more evident pulmonary exhalation, the internal secretions are more abundant, digestion [72] is more active and more ready to operate, consequently the appetite is the more easily excited. (2) When, on the contrary, the heat of the climate, or of the season, &c. relaxes and opens the cutaneous surface, we should say, that the mucous surface is in proportion constricted: during summer, in the south, &c. there is a diminution in the internal secretions, the urine for instance; a tardiness in the digestive phenomena by a default in the actions of the stomach and intestines, and the appetite is slow in returning. (3) The sudden suppression of the functions of the cutaneous organ often determines a morbid increase of action in those of the mucous membrane. Cold air, which checks the perspiration, frequently produces colds and catarrhs, affections which are marked by the sensibility and increased action of the mucous glands. (4) In various affections [73] of the mucous membranes, baths, which relax and determine to the skin, produce beneficial effects.

59. The foregoing considerations evidently establish the influence, which the vital powers of the skin have over those of the mucous membranes. Others, not less important, demonstrate the reciprocal dependence in which the skin is found with the same membranes, as respects their vital powers. (1) During digestion, when the mucous fluids are poured out in abundance into the stomach and intestines, when, consequently, the mucous membranes of the alimentary canal are in high action, the fluid of insensible perspiration is evidently diminished, according to the observation of Santorius: it is very small in quantity three hours after a meal, so that the action of the cutaneous organ is visibly less energetic. (2) During sleep, when all the internal functions [74] become more marked and are in full action, at which time the sensibility of the mucous membranes is consequently highly excited, the skin appears to be seized by a manifest debility—a debility, which is evinced by the cold which it experiences when the animal reposes at night uncovered, and by its want of susceptibility of various impressions.

60. The sensibility of the mucous membranes, like that of the cutaneous organ, is essentially submissive to the immense influence of habit, which, tending incessantly to blunt the acuteness of the sensations of which they are the seat, reduces the pain and the pleasure that we receive through them equally to indifference, which is, as some say, the middle state.

61. I say, in the first place, that habit reduces the painful sensations, which take place on [75] mucous membranes, to indifference. The presence of the catheter, which is passed up the urethra for the first time, is cruel the first day, painful the second, inconvenient the third, scarcely felt the fourth; pessaries introduced into the vagina, bougies into the rectum, tents in the nasal fossæ, the canula in the nasal canal, produce, in different degrees, the same phenomena. It is upon this remark that is founded the possibility of introducing instruments into the trachea to aid respiration, and into the œsophagus to afford artificial deglutition. This law of habit may even transform a painful into a pleasant impression; of this fact the use of snuff, tobacco, and various kinds of food, furnish us with remarkable examples.

62. In the second place I observe, that habit produces indifference to those sensations on the mucous membranes which were at first agreeable. The perfumer placed in a fragrant [76] atmosphere, and the cook, whose palate is constantly affected by delicious flavours, do not experience, in their professions, the exquisite pleasures that they prepare for others. Habit may even change pleasant sensations to painful ones, as in the preceding paragraph we saw it changed painful to pleasing sensations. I observe, further, that this remarkable influence of habit is exercised only over sensations produced by simple contact, and not over those produced by real lesion of the mucous membranes: thus it does not ameliorate the pain produced by stone in the bladder, nor that which attends polypus in the uterus.

63. It is to this power of habit over the vital energies of the mucous membranes that we must, in part, refer the gradual diminution of their functions which accompanies advancing age. All is [77] susceptibility in the infant: in old age all is dull. In the one the very active sensibility of the alimentary, biliary, urinary, and salivary mucous surfaces, is that which principally produces that rapidity with which the digestive and secretory phenomena succeed each other. In the other this sensibility, weakened by the habit of contact, does not so closely connect the same phenomena.

64. Does not the following remarkable modification of the sensibility of the mucous surfaces depend upon the same cause, *viz.* that at their origin, as on the pituitary membrane, the glans, the anus, &c., they give us the sensations of bodies with which they are in contact, and that they do not produce this sensation in the deeply seated organs which they line, as the intestines, &c.? In the interior of these organs this contact is always uniform; the bladder is in contact with the [78] urine only, the gall bladder with the bile, the stomach with the aliments masticated and reduced to an homogeneous, pulpy paste, whatever may be their diversity. This uniformity of sensation prevents perception, because, in order to perceive, we must compare, and here two terms of comparison are wanting. Thus the fœtus has no sensation of the liquor amnii: the air is also very irritating at first to the new-born infant, but at length it is not felt. On the contrary, at the origins of mucous membranes exciting agents vary every instant: the mind can, therefore, perceive their presence, because it is able to establish relations between their various modes of action. What I say is so true, that if in the interior of the organs the mucous membranes be in contact with a foreign body differing from that which is habitual to them, they transmit the sensation of it to the [79] mind; instruments introduced into bladder or stomach are examples of it. Fresh air, which in very hot weather is suddenly introduced into the trachea, causes an agreeable sensation over the surface of the bronchi; but from habit we soon become insensible to it, and the perception ceases.

65. It is very difficult to point out with precision the character of the tonic powers of mucous membranes, because, being almost in every part united to a muscular layer, we can hardly distinguish what belongs to the tonicity of the one from what depends upon the irritability of the other; or otherwise, if the mucous membranes be isolated, as in the nostrils, yet their attachment renders the phenomena of their tonic powers very obscure. Nevertheless, the action of the excretory ducts on their respective fluids, that of the gall bladder, and of the vesiculæ seminales, [80] which are destitute of muscular attachments, and the spasmodic contraction of the urethra, which sometimes takes place when the sound is introduced, leave no doubt of the energy of this tonic power, doubtless similar in its various modifications to that which is observed in the cutaneous organ.

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SECTION VIII.

OF THE SYMPATHIES OF MUCOUS MEMBRANES.

66. I distribute the sympathies of mucous membranes, like those of most of the other organs, into three general classes. In the first class are ranked the sympathies in which irritation, on one part of the mucous surface, produces a sensation in a distant part. A stone in the bladder occasions pain at the end of glans; worms in the intestines excite an itching at the nose. Whytt has seen a painful affection induced over the whole side of the head by a foreign body in the ear; [82] an ulcer in the bladder produces a pain in the superior parts of the thighs every time that the patient passes his urine.

67. I refer to the second class those sympathies in which the irritation of one point on mucous surfaces produces irritability in a different structure; thus, too lively an impression on the pituitary membrane occasions sneezing; the irritation of the bronchi coughing; biliary concretions produce spasmodic vomiting; stones in the bladder occasion retraction of the testicle towards the ring. In all these cases there is contraction of the muscles produced by the irritation of the mucous surface, distant from the place in which that contraction occurs.

68. The last class of the sympathies of mucous membranes embraces those in which the irritation of any part of their extension determines elsewhere the exercise of their tonicity. Here [83]

we must refer to what we have said upon glandular action being augmented by the irritation of the extremities of the excretory ducts. Thus it is evident, that the increase of the tonic power of the parotid for the secretion of the saliva, and of its excretory duct in order to transmit it, when the extremity of this duct is irritated by food, sialogogue medicines, &c.,—it is evident, I say, that this augmentation is a phenomenon purely sympathetic. We may designate each of these three classes by the name of the vital power which they bring into action, calling the first sympathy of sensibility; the second, sympathy of irritability; and the third, sympathy of tonicity.

69. This manner of classing the sympathies is entirely borrowed from the state of the vital powers, of which they are but irregular modifications, and only aberrations, still unknown in their [84] nature. Nevertheless it is subject to very great inconveniences: yet it appears to me to be preferable to that of Whytt, who simply follows the order of the regions; and even to that of Barthy, who, more methodical, examines them successively in the organs connected by systems, in those which are insulated, and in those situated in symmetrical halves of the body.

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SECTION IX.

OF THE FUNCTIONS OF MUCOUS MEMBRANES.

70. I have already examined many of the functions of mucous membranes. I have considered them (1) As one of the grand emunctories of the animal economy. (2) As performing the same functions with respect to heterogeneous bodies, which may be within our organs, as the skin does with regard to the bodies with which it may be in contact. (3) As facilitating the passage of foreign bodies by means of the mucous fluid by which they are lubricated. It remains for me to examine three questions much agitated at this time. (1) If the mucous membranes have any [86] influence over the redness of the blood. (2) If they exhale. (3) If the absorbents arise from them; and if absorption consequently takes place there.

71. The remarkable redness of these membranes, the analogy of respiration, during which the blood becomes changed in colour through the mucous surface of the bronchi, the well-known experiment of a bladder filled with blood and placed in oxygen gas, by which this fluid becomes also changed in colour,—have led to the belief, that the blood, being separated from the atmospheric air merely by a very fine pellicle on certain mucous surfaces, as the pituitary membrane, the palatine, the glans, &c., would there also take a brighter red colour, either by parting with a portion of carbonic acid gas, or by combining with the oxygen of the atmosphere, [87] and that these membranes thus fulfilled functions accessory to those of the lungs. The experiments of Jurine upon the cutaneous organ, experiments adopted by many celebrated physicians, appear also to favour the reality of that conjecture.

72. Observe the experiment that I have tried, in order to ascertain the validity of that fact. Through a wound in the abdomen I drew out a portion of intestine, which I tied at one point. I then returned it, keeping back a part, which I punctured, and introduced into it sufficient atmospheric air to distend all that portion of the bowel between the ligature and the orifice. I then confined the air by another ligature, and reduced the whole. At the end of an hour the animal was opened. I compared the blood of the mesenteric veins, which arise from that portion of intestine distended by air, with the blood of the other mesenteric veins arising from the [88] remainder of the canal: no difference of colour could be observed: the internal surface of the inflated intestine did not exhibit a brighter red. I expected to obtain a more marked effect by repeating the same experiment on another animal with oxygen gas, but I did not perceive any variation in the colour of the blood. As on the mucous membranes, which are ordinarily in contact with the air, this fluid is constantly renewed, and is agitated by a perpetual movement, I tried to produce the same effect in the intestines; for which purpose I made two openings into the abdomen, through each of which I drew a portion of the intestinal tube. I opened these two portions, adapting to one the tube of a bladder filled with oxygen gas, and to the other that of an empty bladder. I then pressed the full bladder so as to make the oxygen gas pass into the empty one through the intermediate portion of intestine which was in the abdomen, so that the warmth [89] there might encourage the circulation. The oxygen gas was in this manner sent many times from one bladder to the other, making a current through the intestine, which from its contraction was more difficult than it at first appeared to be. The abdomen was then opened, but no difference was found between the venous blood returning from that portion of the intestine, and that which flowed from the other parts of the canal. The superficial situation of the mesenteric veins, which are covered by only a fine transparent lamina of peritoneum, and their volume when the animal is not fat, render these comparisons very easy to be made.

73. I think, that from what occurs in the intestines we cannot infer what takes place in the pituitary and palatine membranes, &c.; because, although analogous, their organization may be [90] different. In these parts we cannot examine the venous blood returning from them, as in the intestines: but, (1) If we consider, that in animals, which have for some time respired oxygen gas,

the mucous membrane of the fauces does not exhibit any increase of redness; (2) If we bear in mind, that the lividity of different parts of this membrane, in those asphyxias which are produced by carbonic acid gas, is not occasioned by the immediate contact of this gas with the membranes, but by the reflux towards the surface, of the venous blood which cannot pass through the heart, as occurs in submersion, as demonstrated by Godwin, and as takes place in all those cases in which the blood, previous to death, has found difficulty in passing through the lungs; (3) If we remark lastly, that in these circumstances the contact of the air, after death, does not alter the [91] lividity that the venous blood gives to the mucous membranes, although the skin is then more permeable to every kind of æriform fluid;—we shall see that we must at least suspend our judgment, respecting the colouring of the blood through mucous membranes, until farther observations shall have decided the question.

74. Observe another experiment, which may throw more light still upon the subject. I have distended the peritoneal cavity of different Guinea pigs with carbonic acid gas, with hydrogen gas, with oxygen gas, and with atmospheric air, to see if I could obtain, through a serous membrane, what I had not been able to effect through a mucous surface. In these experiments I have found no difference in the colour of the blood of the abdominal system: it was the same as in fresh animals of the same kind, that I always used to compare with those on which the [92] experiments were made.

75. I believe, nevertheless, that I have observed many times, both in frogs and in animals with warm and red blood, such as cats and Guinea pigs, that the infiltration of oxygen gas into the cellular tissue gives, after a certain time, a brighter colour to the blood than this fluid presents in the artificial emphysemas which may be produced by carbonic acid gas, hydrogen gas, or by atmospheric air, in which circumstances the blood differs very little in colour from its natural shade. But in other cases oxygen gas has had no influence over the colour of the blood; so that, notwithstanding the many experiments that have been made on this point, I cannot state any general result. It appears, that the tonic powers of the cellular tissue, and of the coats of the vessels which ramify in it, receive a very varied influence from the contact of the gases, and that, [93] according to the nature of that influence, the fibres contracting and becoming more or less firm render these parts more or less permeable, both to the æriform fluids, which have a tendency to escape from the blood to unite with that of the emphysema, and to this last fluid, if it tends to combine with the blood. This will doubtless explain the variations that I have observed.

76. Do the mucous surfaces exhale? The analogy of the skin would seem to lead to the belief of it; for it appears well proved, that the perspiration is not a transudation by the inorganic pores of the cutaneous surface, but a true transmission by vessels of a particular nature, and continuous with the arterial system.

77. It appears, at first, that the pulmonary perspiration which takes place on the surface of the bronchi, which has such connection with that of the skin, which increases or diminishes [94] according to the decrease or augmentation of the other, and of which the composition is apparently of the same nature—it appears, I say, that the pulmonary perspiration is produced, at least in part, by the system of exhalent vessels; and that if the combination of the oxygen of the air concurs with the hydrogen of the blood to produce it, during the act of respiration, it is but in a very small quantity, and for that portion only which is purely aqueous. It is necessary to observe further on this subject, that the dissolution of the mucous fluid, which lubricates the bronchi, in the air that is constantly inspired and expired, furnishes a considerable portion of that vapour which rises from the lungs, and which is insensible in summer, but very apparent in winter.

78. The intestinal juice, that Haller has particularly considered, but which appears to be less in [95] quantity than he had estimated, the gastric juice, and that of the œsophagus, are very probably disposed of by way of exhalation on their respective mucous surfaces; but in general it is very difficult to distinguish with precision, in these organs, what belongs to the exhalent system from what is furnished by the system of mucous glands, which, as we have said, are everywhere subjacent to them. Thus we constantly see the mucous fluids of the œsophagus, stomach, and intestines, mix themselves with the other fluids of these parts.

79. That mucous membranes absorb is evidently proved by the absorption of the chyle upon the intestinal surfaces, of venereal virus upon the glans and urethra, of variolous poison which is sometimes rubbed upon the gums, of the serous portions of the bile, of the urine, and of the [96] semen, when they remain in their respective reservoirs. When, from paralysis of the fleshy fibres which terminate the rectum, the fæces accumulate at the extremity of that intestine (a very common case in aged persons, and of which Desault has cited many instances), these accumulations frequently become hard, probably from the absorption of their juices, which are obstructed there. We have many cases in which the urine has been almost entirely absorbed by the mucous surface of the bladder, when there has been absolute obstruction in the urethra. Whatever may be the mode of this absorption, it appears that it is not performed in a constant, uninterrupted manner, like that of the serous membranes, in which the exhalent and absorbent systems are in a continual alternate action; but that it occurs only under certain circumstances, of which perhaps the greatest part are not in the natural order of the functions. Finally, we have [97] yet fewer data respecting the mode of mucous absorption than on that of cutaneous absorption: we confess it is very little understood, and many even question its existence.

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[98]

SECTION X.

REMARKS ON THE AFFECTIONS OF MUCOUS MEMBRANES.

80. It is not my design to examine the affections of mucous membranes; I shall notice only some phenomena, which in these affections I believe deserve a particular attention, and the explanation of which I propose to physiological physicians.

81. Why do mucous membranes seldom contract adhesions from inflammation, since that occurs so frequently in serous surfaces under the same circumstances? Why does not the internal surface of the inflamed stomach, intestines, or bladder, adhere in its various portions like the [99] pleura, tunica vaginalis, testis, &c.

82. Why, in inflammations of mucous membranes, is there an abundant flow of that fluid which habitually moistens them, and which constitutes the different kinds of catarrhs, whilst the source of the fluid that exhales from serous membranes is generally dried up in analogous cases?

83. Why do polypi, a kind of affection peculiar to mucous membranes, seldom arise but at the origins of these membranes in the vicinity of the skin, as in the nose, pharynx, vagina, &c., and not in their more internal portions, as in the stomach, intestines, &c.? Does this arise from the peculiarity of the texture that I have shown mucous membranes to have in the vicinity of those places where they arise from the skin, or must we attribute this fact to the more numerous causes of irritation which act upon the origins of these cavities? [100]

84. Are not aphthæ an isolated inflammatory affection of the glands of the mucous membranes, whilst catarrhs are characterized by a general inflammation of all the parts of these membranes?

THE END.

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FOOTNOTES:

[A] The following questions have been much disputed: Is there a cystic and an hepatic bile? Is the one of a different nature from the other? Does their quantity increase or vary? &c. Contrary, and even opposite, opinions have been supported by numerous experiments made upon living animals, as Haller as well observed. These experiments, though at first sight contradictory, in reality are not so, as I have had the opportunity of convincing myself, by repeating them in the different stages of digestion, and during the abstinence of the animal, which previously had never been done with precision. The following are what I have observed in dogs that I have used in my experiments. (1) During abstinence, the stomach and the small intestines being empty, yellowish clear bile was found in the hepatic duct and ductus communis choledochus; the surface of the duodenum and jejunum were stained by a bile which had the same appearance; the gall bladder was very much distended by a greenish bitter bile, which was deeper in colour and more in quantity, according to the length of the abstinence. (2) During the gastric digestion, which may be prolonged for a sufficient length of time by giving the dog large pieces of meat, which he swallows without chewing, appearances were similar. (3) At the commencement of intestinal digestion, the bile in the hepatic duct was always found yellowish; that of the ductus communis choledochus deeper in colour; the gall bladder not so full, and its bile becoming already more clear. (4) Towards the end of digestion, and immediately after it, the bile of the hepatic duct, of the ductus communis choledochus, that contained in the gall bladder, and that which was spread over the duodenum, were exactly of the same colour as the common hepatic bile, a clear yellow, having but little bitterness. The gall bladder was but half full; it was not contracted, but flaccid.

These observations, repeated a great number of times, evidently prove, that such is the manner in which the bile flows during abstinence and during digestion. (1) It appears that the liver is continually separating from itself a sensible quantity of bile, which increases during digestion. (2) That which is secreted during abstinence is divided between the intestine, which is always found coloured with it, and the gall bladder, which retains it without transmitting any portion of it through the cystic duct, and where, thus retained, it acquires a deeper colour and a character of acrimony, necessary, without doubt, to the digestion which is soon to follow. (3) When the food,

having been digested by the stomach, passes into the duodenum, then all the hepatic bile, which was before divided, flows into the intestine, and even in greater abundance; the gall bladder also pours that which it contains upon the alimentary pulp, and with which it is then found quite incorporated. (4) After the intestinal digestion the hepatic bile diminishes, and begins to flow, part into the duodenum and part into the gall bladder, where, being then examined, it is clear and in small quantity, because it has not yet had time either to become coloured, or to collect.

There is, therefore, this difference between the two kinds of bile, that the hepatic flows in a continual manner into the intestine, and the cystic, during the absence of digestion, flows back into the gall bladder; and whilst that function is going on it passes towards the duodenum; or rather it is always the same fluid, of which one part preserves the character it has when it leaves the liver, and the other part undergoes a change in the gall bladder. The difference of colour in the cystic bile, according to the time that it has remained in the gall bladder, is analogous to the colour of the urine, which becomes deeper as it is retained longer in its receptacle.

[B] The bile in the gall bladder, the urine in the bladder, and the semen in the vesicula seminales, are certainly absorbed; but it is not the fluid itself that re-enters the circulation, but only its finest parts, some of its principles that we are not well acquainted with, probably its aqueous or lymphatic portion. This does not resemble the absorption in the pleura and other analogous membranes, in which the fluid rejoins the blood in the same state as it left it.

[C] This is a necessary consequence of the disposition of the vascular system of the stomach. The arteria coronaria ventriculi superior being situated transversely between the stomach and the omentum, and furnishing branches to both, it is evident, that when the stomach, by separating the duplicatures of the omentum, lodges itself between them, and this in applying itself over the stomach becomes shortened, the branches that it receives from that artery cannot in the same manner apply themselves to it. To effect this it would be necessary, that they should proceed from the one to the other without the intermediate trunk that cuts them at right angles; then the stomach, by distending itself, would separate them in the same way that it does the omentum, and would lodge between them, instead of pushing them before it with their common trunk, and folding them upon themselves.

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Obvious typographical errors and punctuation errors have been corrected after careful comparison with other occurrences within the text and consultation of external sources.

Except for those changes noted below, all misspellings in the text, and inconsistent or archaic usage, have been retained. For example, newly-born, newly born; circumvolutions; atmospherical.

Pg v (TOC), page '101' replaced by '98'.
Pg 54, 'the mach, small' replaced by 'the stomach, small'.
Pg 57, 'membranes is spread' replaced by 'membrane is spread'.
Pg 81, 'OF THE SYMPATHY' replaced by 'OF THE SYMPATHIES'.
Pg 86, 'fine pelicle' replaced by 'fine pellicle'.
Pg 90, 'those asphyxies' replaced by 'those asphyxias'.

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