ELEMENTS

OF

PHYSIOLOGY.

SECTION XXVI.

OF FOOD, AND THE APPETITE FOR IT.

§ 332.

AS the waſte of the animal powers is again reſtored by ſleep, ſo in like manner the inceſſant loſs of the natural powers, and even of the very elementary parts of the body, is repaired by freſh and repeated ſupplies of food.

§ 333.

To the acquiſition and uſe of this food we are forcibly led by the frequent and irreſiſtable calls of *nature*. Theſe calls, though widely different from each other in their natures, tend notwithſtanding to the final accompliſhment of the ſame end: they conſiſt, on one hand, of the inſupport-

able torments of *hunger* and *thirſt*; and on the other, of the very pleaſing, but no leſs powerful, allurements of *appetite*.

§ 334.

The ſtimulus of *hunger*, ſome phyſiologiſts have ſought for in the mutual friction between the rugæ of the ſtomach when empty; others in that which appears, indeed, to be of primary importance in giving birth to this potent ſenſation, namely, not only in a more copious ſecretion and afflux of the humours diſcharged into the firſt paſſages, more eſpecially of the ſaliva, the pancreatic juice, and the bile, but alſo in a certain degree of morbid acrimony, with which theſe ſame humours are apt to be contaminated, unleſs ſuch a ſtate be guarded againſt by regular ſupplies of nouriſhment.

§ 335.

Thirſt is a diſtreſſing ſenſation, ariſing principally from a very troubleſome dryneſs of the fauces and eſophagus; and alſo from a peculiar impreſſion produced by taking in acrid, but more eſpecially ſaline, ſubſtances.

§ 336.

With reſpect to the abſolute *neceſſity* of ſatisfying and removing theſe ſtimuli, no fixed and poſitive rule can with propriety be laid down, as ſuch neceſſity

neceſſity is doubtleſs rendered more or leſs urgent by varieties in age, habit of body, and more eſpecially by the power of cuſtom. From a general conſideration of this ſubject, however, the reſult appears to be, that an adult and healthy perſon, who is under no undue impreſſions or influence, (in whom, for inſtance, thoſe aſſuaſive calls of nature are neither ſilenced by the louder ravings of enthuſiaſtic fanaticiſm, nor by other preternatural cauſes) cannot refrain from the uſe of food, for even one whole day, without a very great proſtration of ſtrength; and can ſeldom faſt for more than eight days without incurring the utmoſt hazard of life.

§ 337.

With regard to *drink*, although a deſire for this appears to urge with the greater vehemence and intenſity of the two, it is, notwithſtanding, much leſs neceſſary to life and health than the article of *food*. This we infer, with apparently ſtrict propriety and truth, not only from numerous ſpecies of warm-blooded animals, as mice, quails, &c. that are never impelled by neceſſity to the uſe of drink, but alſo from actual examples of certain individuals of the human race, who have continued, through a long ſeries of time, in the enjoyment of life, health, and ſpirits, without recourſe to the uſe of drinks of any kind.

§ 338.

As to *food*, controverſies have exiſted reſpecting the kind moſt proper to ſatisfy the internal calls of our nature: whether, for example, the ſtructure and conſtitution of the human body correſpond moſt perfectly with food taken from the animal, or with that derived from the vegetable, kingdom; and which of theſe two kinds of ſubſtances nature, therefore, deſigned to conſtitute the aliment of man?

§ 339.

That man is by nature an herbivorous animal, Rouſſeau attempted, with a great degree of acuteneſs, to prove, not only by arguments taken from the figure of his teeth, and the length of his inteſtines, but by the further conſideration, that woman is naturally uniparous, and furniſhed with two mammæ, &c.; to all which might be added, actual examples of rumination having been performed by human ſubjects, a proceſs well known to belong excluſively to herbivorous animals.

Thoſe, on the contrary, who, with Helvetius, conſider man as a carnivorous animal, attempt to ſupport their opinion by the ſhortneſs of his *inteſtinum cæcum*, and other arguments of a ſimilar nature.

§ 340.

But from more accurate obſervation, and a more minute inveſtigation of the ſubject, it appears, that nature did not intend to reſtrict man to the excluſive uſe of either the one or the other of thoſe kinds of *aliment*, but more indulgently deſtined him to a free participation of both. That this is indeed the kind deſtination of man with reſpect to the nature of his food, we very naturally infer from his teeth, eſpecially the *molares*, and the conformation of his inteſtines, briefly mentioned above, poſſeſſing a middle ſtate between the ſame parts, as they exiſt in carnivorous and in herbivorous animals. This prerogative of man is, however, ſtill more forcibly demonſtrated, by the nature of the articulation which connects the condyles of the lower jaw to the *oſſa temporum* in human ſubjects.

§ 341.

If the obſervations be true (and they ſurely cannot be doubted) which we ſtated on a former occaſion, reſpecting the high privilege of man, in being by far better calculated than other animals for traverſing an extenſive range of climate on the globe we inhabit, it from thence ſpontaneouſly follows, that he would have been indeed very illy accommodated, in being ſolely reſtricted either to the one or the other of the above kinds

of food: for as ſome regions of the globe afford *animal*, and others *vegetable* food alone, the obvious and unhappy reſult of ſuch an excluſive reſtriction would have been, that man, though calculated and deſtined to reſide in all latitudes of the earth, muſt, notwithſtanding, in ſome of them, be denied the uſe of ſuch aliments as nature had rendered eſſentially neceſſary to the continuation of his exiſtence.

§ 342.

Of all animals, with which we are in any meaſure acquainted, man may, with the ſtricteſt propriety and truth, be ſaid to be *omnivorous*. As on the one hand he is calculated to banquet in luxury, amidſt the moſt profuſe variety of delicacies that art can prepare from the immenſe reſources of the animal and vegetable kingdoms, ſo, on the contrary, he is able to retain his health and vigour when ſubſiſting on the moſt ſimple and frugal fare.

Thus, to produce only a very few examples, a great many men even at the preſent day ſubſiſt ſolely on a vegetable diet, ſuch as potatoes, cheſnuts, dates, &c. which conſtituted alſo the food of the firſt progenitors of the human race: for it appears highly probable, that thoſe ſimple and hardy ſons of nature, ſupported life firſt by the fruits and

roots

roots of plants, and afterwards, by the more ſubſtantial and durable fare of grains and pulſe.

Some of the Mooriſh tribes in Africa live almoſt entirely on the gum ſenegal.

The inhabitants of Kamſchatka and of a great many other maritime ſituations ſubſiſt on fiſh.

In Europe itſelf, the *Morlachi* are ſupported almoſt entirely on a diet of fleſh.

Some nations of Barbarians ſubſiſt even on raw fleſh, a circumſtance which is undoubtedly true, with reſpect to the Samoids, the Eſquimaux, and certain tribes of people inhabiting South America.

Neither are the liquids made uſe of as drinks, in certain nations, leſs ſingular and ſtriking.

Thus the inhabitants of ſeveral iſlands, which lie between the tropics, more eſpecially thoſe ſituated in the Pacific Ocean, are entirely deſtitute of ſweet and pleaſant water, and therefore, as a ſubſtitute for this fluid, uſe the delicious juice of the *lacteſcent cocoa*.

Others again drink the waters of the briny ocean;—from all which facts and circumſtances,

taken collectively, together with an infinitude of others that might be adduced, we need not hesitate a moment to pronounce, that man is literally an *omnivorous animal.*

SECT. XXVII.

OF MASTICATION AND DEGLUTITION.

§ 343.

FOR the purpose of masticating the more solid species of food, both our under, and upper jaws, are armed with *three* different kinds of teeth.

These are *first*, the *incisores*, which, in most men, are chisel-formed, and well calculated to bite off morsels of food.

Secondly, the *canini*, strong, conical and completely adapted for breaking substances of greater firmness.

And *lastly*, the *molares*, of different sizes, exquisitely fitted for the process of grinding.

§ 344.

§ 344.

The mandible or lower jaw is connected to the other parts of the head, by means of a very ſingular variety of articulation, which appears to be of a middle nature between *arthroida* and *ganglimus*. Being furniſhed with a pair of double concave cartilages, it thus unites, to a ſufficient degree of ſtrength and firmneſs, a capacity of being eaſily and very conſiderably moved in all directions.

The under jaw is drawn back, in opening the mouth, chiefly by means of the *muſculus biventer*, but in part alſo by the geniohyoidei and the mylohyoidei.

It is brought back again, when we attempt to cut any thing through with the dentes inciſores, and preſſed with aſtoniſhing force againſt the oppoſite jaw, during our efforts to cruſh any hard ſubſtances, by the maſſeter and temporal muſcles.

It is moved laterally in chewing, by the action of the internal and external pterygoid muſcles; the latter of which have alſo the power of moving it in a forward direction.

§ 345.

§ 345.

Subſtances taken into the mouth for the purpoſe of being chewed, are retained, placed in a proper ſituation, and thus effectually ſubjected to the action of the teeth, by means of the *muſculus buccinator*, and the tongue, an organ of extreme flexibility, and very capable of changing its form (§ 233).

§ 346.

During the act of manducation we emulge, as it were, a certain quantity of *ſaliva*, which is an aqueous liquid, of a nature ſomewhat ſaponaceous; it contains a ſmall quantity of earthy matter, (which gives origin to tartarous incruſtations of the teeth, and to ſmall ſublingual calculi); this fluid, from being in perpetual contact with the tongue, makes no ſenſible impreſſions of taſte on that organ, although it contains a ſmall quantity of microcoſmic ſalt; it poſſeſſes antiſeptic and reſolvent properties, and has alſo a power of ſpeedily exciting the proceſs of fermentation in vegetable ſubſtances, eſpecially in thoſe of the farinaceous kind.

§ 347.

The ſources from whence this fluid is derived are, ſmall conglomerate glands, of three ſeveral orders,

orders, the lateral and internal, of which are ſituated beneath the lower jaw.

The moſt conſiderable of theſe glands, called *parotids*, (remarkable, on account of being extremely ſubject to metaſtaſes), excrete their ſaliva through the Stenonian duct, juſt behind the middle molar tooth of the upper jaw.

The ſaliva furniſhed by the *ſubmaxillary* glands, is diſcharged through the duct of Wharton.

That derived from the *ſublingual* glands, which are the leaſt of all, flows through the numerous ducts of Rivinus.

§ 348.

The excretion of ſaliva, (of which, in conformity to the opinion of Nuck, about a pint is commonly ſuppoſed to be ſecreted in the ſpace of twelve hours), is conſiderably encreaſed both by the application of any ſtimulating ſubſtance, and alſo by mechanical preſſure, the latter of which appears to act merely by emulging the containing parts.

Thus, whatever hard ſubſtances we chew, become perfectly moiſtened and macerated, as it were, by a copious afflux of ſaliva produced in conſe-

conſequence of the preſſure, to which the *parotids* are particularly expoſed from, being ſituated ſo near to the articulation of the lower jaw.

With regard to the operation of ſtimuli on the ſecretion of this fluid, it is neceſſary farther to obſerve, that when acrid ſubſtances are taken into the mouth, a plentiful afflux of ſaliva is immediately produced, which has the effect of diluting and thus effectually counteracting the irritating acrimony: an increaſe of the ſame fluid is alſo occaſionally produced by the ſtimulus of the imagination; to this cauſe muſt we refer that afflux of ſaliva, which ſo frequently accompanies a ſtrong appetite for food.

§ 349.

With the ſaliva are blended a fine aqueous, dew-like fluid, which tranſudes from the ſoft parts of the mouth, and alſo a mucus, ſecreted by ſmall glands, ſituated in the lips and cheeks: it is a portion of this mucus by which the tongue is lubricated.

§ 350.

The morſel during maſtication, being thoroughly moiſtened by this mixture of ſaliva and other animal juices, is thus, not only converted by degrees into a ſoft pulpy bolus, more fit for the purpoſe

poſe of deglutition, but is likewiſe prepared, at the ſame time, for further digeſtion and final aſſimilation.

§ 351.

The actual buſineſs of deglutition, although it appears to be of a very compound nature, and is indeed performed by the co-operation of a great many different parts, may be conſidered as commencing and proceeding in the following order; viz. the tongue being firſt retracted towards its baſis, and becoming therefore ſomewhat turgid and ſtiff, receives on its excavated *dorſum* or back, the lubricated and moiſtened bolus, which is from thence forced onwards into the fauces, where it is received by the expanded *infundibulum* of the *pharynx*, which appears, at the ſame time, to advance ſomewhat upwards; on the reception of the food the infundibulum makes a ſingular and violent exertion, which may be ſuppoſed to proceed from a ſpecies of *vita propria;* from this funnel-like entrance, the bolus is again protruded onward, by a threefold contraction of the pharynx, into the *œſophagus*. All the above motions ſucceed each other with the utmoſt degree of rapidity, and are of extremely ſhort continuance.

§ 352.

For the purpoſes of expanding this paſſage, and rendering it at the ſame time ſteady and ſecure,

nature

nature has made the moſt ample proviſion by a variety of auxiliary parts.

The motion of the tongue, in this momentous buſineſs, is regulated and directed by the os hyoideum.

To prevent any of the ſubſtances ſwallowed, from paſſing, by miſtake, either into the internal nares, or into the euſtachean tubes, the ſoft palate is very wiſely provided. This fleſhy curtain, depending equally from the arched roof to which it is attached, is capable of being rendered tenſe by the action of a peculiar ſet of muſcles, and thus the above paſſages may be completely cloſed.

The *glottis* is ſecurely guarded by the tongue itſelf, becauſe at the very inſtant in which we attempt to ſwallow, the larynx, being drawn upward and forward, is in a certain degree concealed beneath the retracted baſis of the tongue, and is ſo compreſſed by it, that the glottis, not only by this conſtriction, but alſo by the additional ſecurity of the epiglottis, is thus very effectually guarded againſt the intruſive entrance of any heterogeneous ſubſtances.

§ 353.

Finally, the buſineſs of deglutition is greatly facilitated by means of a quantity of mucus, with which

which the whole of the paſſage above deſcribed is lubricated; and which, beſides the lingual glands already mentioned (§ 235), is chiefly furniſhed by the numerous ſinuſes of the tonſils, and by that infinitude of mucaginous *cryptæ*, ſo profuſely beſtowed on the larynx itſelf.

§ 354.

With reſpect to the *œſophagus* itſelf, through which all ſubſtances ſwallowed muſt neceſſarily paſs, previouſly to their entrance into the ſtomach, it is a fleſhy canal, rather narrow in its diameter, and exceedingly firm and ſtrong, but at the ſame time pliable, dilatable, and poſſeſſed of a high degree of ſenſibility: it is compoſed of tunics or coats, which, if we except the difference in their thickneſs, bear no ſmall reſemblance to the coats of the other portions of the alimentary canal.

Thus, the external covering is muſcular, made up of fibres running both longitudinally and in tranſverſe or circular directions.

The middle coat is nervous, ending on each ſide in a very lax cellular membrane, by means of which it is connected, as well to the preceding, as to the ſubſequent tunic.

Laſtly,

Laſtly, the internal coat is lined by mucus of an exquiſite degree of lubricity.

§ 355.

The following appears to be the mode in which this canal performs its office; as ſoon as it has received either a draught or bolus completely within its *parietes*, the parts immediately above preſently contract themſelves, thus forcing downwards the ſubſtance to be ſwallowed; which, if it be a bolus, can be protruded onward only by one uniform ſeries of exertions in the ſurrounding tube, till it has paſſed through the diaphragm, and been finally received into the cavity of the ſtomach itſelf.

SECT. XXVIII.

OF DIGESTION.

§ 356.

THE chamber, or immediate ſeat of digeſtion, is the *ſtomach*, a viſcus more uniformly poſſeſſed than any other, by almoſt every individual throughout the immenſe range of *animated nature:* if, therefore, we eſtimate the dignity of the ſeveral viſcera from this circumſtance alone, the ſtomach is, doubtleſs, to be conſidered as an

organ surpassing all the others in utility and importance to the animal economy.

§ 357.

The human stomach resembles a leathern pouch, of very considerable dimensions, sufficient, for the most part, in an adult, to contain three pints, or more, of water, and furnished with two separate orifices or mouths :

These are, *first*, a superior orifice, called *cardia*, which is formed in the place where the œsophagus, by a plaited and somewhat oblique aperture, opens into the stomach itself, and points towards the bottom of this viscus, or that extremity which regards the left side of the body.

Secondly, an *inferior* one, which constitutes the termination of the right, and less capacious end of the stomach : this orifice is called *pylorus*, and descends a short distance into the cavity of the adjoining duodenum.

§ 358.

The situation of the stomach, when empty, is different from that of the same organ, when full : thus, in the *former* state, it hangs loose and flaccid in the abdominal cavity, in such a manner that its greater curvature looks in a backward direction ;

and its pylorus, being turned ſomewhat upwards, forms a plaited or twiſted angle with the duodenum, to which it is connected.

But in the *latter* ſtate, when diſtended with food, its greater curvature is again turned, and looks in an anterior direction, ſo that the pylorus enters now, by a more direct route, into the duodenum; whereas the cardia, on the contrary, is ſo folded and bent as to be completely cloſed.

§ 359.

The ſtomach is compoſed of four principal coats, diſtinguiſhed and ſeparated by three others, of an entirely cellular nature, which lie between them.

The moſt *external* of theſe coverings is common to the ſtomach, with all the reſt (ſave a ſmall portion) of the alimentary canal, and is continued over the *omenta*, which ſhall be ſpoken of hereafter.

Next to this, lies that *cellulo-muſcular* coat, ſo very ſtriking in its nature and properties, on which depend both the exquiſite *irritability* of the ſtomach (§ 306.), and alſo its periſtaltic motion; the latter of which ſhall be a ſubject of conſideration in another place. This coat is compoſed of different

ferent ſtrata of muſcular fibres, which are uſually divided into three orders, one longitudinal, and two circular; the circular fibres are again divided into thoſe that are *directly*, and thoſe that are *obliquely*, circular. It muſt, however, be obſerved, that ſo extremely variable and irregular are the fibres of this coat, with regard to their direction and diſtribution, as ſcarcely to admit of reduction to, and arrangement under, any determinate and general rules.

The third principal coat is called the *nervous*, an appellation extremely improper, as it is compoſed wholly of condenſed cellular membrane, becoming gradually more ſoft and lax on each ſide; by which means it is connected externally to the muſcular, and internally to what we ſhall preſently call the *villous*, coat. It is, notwithſtanding, ſo firm and robuſt, that it may be aptly enough called the *baſis* of the whole ſtomach.

Laſtly, the *internal* coat, which has been very improperly called *villous*, is exceedingly tender, ſomewhat ſpongy, porous, and folded into a very great number of rugæ or wrinkles, ſo that its area is much more extenſive than that of any of the other coats which we have juſt deſcribed: it every where exhibits cells of the utmoſt minuteneſs, ſome-

what ſimilar in appearance to thoſe larger ones, with which the *reticulum* of ruminating animals is very beautifully and elegantly characterized.

The internal ſurface of this coat is lined with mucus, apparently ſecreted by ſmall mucaginous cryptæ, ſome of which may be, indeed, readily enough diſtinguiſhed near to the *pylorus*, or lower orifice of this organ.

§ 360.

The ſtomach is furniſhed with an aſtoniſhing apparatus of nerves, whence its ſenſibility is ſo exquiſite, that it is capable of being very readily affected by ſtimuli of almoſt every kind, whether they be *external*, as cold &c. or *internal* as food, and even by the inquiline humours themſelves. From the ſame ſource ariſes alſo that extenſive, and truly admirable conſent, which exiſts between this important viſcus and moſt of the other functions of the body; to which head belongs, in a particular manner, the ſtriking effects, produced on the ſtomach, by all mental commotions, and alſo, on the other hand, the very powerful influence of an entirely ſound and healthy ſtate of this organ, on the cheerfulneſs and ſerenity of the *mind*.

§ 561.

§ 561.

The number and functions of the *blood veſſels*, belonging to the ſtomach, are no leſs conſiderable and ſtriking, than thoſe of the *nerves*. The ſmall arteries, (of which an infinitude of different orders, are minutely interſperſed throughout the cellular coats of this organ), appear to conſtitute the immediate ſources of the *gaſtric juice*, a liquor which flows in perpetual ſtreamlets from the internal ſurface of the ſtomach.

§ 362.

This juice bears, on the whole, no ſmall reſemblance to ſaliva, except that, agreeably to the experiments of the illuſtrious Spalanzani, its *powers* are counter to *thoſe* which promote fermentation. As to the reſt of its properties, it is ſaponaceous, equally antiſeptic with the ſaliva, and is indeed, a very powerful menſtruum, ſufficient gradually to diſſolve milk after it has been gently coagulated in the ſtomach.

§ 363.

The gaſtric juice appears to be the moſt powerful and active agent in the great buſineſs of digeſtion. If the *food* be carefully maſticated, and ſufficiently blended with the menſtruum furniſhed by the ſalivary glands, this fluid of the ſtomach com-

pletely diſſolves, and finally converts it, into a ſoft pultaceous chyme.

§ 364.

This momentous function is alſo further aided and promoted, by a variety of acceſſory and aſſiſtant powers: of theſe the moſt conſiderable is the *periſtaltic motion*, by means of which the food, now reduced to a pulpy conſiſtence, is thoroughly agitated, and kept perpetually in a ſtate of wavy commotion. Although the force of the periſtaltic motion fall far ſhort of the chimerical calculations, formerly made on this ſubject, by mathematical phyſicians, and although it be not itſelf the ſole cauſe of digeſtion, it is, notwithſtanding, of the utmoſt efficacy and influence in this important proceſs.

§ 365.

Among the auxiliary powers, of this kind, may be alſo reckoned another ſpecies of motion, which the preſſure of the ſurrounding parietes of the abdomen, communicates to the ſtomach: to theſe we may ſtill farther ſubjoin, the extreme warmth of the ſituation in which this viſcus is placed; ſo very powerful was this *fotus* or bath, formerly eſteemed, in conſequence of the abundant quantity of blood contained in the neighbouring veſſels

and

and viſcera, that inſtead of the term *digeſtion*, that of *coction*, was uſed by the greater part of phyſiologiſts.

§ 366.

To determine, with preciſion, the period of time requiſite for the *converſion* of our aliment into chyme by the joint co-operation of the foregoing powers (§ 361.), will appear almoſt impoſſible to any one, who may conſider the great variety of circumſtances, on which ſuch converſion muſt depend: theſe circumſtances are, the quality and quantity of the food taken in, the different degrees of force in the digeſtive powers, the greater or leſs attention and care beſtowed on the preparation of the food for digeſtion, by previous maſtication, &c.

For in a healthy ſubject, the unimpaired ſtomach does not diſcharge ſuch alimentary matters as have been taken in, previouſly to the converſion of their digeſtible parts into a perfect pulp. From whence it is evident, that different periods of time are requiſite, for the complete digeſtion of different kinds of food. If, however, it be allowable to form any general concluſion on this ſubject, it would appear, that from the third, to the ſixth hour, after the uſe of aliment, the ſtomach has, for the moſt part, diſcharged through the pylorus,

in a very gradual manner, the whole of its pultaceous contents.

§ 367.

The pylorus is an annular rim, not formed, (like the other rugæ on the internal ſurface of the ſtomach), by the folding of the villous coat alone, but conſiſting, in part, alſo of a few *faſciculi* from the ſubjacent *nervous*, and alſo of certain fibres from the *muſcular*, coat: all which parts are ſo organized and arranged, as to conſtitute a coniform termination to the ſtomach, that is extended into, and embraced by, the duodenum, in the ſame manner as the *os uteri* is received and embraced, by the ſuperior part of the vagina.

SECT. XXIX.

OF THE PANCREATIC JUICE.

§ 368.

SUBSEQUENT to the expulſion of the chyme through the pylorus, that pulpy maſs muſt be ſubjected, in the duodenum (a ſhort, but remarkable portion of the inteſtinal tube), to new and conſiderable changes, previouſly to the formation

mation and final ſeparation of complete, alimentary chyle. Theſe neceſſary changes are effected in the chyme by the acceſſion and admixture of various kinds of inquiline humours, the moſt ſtriking and important of which, are, the *bile* and the *pancreatic juice*.

§ 369.

Of theſe two humours, we will ſpeak in ſeparate ſections. We proceed therefore, to conſider the liquor of the pancreas firſt, becauſe it appears to bear a very conſiderable reſemblance, both in its nature and uſes, to thoſe other two diſſolvent humours, of which we have already ſpoken, namely, the ſaliva and the gaſtric fluid.

§ 370.

Athough it be indeed a matter of no ſmall difficulty, to procure the pancreatic liquor of a ſound animal, in a pure and unadulterated ſtate, yet the obvious and unequivocal reſult of all the facts, which the moſt attentive inveſtigation has been able to ſupply, with regard to its nature, is, that it bears the ſtrongeſt ſimilitude to the ſaliva in all its general properties. Were it not for the purpoſe of ſhowing how miſchievous, and even deſtructive, the practice of medicine may become, unleſs directed by ſound principles of phyſiology, I ſhould not think it neceſſary nor even proper, at the

the preſent enlightened period, to mention the erroneous phyſiological hypotheſes, entertained by Franc. Sylvius, and his humble followers, Regn. de Graef, Flor. Schuyl, and others, reſpecting the viſionary or ſuppoſed acidity of the pancreatic liquor, eſpecially as thoſe opinions have been long ſince very ably refuted by *Pechlin*, Swammerdam, and Brunner, characters of the firſt celebrity in the annals of medical ſcience.

§ 371.

The ſources from whence the lymph and ſaliva are derived, bear no ſmall reſemblance to that which conſtitutes the ſubject of our preſent conſideration, namely, the *pancreas:* this latter is by far the largeſt of all the conglomerate glands of the human body, and exhibits, in the whole of its ſtructure, a very ſtriking ſimilitude to the glands, that give birth to the ſalivary fluid; with theſe laſt mentioned bodies it alſo further agrees, in this particular, that its excretory canals, ariſing from radicles of the utmoſt minuteneſs, run together and unite by degrees, till they conſtitute finally a common duct, which has received its name from Jo. G. Wirſung, who firſt diſcovered and demonſtrated it in the human ſubject, in the year 1642.

This

This duct passes through the coats of the duodenum, and by a constant *stillicidium*, weeps into the cavity of that intestine, the fluid it had received from the gland to which it is appended.

§ 372.

Finally, the excretion of this fluid appears to be promoted by the very same powers, which were formerly said to be subservient to the excretion of saliva, namely, *pressure* and *stimulus*.

By means of the former, it is emulged chiefly when the stomach is distended and rests immediately on the pancreas.

The substances that contribute most, by their irritations, to excite a discharge of the pancreatic fluid are, first, the chyme itself, as it passes through the pylorus in a crude and unassimilated state; and secondly, the bile, which is discharged through the very same orifice with the liquor of the pancreas.

§ 373.

The use of this fluid is doubtless to dissolve the chyme, more especially that part of it, which has not been sufficiently digested in the stomach: by its abundant afflux, it contributes to assimilate this pulpy

pulpy maſs ſtill more and more to the nature of the inquiline humours, and thus finally mature it for the further proceſs of chylification.

SECT. XXX.

OF THE BILE*.

§ 374.

THE ſecretion of bile is the peculiar deſtination of the *liver*, the largeſt and moſt ponderous viſcus in man. This ſuperiority of ſize is more eſpecially obſervable, during the fœtal

* Doctor Maclurg, of Virginia, publiſhed in the year 1772, an experimental treatiſe on the formation, the nature and the uſes of the human bile, which has acquired for its learned and ingenious author, no ſmall degree of reputation both at home and abroad. That this elaborate publication poſſeſſes an uncommon ſhare of merit, not even the avowed enemies of the Doctor are themſelves able to deny. The author has ſhewn himſelf to be, at leaſt, a very patient experimenter, and an extremely attentive obſerver. He appears to have made himſelf perfectly maſter of the opinions of all authors of celebrity and diſtinction, who had previouſly written on the ſame ſubject. With regard to the literary merit of the compoſition itſelf, it is doubtleſs entitled to the higheſt encomiums that even the moſt partial eulogiſt can beſtow. The order

ſtate, in which, the younger the fœtus the greater is the proportional magnitude of the liver, when compared with that of the other viſcera of the

order is inimitably lucid, the ſtyle is chaſte, manly and nervous in the higheſt degree, and as to cloſeneſs and propriety of argumentative arrangement, not even the ſupercilious logician himſelf, can find room to ſuggeſt the ſhadow of an amendment.

All human compoſitions are, however, like the ſources from whence they originate, in ſome meaſure faulty and imperfect. To this general maxim, humiliating as it may appear to the pride of the ſelf-adoring philoſopher, the treatiſe of the illuſtrious Maclurg is by no means an exception. In ſeveral of the Doctor's experiments there appears to be a want of ſufficient accuracy and definitude, in others a want of object and deſign. Over theſe faults, however, conſiderable as they are in the works of an experimentaliſt, we feel inclined to ſpread a kind mantle of palliation, when we recollect that our author experimented and wrote in the early morn of ſcientific chemiſtry. Experimenters had not yet become perfect adepts in their nice and momentous art; they had not yet acquired ſufficient circumſpection and addreſs to obviate every ſource of fallacy, and to avail themſelves of every circumſtance that might pave the way to ſatisfactory and unequivocal reſults.

But another charge of a more weighty and important nature, lies againſt our learned and ingenious author. He has certainly built, on nothing more ſubſtantial than the flimſy baſis of deceptious analogy, ſome of the leading principles of his favourite doctrine. Thus, for example, he ſuppoſes the

bile

body. The dignity and high importance of this viſcus in the animal economy may be fairly deduced, from the univerſality of its preſence; thus

bile to be a fluid, the direct reſult of a putrefactive degeneracy in a portion of the circulating volume of the blood. His moſt plauſible reaſons in ſupport of this opinion are, *firſt*, that the parts, from whence the incipient radicles of the vena portarum immediately originate, contain, and communicate with, matter already in a ſemiputreſcent ſtate. And *ſecondly*, that the bile is moſt abundant in quantity and moſt active with regard to its quality, at that ſeaſon, and under thoſe circumſtances, which are moſt favourable to the commencement and progreſs of putrefaction in the living ſyſtem, as well as in all other phyſical bodies.

Plauſible as thoſe arguments may, on firſt view appear, they are certainly, as already obſerved, founded on nothing better than fair, but fallacious analogy. The principle which they tend to eſtabliſh ſtands in the moſt direct oppoſition to the reſult of experiment—ſacred experiment! the only unerring guide to conduct the candid enquirer to the everlaſting temple of truth. Did our learned author (I would beg leave to aſk) ever faithfully experiment on ſeparate portions of the blood, drawn from different parts of the body, in order to determine the comparative proximity of each portion, to the putrefactive ſtate? I preſume he never did, otherwiſe his opinion on this ſubject would have been, doubtleſs, very different from what we find in his ingenious publication. For it is a truth, nothing the leſs ſacred and reſpectable on account of its novelty, that if equal quantities of blood be taken from the *vena portarum*, and from the lungs or any part of the arterial ſyſtem, and expoſed to the ſame incumbent

circum-

in all animals poſſeſſing red blood, it exiſts no leſs generally and uniformly than the heart itſelf.

circumſtances, the *pulmonic* or *arterial*, will aſſume the putrefactive proceſs, much ſooner than the *hepatic*, blood. The cauſe of this phenomenon muſt be ſufficiently obvious to any one acquainted with the late diſcoveries, in the divine ſcience of chemiſtry. We would attempt its ſolution in the following manner.

Vital air (which is indeed the genuine ſeptic principle, if any ſuch principle exiſt) is in all caſes eſſential to the progreſs of putrefaction. This air, or rather its baſe (termed oxygene by the ingenious chemiſts of France) is, as we have the ſtrongeſt reaſons to believe, from the experiments of Goodwyn, Beddoes, Girtanner, and others, intimately blended with the circulating blood in its paſſage through the lungs. As the blood proceeds in its mazy route through the different parts of the arterial ſyſtem, it is gradually robbed of its concommitant oxygene or baſe of vital air, by the myſterious action of the animal ſyſtem. The conſequence of this ſpoliation is, that the florid *arterial*, aſſumes a much darker colour, and ſuffers finally a complete tranſmutation into *venous* blood. In this latter ſtate the putrefactive proceſs is leſs apt to commence, becauſe the blood contains leſs oxygene in a ſtate of intimate mixture, or perhaps I might with more propriety ſay, in a ſtate of combination. For in proportion as the baſe of vital air is more intimately blended with, and therefore more nearly approximated to, the conſtituent parts of the blood, the more powerfully can it co-operate with other auxiliary agents, in inducing *theſe parts* to aſſume that inteſtine motion, which conſtitutes the putrefactive proceſs. Although our learned author is decidedly of opinion, that putrefaction commences more readily, if vital air be excluded altogether from

§ 375.

The ſubſtance of the liver is of a nature, *ſui generis*, and may be readily diſtinguiſhed, at firſt

from the putrefying ſubſtances, yet it is now well known, that the very reverſe of this is true. Exclude vital air from a body, in the compoſition of which none of this energetic fluid exiſts, and you thereby embalm that body in a degree equal, if not ſuperior to the embalmment of the unperiſhable mummies of the Eaſt.

No body, whatever, is capable of taking on the putrefactive proceſs, that does not contain in its compoſition more or leſs of thoſe ſimple ſubſtances that belong to the claſs of *inflammables*. Reaſoning therefore a *priori*, or climbing the arduous ſteeps of ſcience by the more laborious ſteps of experiment and obſervation, we are warranted in either caſe to conclude, that putrefaction conſiſts, in a very conſiderable degree, in the intimate combination of the baſe of vital air to certain ſubſtances of an inflammable nature. Both the primary elements of which putrefiable bodies are compoſed, and alſo the reſults of actual putrefaction, co-operate in the eſtabliſhment of the ſame concluſion.

It is certainly a truth, that vital air is as eſſential to the putrefactive proceſs as it is to the ſupport of combuſtion, or the continuance of animal life.

Upon the whole, we may without the ſmalleſt heſitation conclude, that the former opinions of phyſiologiſts reſpecting the ſuppoſed putreſcent diſpoſition of the hepatic blood, are wholly inſupportable by argument or fact, being indeed directly oppoſed to the literal reſult of poſitive experiment;

ſight, from that of all the other viſcera of the body: it conſiſts of a parenchyma of a well known colour and very tender texture: this parenchyma is abundantly ſupplied with nerves, with lymphatic veſſels (very viſible on both ſurfaces), with biliferous ducts, and finally with blood-veſſels, from whence theſe ducts originate: with reſpect to theſe blood-veſſels, ſome of which are remarkably large, we will immediately ſtate a few obſervations on each of their ſeveral orders.

§ 376.

The firſt veſſel which here preſents itſelf for our conſideration is, the *vena portarum*, which differs very widely from every other portion of the venous ſyſtem, not only in its ſingular appearance, but alſo in the peculiarity of its courſe and diſtribution, of which a few words were ſpoken on a former occaſion (§ 87). This large veſſel is formed by the conflux of by far the greater number of the venous branches that originate and run from the viſcera, ſituated in the lower part of the abdomen, and is inveſted and ſtrengthened by

and therefore, that the pious eulogia ſo profuſely beſtowed on the powers of the animal economy, in being able to form an *antiſeptic* out of a highly *putreſcent* fluid, appear to be as viſionary and hypothetical, as *nature's* final intention in the preparation of this fluid was thought to be beneficent, and her proceſs itſelf beautiful, and intereſting.

a cellular covering, commonly known by the name of *capſula Gliſſonii*. No ſooner does this trunk make its entrance into the liver, than it is divided into ſeveral branches, which as they run in various directions through its ſubſtance, ſuffer ſtill farther diviſions, till they are finally encreaſed to a countleſs number of the moſt ſubtle ramifications, which pervade, with the utmoſt minuteneſs, every portion of this viſcus. This whole ſyſtem of the vena portarum was formerly compared, by Galen, to a tree, the roots of which are diſperſed throughout the whole cavity of the abdomen, while its branches are encloſed in the more contracted volume of the liver.

§ 377.

Another blood-veſſel of a different kind, with which the liver is furniſhed, is the *arteria hepatica*. This veſſel originates from the cæliac artery, and although far inferior to the vena portarum, both in its capacity and in the number of its branches, is, notwithſtanding, divided into ramifications of aſtoniſhing ſubtility, and is alſo diſtributed with a great deal of minuteneſs throughout every part of the liver.

§ 378.

The extreme terminations of both the foregoing kinds of veſſels, end in genuine veins, which gradually

gradually uniting, form by their general conflux, certain large venous trunks, that lose themselves finally in the inferior *vena cava*.

§ 379.

Those extreme terminations, by which these small branches of the vena portarum and arteria hepatica become radicles to the vena cava, form a very subtle vascular texture, exhibiting a singular and striking appearance, as if the vessels were convoluted, or wound up into globes of inconceivable minuteness. These globular bodies imposed so effectually on Malpighi, as to induce that illustrious physiologist to consider them as glandular, hexagonal, and hollow kernels, destined to constitute the immediate chambers of secretion.

§ 380.

From those same globular convolutions of blood-vessels arise, lastly, the *pori biliarii*. These are very tender ducts, which convey the gallish liquid from the blood, and completely eliminate the same from the system of the liver, through the *ductus hepaticus communis*, a canal which they form by their general conflux.

§ 381.

It is common for physiologists to enquire, from what kind of blood the bile is immediately

ſecreted; whether from arterial, or from that contained in the *vena portarum?*

Although the former of theſe opinions appears, on the firſt view of the ſubject, to be rendered moſt probable from the analogy of other ſecretions, which are evidently the reſult of arterial action, yet from a more accurate inveſtigation of the matter we will readily be convinced, that by far the greater part, if not indeed the whole, of the biliary ſecretion, is derived from the vena portarum: the blood of this veſſel being lurid, and highly impregnated with phlogiſton, correſponds preciſely with the nature of the bile; but how extremely different, on the other hand, are the habit and conſtitution of the florid and fiery arterial blood, which the cæliac artery tranſmits from the aorta immediately to the liver!

With reſpect to arguments drawn from analogy we may obſerve, that as the vena portarum is ſubjected to an arterial diſtribution, ſo it may, in like manner, poſſeſs the power of performing an arterial function: this ſame opinion, for which we contend, appears alſo to derive additional ſupport from the analogy which exiſts between the liver and the lungs: to perform the leading function of theſe laſt mentioned viſcera, is doubtleſs the immediate deſtination of the large pulmonary arteries; whereas,

whereas, on the other hand, the bronchial artery is only subservient to the nourishment of the parts, on which it is distributed :—the discharge of an office, similar to this latter, is also, if we be not greatly deceived, the more immediate destination of the *arteria hepatica*. Notwithstanding what we have here advanced, we are still ready to acknowledge, that the hepatic artery may possibly contribute somewhat towards the secretion of bile; but, that its influence, in this respect, is indeed very inconsiderable, and not yet sufficiently ascertained and demonstrated, are positions to which we subscribe with the utmost confidence.

382.

The biliary *hepatic liquor*, when once secreted, flows in a gentle but uninterrupted streamlet through the *hepatic duct*; and, when the *intestinum duodenum* is empty, glides directly onward, through the common *ductus choledocus*, into the cavity of that viscus; but when the duodenum is distended with chyme, it becomes necessary for this fluid to pursue a different route, whence it regurgitates from the *hepatic*, and flows through the *cystic duct* into the gall-bladder, where it is retained a certain time, and thence derives the name of *cystic bile*.

§ 383.

The *gall-bladder* is an oblong ſack, ſomewhat pyriform in its figure, attached to the concave ſuperficies of the liver, and compoſed of three membranes or coats.

Theſe are, firſt, the *external*, which does not inveſt the whole of the cyſt, and is derived from the peritoneum.

Secondly, the *middle*, uſually called the nervous coat, which, as in the ſtomach, the inteſtinal tube and the urinary bladder, conſtitutes here likewiſe the principal part of the tone and firmneſs of the ſac.

And, laſtly, the *internal*, which bears a certain ſimilitude to the internal membrane of the ſtomach (§ 359.); like that it is interſperſed with an infinitude of minute blood-veſſels, and like that it is alſo marked by rugæ or wrinkles, which form, here and there, fine net-like checkerings, that exhibit the appearance of the moſt exquiſitely elegant lattice-work.

§ 384.

The neck of the gall-bladder is conical, and forms, by its termination, the *cyſtic duct*, which purſues

purſues not a direct, but ſomewhat circuitous or ſerpentine route, and is furniſhed with a few minute valves of a lunated or falciform figure.

§ 385.

The gall-bladder retains the bile, when once received, till that liquor either flows out ſpontaneouſly, in conſequence of being favoured by a reclined and ſomewhat ſupine poſition of the body, or till it is emulged from the cyſt by the preſſure of the neighbouring inteſtines, namely, the *jejunum* and *ileum*, or by the occaſional paſſage of hardened fæces through the tranſverſe colon.

Different ſtimuli acting on the duodenum have alſo the effect of ſoliciting a more copious effuſion of bile into the cavity of that inteſtine.

The remarkable *contractility* of the gall-bladder, evidenced and ſatisfactorily eſtabliſhed by live diſſections and certain pathological phenomena, (although this ſac be indeed completely deſtitute of all genuine *irratibility*), (§ 307.), will appear to contribute, not a little, to the excretion of the bile; eſpecially when we conſider the ſtimulant impreſſion which this fluid, after retention in the cyſt, muſt make on its ſurrounding *parietes* or walls.

§ 386.

For although the *cyſtic* exhibits, in its general properties, the moſt ſtriking ſimilitude to the *hepatic* bile (§ 382.), it is notwithſtanding concentrated, as it were, by reſt and ſtagnation, and thence rendered more tenacious and bitter: this effect appears to be owing, in a particular manner, to the lymphatic veſſels of the cyſt, which ſlowly abſorb the aqueous parts of the bile, while thus encloſed and retained in a quieſcent ſtate.

§ 387.

We proceed now to the conſideration of the bile itſelf. This is an animal fluid of the higheſt dignity and importance in the living ſyſtem: its nature and uſes have, for twenty pears paſt, laid a foundation for more literary controverſies among phyſiologiſts, than have exiſted reſpecting any other fluid that belongs to the body of man.

What we ſhall advance on this ſubject will relate immediately to the cyſtic bile, as this is to be eſteemed the more perfect of the two, and is therefore in a ſtate more favourable for ſucceſsful inveſtigation.

§ 388.

Bile, taken from the recent corpſe of an adult ſubject, who had not previouſly laboured under

any

any diſeaſe, is a liquor ſomewhat viſcid, of a faint green colour, inclining towards a brown, inodorous, and, if compared with the gall of brutes, of a ſlightly bitteriſh taſte.

§ 389.

Although the conſtituent parts of this fluid neither ſeparate from each other ſpontaneouſly, nor yet by ſo ſimple a mode of treatment as is ſufficient to produce that effect on the parts that compoſe the blood, they may, notwithſtanding, be ſubjected, without much difficulty, to ſuch an examination as will make it appear, that they doubtleſs poſſeſs and exhibit a certain analogy to the elementary parts of the blood, though this analogy ſhould not be purſued to too great an extent.

The bile contains, in the firſt place, an aqueous menſtruum, which has been denominated by ſome late phyſiologiſts, its *ſalivary* part: this may be aptly enough compared to the aqueous portion, and reſembles alſo, though not in every particular, the ſerum of the blood.

From the bile we can alſo ſeparate and procure a ſmall portion of a white and grumous ſubſtance, which may be ſaid to poſſeſs a certain, though remote reſemblance to the plaſtic *lymph* of the blood.

Finally,

Finally, the moſt ſtriking and important principle which the bile contains is the *matter* of *phlogiſton*, derived in large quantities from the blood of the vena portarum, which is highly impregnated with this ſubtle element.

§ 390.

This active inflammable part evidently manifeſts its exiſtence in dried bile, but more eſpecially in gall ſtones, by burſting immediately into flame, when placed in contact with a burning ſubſtance. To the action and influence of this principle muſt we attribute thoſe ſtriking and ſingular qualities, formerly enumerated, ſuch as colour, taſte, &c. which ſerve to diſtinguiſh the bile from the other inquiline humours belonging to the ſyſtem; and from the ſame ſource muſt we alſo derive the other remarkable properties of this fluid, which ſhall be mentioned hereafter.

§ 391.

The bile is not of ſuch a nature as to poſſeſs, like ſoap, an equal affinity to oil and water, and thus ſerve to mix and intimately combine theſe two elements together. The contrary opinion (which was erroneouſly entertained on this ſubject by Boerhaave, and afterwards by Schroder) was formerly invalidated and refuted by certain remarkable experiments of my own (ſince confirmed and

and further increaſed by other writers), and is now entirely repudiated by the greater number of phyſiologiſts. On the other hand, if bile be applied to the two foregoing elements, i. e. oil and water, when in a ſtate of intimate mixture and combination, it produces an evident diſunion and ſeparation of them from each other. This fluid poſſeſſes indeed no alkaline properties, but is, notwithſtanding, equally unfriendly to the exiſtence of acid acrimony, to fermentation, and to putrefaction.

§ 392.

By conſidering with due attention the foregoing obſervations, we may eaſily aſcertain the true, the important, and the diverſified uſes of the bile, in the proceſs of chylification.

For in the firſt place, from that equable and uniform chymous pulp which the ſtomach has diſcharged into the duodenum, which the pancreas has diluted by an effuſion of its own juice, and which moves ſpontaneouſly onward to the cavity of the ſmall inteſtines, it gradually precipitates the fæces, and thus ſeparates from them that cream-like fluid denominated *chyle*.

The

The bile itſelf ſuffers, at the ſame time, a diviſion into two parts, the one aqueous, the other phlogiſtic. The latter part adheres to the fæces, tinges them, and is afterwards diſcharged, along with them, out of the body; whereas the former appears to be mixed with the chyle, and re-conducted back to the maſs of blood.

Thus the abundant phlogiſton, now become troubleſome and noxious to the blood, is firſt directed to the liver, where it is rendered ſubſervient to the formation of a ſingular and very important humour: After this humour has fully anſwered the end of its deſtination, its ſuperfluous, or rather noxious part is included among the excrements, and finally eliminated from the ſyſtem.

A further uſe of the bile is, to evolve and exterminate from the alimentary canal, the fixed air, which had been hitherto confined among the chymous maſs: it appears alſo to act on, and aid, the inteſtinal tube, by means of its ſtimulus, thus exciting it to perform its periſtaltic motion with greater vigour and energy.

I ſilently pretermit a variety of other uſes, commonly attributed to the bile, which appear to me to reſt on more doubtful and equivocal evidence,

ſuch,

ſuch, for inſtance, as its power of regurgitating into the ſtomach when empty, and thus exciting appetite, a phenomenon that, in my opinion, can very ſeldom occur in a well formed and healthy human ſubject.

SECT. XXXI.

OF THE FUNCTION OF THE SPLEEN.

§ 393.

THE *ſpleen* is very intimately connected with the liver, not only by an intercourſe of veſſels, but alſo by the affinity and ſubſerviency of its function: it is ſituated in the left hypochondriac region, oppoſite to the liver; its figure is oblong, generally, indeed, accommodated to the ſituation of the neighbouring viſcera with which it lies in contact: it is ſubject however, to multiplex varieties with regard to form, number, and other ſpecies of *luſi naturæ*, or preternatural phenomena.

§ 394.

Its colour is livid, its texture altogether ſingular, being ſoft, friable, eaſily lacerated, and therefore

fore ſecurely protected by two membranous coverings, the internal of which belongs properly to the ſpleen itſelf, while the external appears to be derived from the omentum.

§ 395.

The ſituation and ſize of the ſpleen are now and then, no leſs than its figure, ſubject to ſtriking and ſingular variations, ariſing in a great meaſure from the different ſtates of the ſtomach, with reſpect to fulneſs and depletion: thus, for example, when the ſtomach is empty, and hangs in a looſe and depending poſition, the ſpleen is diſtended with blood; but when the former viſcus becomes turgid again, the latter is emulged, and conſequently diminiſhed in bulk by the preſſure to which it is ſubjected.

The ſpleen is alſo agitated by another perpetual, though gentle and uniform motion, in conſequence of reſpiration, being ſubjected to the immediate action of a primary inſtrument of that function, namely, the diaphragm.

§ 396.

The texture of the ſpleen, phyſiologiſts formerly ſuppoſed to be cellular, and uniformly compared it to the *corpora cavernoſa* of the penis: this opinion, however, is evidently founded in error, and has

has been very ſatisfactorily refuted by a more accurate examination of the human ſpleen. For, from ſuch examination we learn, that almoſt the whole volume of this viſcus is compoſed of blood veſſels, extremely large in proportion to its ſize; ſo that it is ſupplied with a greater profuſion of blood, than any other part belonging to the body of man.

§ 397.

The ſplenic artery, conſpicuous (agreeably to the experiments of Wintringham) on account of the aſtoniſhing fineneſs and ſtrength of its coats, is divided into an infinitude of minute ramifications, which conſtitute finally, by their evaneſcent extremities, very ſmall pulpy pencils: theſe pencils afford origin, again, to fine filiform veins, that conſtitute by their gradual confluence, large and lax trunks highly capable of dilatation.

§ 398.

This vaſt congeries of blood veſſels, is, however, knit together and ſupported by a ſmall quantity of cellular parenchyma, from whence the abſorbent veſſels ariſe, the trunks of which run on the plain or flat ſide of the ſpleen, between the two membranous coverings, of which we have already ſpoken.

§ 399.

§ 399.

This texture of the ſpleen, ſo very lax and highly capable of admitting blood, correſponds admirably with what we formerly ſaid reſpecting the ſanguineous diſtenſion of this viſcus (§ 395): and we may further obſerve, that the phenomena of the congeſtion, and tardy progreſſive motion of this crimſon fluid in the ſpleen, conſidered in conjunction with the nature of the ſurrounding and contiguous viſcera, tend not a little to illuſtrate the peculiar ſtate and condition of the ſplenic blood, which of themſelves appear to ſhed conſiderable light on the *function* of this myſterious viſcus, a ſubject of ſuch repeated controverſies among phyſiologiſts.

§ 400.

The blood contained in the veins of the ſpleen is very fluid, diſſolved, coagulated with the utmoſt difficulty, and admits of but a ſlight and partial ſeparation of the ſerum from the craſſamentum; its colour is alſo livid and obſcure, as in the fœtus; all which phenomena appear evidently to combine in aſcertaining and even demonſtrating the preſence of an abundant quantity of the phlogiſtic element. That this element is, however, unequivocally preſent in large quantities, I further aſcertained to my entire ſatisfaction, by the following ſimple and concluſive experiment: to the ac-

tion of pure dephlogiſticated air, I expoſed recent ſections and ſlices of the ſpleen of a human ſubject; no ſooner were theſe pieces brought in contact with this vital fluid, than they were overſpread with a very florid and beautiful crimſon bluſh, while the air itſelf, thus deſpoiled of its native fire, was on the other hand, contaminated by the ſplenic phlogiſton.

§ 401.

When we contemplate the foregoing circumſtances collectively, and conſider in the laſt place, that the *ſpleen* is the only viſcus of a ſimilar nature wholly unfurniſhed with any veſtige of an excretory duct, ſave thoſe veſſels which we have already ſaid run to the liver, we are obliged from the force of concurring teſtimony to conclude, that the ſole office of the organ now under conſideration, is to act in ſubſerviency to the function of the liver, and contribute towards the formation of bile by the co-operation of its phlogiſtic parts.

§ 402.

This opinion is ſtill farther ſubſtantiated by a very curious and uſeful obſervation, made on ſuch individuals of the animal kingdom, as have been deprived of the ſpleen by exciſion. It appears that in animals ſubjected to this operation (which, however ſingular and ſeemingly barbarous, has

been, notwithſtanding, very frequently performed from remote periods of time) the cyſtic bile has been uniformly afterwards found to be pale, weakly impregnated with phlogiſton, and diſpoſed to a grume-like coagulation of its lymphatic portion.

SECT. XXXII.

OF THE FUNCTION OF THE OMENTUM.

§ 403.

THE *omentum gaſtrocolium*, or *omentum magnum*, (ſo called to diſtinguiſh it from the *parvum* or *hepaticogaſtricum*), is indeed a very ſingular production of the peritoneum, originating immediately from the external coat of the ſtomach.

§ 404.

For notwithſtanding the continuations of the *peritoneum*, in the abdominal cavity, be almoſt innumerable, and although all the parts contained in this cavity, whether viewed collectively or individually, be ſo uniformly inveſted by it, that, on opening the abdomen, it is impoſſible to diſcover a ſingle viſcus which this membrane does not embrace, yet the modes in which it furniſhes this covering

covering to the ſeveral viſcera, are ſo diverſified, as to merit a diviſion into different claſſes.

Thus, for example, the abdominal cavity contains certain parts, over which the peritoneum is only ſpread in ſuch a partial and ſimple manner, as to inveſt but one of their ſurfaces; this obſervation may be applied particularly to the kidneys, the *inteſtinum rectum*, the *veſica urinaria*, and in ſome meaſure alſo, to the pancreas and gall-bladder.

There are alſo other viſcera, which, notwithſtanding their attachment and adheſion to the ſurrounding parietes of the abdomen, yet project alſo to a conſiderable diſtance into the abdominal cavity itſelf, and derive from the peritoneum a covering, which inveſts, by far, the greater part of their external ſurfaces: of this deſcription are the liver, the ſpleen, and even the ſtomach and female uterus, to which we may add, finally, the teſtes of a male fœtus, previouſly to their deſcent into the ſcrotum.

Conſiderably different again, (in point of peritoneal covering), from both the foregoing claſſes of viſcera, is the whole of the inteſtinal tube, except that portion which is denominated *inteſtinum rectum*. This tube paſſes through the adominal

cavity in ſuch a manner, as to carry along with it, two remarkably broad proceſſes of the peritoneum, namely the *meſentery* and *meſocolon*, to which it adheres in a ſtate of ſuſpenſion: under the ſame claſs with the two preceding proceſſes, may we alſo arrange thoſe ſingular peritoneal productions, denominated the broad ligaments of the uterus.

§ 405.

But finally, the moſt extenſive of all is that peculiar continuation of the peritoneum called the *omentum*. This production is a large empty ſac of a very delicate texture, that hangs in a depending poſition from the great curvature of the ſtomach; it is ſpread over the region of the *ſmall inteſtines* in particular, nicely adapts itſelf to their irregular convexities, and dips down, in ſome meaſure, into their numerous interſtices.

§ 406.

Beſides the blood veſſels by which the omentum is painted, it is alſo marked by numerous *ſtriæ* or *broad lines* of adipoſe ſubſtance, which meet, interſect, and thus form a variety of reticular intertextures, from whence the membrane has received the name *vernaculum*. In perſons diſpoſed to obeſity this adipoſe ſubſtance encreaſes now and then to ſuch a ſize, as to become not only troubleſome but even dangerous: it is alſo this

adipoſe

adipose portion that affords origin to that oily halitus by which the omentum is constantly surrounded and moistened.

§ 407.

It has been the opinion of certain celebrated characters, and a further attempt was made by the illustrious Haller to prove, that the fat contained in the omentum is destined to be taken up by absorption and conveyed to the liver, for the purpose of supplying the bile with its oily portion, &c. With respect to the truth of this opinion, however, I must still be permitted to entertain and express a serious doubt, having never yet been convinced that sound, uncontaminated, bile contains any oil; nor have I ever been able to discover any orifices subservient to such an absorption, not even in frogs themselves, where Malpighi alleged, and even attempted to prove, their existence; much less in that part which is the subject of our present consideration, namely, the omentum of man.

§ 408.

What appears, from the nature and situation of the part, as well as from the concurring belief of all physiologists of the present day, to be a much more unequivocal use of the omentum, is, to lubricate the intestines, and by that means aid and

facilitate their perpetual motion. The ſame appear alſo to be the uſe and deſtination of certain ſimilar, but ſmall, adipoſe *burſæ*, by which the *colon* and *rectum* are inveſted.

The omentum alſo further ſerves to prevent the occurrence of an adheſion between the inteſtines and peritoneum, by which the whole office of the primæ viæ would be ſubverted.

§ 409.

That this adipoſe curtain is deſtined to ſerve as a defence againſt cold, (though an opinion very generally received), appears, notwithſtanding, to reſt on evidence of a more queſtionable nature: the omentum of a man in perfect health, which ought by no means to be burthened with an accumulation of fat, is indeed, but very illy calculated to anſwer ſuch an intention.

When we conſider, in the mean time, the ſingular ſtructure of the two *omenta*, more eſpecially of that denominated *omentum parvum* or *gaſtrohepaticum*, it appears ſufficiently probable, that beſides the uſes already enumerated, the latter is ſtill deſtined for another, of, perhaps, even *ſupreme importance*, which is as yet unknown to us, and which future reſearches in comparative anatomy will be alone able to develope.

SECT.

SECT. XXXIII.

OF THE FUNCTIONS OF THE INTESTINES.

§ 410.

THE inteſtinal tube itſelf (before which the omentum is ſpread, and into which we have already ſeen the chyme conveyed, in order to be further elaborated and ſufficiently fitted for the ſeparation of chyle), is divided into two leading portions, namely, the *ſmall* and *great*; of the functions of which we will now treat ſeparately and in order.

§ 411.

The *ſmall* portion of inteſtines is again ſubdivided into three parts, namely, the *duodenum*, *jejunum*, and *ileum*.

The duodenum derives its name from the circumſtance of its length.

The jejunum from that of its general habit, becauſe, in a recent corpſe, it appears collapſed and empty as it were, even although it contain at the ſame time a quantity of pulpy chyme. In the third diviſion, called *ileum*, the chyme depoſits its fæces, and ſuffers an evolution of its air, which

had been hitherto fixed, ſo that this laſt of the ſmall inteſtines, being at the ſame time the longeſt, and deriving its name from its circumvolutions, appears more turgid, ſomewhat inflated, and marked here and there with ſmall bubble-like eminences, after the manner of the large portion of this tube.

§ 412.

The coats of the ſmall inteſtines are perfectly ſimilar to thoſe compoſing the ſtomach, of which we have already ſpoken (§ 359.)

The *external* is a production of the meſentery.

The *muſcular* coat conſiſts of two orders of fibres, to wit, *longitudinal*, which are interrupted in their courſe, and run rather *externally*, eſpecially on that ſide of the inteſtine that looks in a contrary direction from the meſentery; and more *internal*, *annular*, or *falciform* fibres, which are calculated to contract or narrow the diameter of the tube; whereas the former are intended to diminiſh its longitudinal extent. On both the preceding orders of fibres depends that exquiſitely energetic and pertinacious *irritability* of the inteſtines, of which we have ſpoken on a former occaſion (§ 306.)

The

The *nervous* coat consists of compacted cellular membrane; and may, by a very simple mode of treatment, especially by blowing into it, be again reduced to a spongy, foam-like tissue: throughout this coat a variety of blood-vessels, detached from the mesenteric, are distributed in the form of arborets or branching shrubs, of inimitable elegance and beauty. As in the stomach, so likewise in the intestines, the nervous coat is the principal seat of tenacity and strength.

Finally, the internal coat (which merits more unequivocally, in the small intestines, than in any other part of the alimentary canal, the name *villous*), is continued here and there, in conjunction with the internal surface of the preceding membrane, into wave-like productions and rugous folds, that in the intestines, when inflated and dried, exhibit a falciform appearance, and are denominated valvulæ Kerkringii.

§ 413.

Of the *villi* themselves, an immense number overspread, in the closest order, the whole internal surface of the small intestines: their subtle and exquisitely elegant vascular structure, was first discovered and demonstrated by the labours of the indefatigable Leiberkuhn. While the intestines are destitute of chyle, the *villi* may be compared

in

in ſome meaſure to ſmall purſes hanging in a looſe and flaccid poſition, and conſiſting internally of a ſoft ſpongy texture; but when they become turgid, in conſequence of the abſorption of this milky fluid from the inteſtinal canal, their figure undergoes ſuch a ſtriking change, as to bear no ſmall reſemblance to the *phallus eſculentus* *.

§ 414.

Thoſe *villi* are ſurrounded, at their baſes, by an infinitude of *ſmall glandular follicles*, which are lodged principally in the nervous coat, and communicate by very minute orifices with the inteſtinal cavity, into which they diſcharge a mucus that ſerves to line and lubricate the whole internal ſurface of that tube.

Theſe minute glands are commonly ſuppoſed to conſiſt of three orders. *Firſt*, the Brunnerian or larger glands, which are ſeparate from each other, and ſituated principally on that part of the duodenum, which lies next to the pylorus.

Secondly, the Peyerian, which are conſiderably ſmaller, planted in cluſters, and lodged, in particular, on the other extremity of the ſmall inteſ-

* A ſpecies of *fungus*, denominated *phallus*, from its ſtriking ſimilitude to the male penis.

tines,

tines, which looks towards, and is contiguous to, the valve of the colon.

And, *laſtly*, the glands of Leiberkuhn, the moſt minute of all, of which about eight are ſaid to belong to each *villus*.

It ought to be obſerved, however, that this diviſion of the ſources of mucus appears to reſt on very equivocal evidence. For if I be not greatly deceived, both the Brunnerian and Peyerian glands, as commonly exhibited in plates, are the reſult of a vitiated and diſeaſed ſtate of the inteſtinal tube. I am induced to entertain this opinion from having never been able to diſcover, in the ſound ſmall inteſtines of ſubjects carefully examined in different periods of life, the ſmalleſt veſtige of ſuch fungous papillæ, perforated with orifices; whereas, on the other hand, I have frequently ſeen, in caſes of *aphtha*, almoſt the whole inteſtinal canal planted with countleſs numbers of them, partly ſtanding alone, and partly arranged in crouded cluſters. From conſidering the foregoing circumſtances, I feel a confidence in concluding, that none can be accounted true muciferous glands, except thoſe extremely minute miliary bodies, which, on gently ſeparating the *villous lining*, may be readily detected on its *averted ſurface*, but cannot,

cannot, without great difficulty, be diſtinguiſhed on the ſide next to the eye.

§ 415.

It has been incontrovertibly eſtabliſhed, not only from that well known experiment firſt inſtituted (if I miſtake not) by Pechlin, but alſo from ſeveral others, that as the ſtomach, ſo in like manner the cavity of the ſmall inteſtines, is ſupplied with a conſtant influx of a liquid, denominated, from the place into which it is diſcharged, *inteſtinal juice*. It appears probable that this fluid is ſimilar in its nature to the gaſtric liquor, although a more accurate inveſtigation of it is, certainly as yet, a deſideratum in phyſiology: neither can I venture to ſay any thing deciſive reſpecting the *quantity* of this liquid ſecreted: I am, however, fully of opinion, that Haller has been too profuſe in his eſtimate, where he alleges, that this ſecretion amounts to eight pounds in the ſpace of twenty-four hours.

§ 416.

Further, it is alſo common to the inteſtines with the ſtomach, to be agitated by a *ſimilar*, but far more *lively* and vigorous *periſtaltic motion*, which, in particular, while the chymous pulp is advancing, onward, throws the ſame into gentle commotion,

by

by a wavy and progreſſive conſtriction, and thus propels it forward from the duodenum towards the great inteſtines. For although we cannot abſolutely deny the phenomenon of an anti-periſtaltic commotion, in conſequence of which the inteſtines are ſubjected to a retrograde action, it muſt, notwithſtanding, be acknowledged, that this, in a healthy ſubject, is much feebler than the former, that it occurs more rarely, and poſſeſſes a more precarious and ſhort-lived exiſtence.

§ 417.

In conſequence of the co-operation of thoſe energetic cauſes, hitherto enumerated (viz. both the *principles* of *motion*, of which we have juſt ſpoken, and likewiſe the *ſolvent* and *alterative* powers of the inquiline humours that are every where blended in abundance with the chyme), the following remarkable changes are produced in this heterogeneous maſs :—in the jejunum it exhibits the appearance of a more liquid pulp, poſſeſſing a colour ſomewhat grey, and an odour ſlightly acid : after its entrance into the ileum it begins to ſeparate into two portions ; theſe are, *firſt*, the *fæces*, marked by a pale yellow colour, inclining more or leſs towards a brown, and poſſeſſing a fetid odour ; and, *ſecondly*, a white milk-like fluid, denominated *true chyle*, which floats on the ſurface of the fæces, and is ſeparated from them by the action

action of the hepatic liquor or bile. This chymous emulsion, designated by the name of chyle, is destined to be received by *absorption* into the *lacteal vessels*, through which mazy tubes we will accompany it farther in the *following section ;* and shall, in the mean time, close the *present*, by tracing, in as brief and intelligible a manner as possible, the route pursued by the residuary fæces.

§ 418.

These, therefore, after having become more and more inspissated, in consequence of a tedious course through the ileum, are obliged at length to pass the valve of the colon, and thus enter the tract of the *great intestines ;* for which purpose the neighbouring extremity of the ileum is furnished, and lubricated internally, by a more copious quantity of mucus, destined to destroy the friction of the fæces, and consequently facilitate their transition through the foregoing valve.

§ 419.

The *valve of the colon* (denominated very justly in honour of its real and illustrious discoverer, *valvula Fallopii*), is a short continuation or process of the *ileum* projecting into the cavity of the great *intestinal portion*, by which it is surrounded and closely embraced : the more exterior *labia* of this *process* are so constituted, by means of a more prominent

prominent or extenſive ruga of the *great inteſtine*, as to conſiſt not only of its internal and nervous coats (as is the caſe with the greater number of ſuch plicæ), but to contain alſo in its compoſition ſome fibres from the muſcular coat. Hence the function of this valve appears to be twofold, to prevent the premature paſſage of the fæces from the ſmall into the great inteſtines, and alſo to obſtruct their regurgitation from the latter into the former.

§ 420.

The great inteſtinal portion, which in like manner with the ſmall, is alſo divided into *three ſections*, begins from the *cæcum* (to which is appended the *vermiform proceſs*, a part indeed of equivocal uſe in the economy of an adult ſubject), and conſtitutes collectively a canal ſo capacious, as to admit the inſpiſſated fæces to be gradually collected and retained in its cavity, till a convenient opportunity for their evacuation.

§ 421.

As the *great* is ſuperior to the *ſmall* portion of the inteſtines in diameter, ſo it likewiſe exceeds it in the thickneſs and ſtrength of its coats. The muſcular coat, in particular, poſſeſſes this peculiarity, that its longitudinal fibres (if we except the lower part of the rectum) are collected into three

faſciculi

faſciculi or bundles, called *ligamenta coli ;* aud the colon itſelf is thus divided into diſtinct ſegments of a veſicular or cyſtiform appearance. The internal coat in the *great*, is not of ſuch a beautiful and elegantly floccoſe appearance as in the *ſmall* inteſtines, but poſſeſſes a nearer reſemblance to that which inveſts the cavity of the ſtomach.

§ 422.

The periſtaltic motion appears to be leſs vivid and active in the great, than in the ſmall inteſtines. On the other hand, the *abdominal preſſure* is conſiderably greater on the former than on the latter, in as much as the whole *colon* is ſubjected to its immediate action and influence.

§ 423.

The inſpiſſated and hardened fæces contained in the large inteſtines, are protruded ſlowly onward, till having at length reached the rectum, they excite, by their ſtimulus on the internal ſurface of that tube, a propenſity to an evacuation. For the purpoſe of facilitating this evacuation, ample and wiſe proviſion is made, partly by a defect or interruption in the tranſverſe rugæ, but more eſpecially by a profuſe quantity of mucus, that lubricates the internal ſurface of the rectum near to its extremity.

The evacuation of the fæces is, however, principally accompliſhed by a downward direction of the abdominal preſſure, overcoming the reſiſtance of the coccyx and both the ſphincters, the interior of which is a very ſingular faſciſculus or bundle of annular fibres, but the exterior, a genuine cutaneous muſcle: theſe ends being quite completed, there ſucceeds an entire remiſſion of the abdominal effort, the inteſtine is retracted by the *levator ani* in particular, and finally cloſed again by the contraction of the ſphincters.

SECT. XXXIV.

OF THE FUNCTIONS OF THE ABSORBENT SYSTEM.

§ 424.

FROM obſervations delivered in a former ſection it is ſufficiently evident, that the chyle, which we left in the *inteſtinum ileum*, completely diſengaged from its fæces, is a compound of ſeveral different humours. Although it be almoſt literally impoſſible to calculate, with accuracy and definitude, the preciſe quantity of *inquiline humours*, ſuch as ſaliva, gaſtric juice, pancreatic juice, inteſtinal juice, bile, &c. that is mixed and blended

with the chyme, it appears, notwithſtanding, a matter of the higheſt credibility, that theſe ſeveral humours, taken collectively, very far exceed, in quantity, the other conſtituent part of the chyle, which is derived immediately from alimentary ſubſtances, recently taken as nutriment. Hence we may derive a ſolution of that problem in phyſiology, by what means alimentary matters, though of the moſt different and even oppoſite kinds, may, notwithſtanding, be converted into the ſame aſſimilized, homogeneous, and milk-like chyle, equally adapted to the *nature*, and calculated to ſerve as the *nutriment*, of animals?

§ 425.

The *channels* through which the chyle muſt flow, in its paſſage from the inteſtines to the *maſs of blood*, (the reſervoir deſtined for its ultimate reception), conſtitute a part of the *abſorbent ſyſtem*, which we have hitherto mentioned only occaſionally, and in a very curſory manner, but will now aſſume as the profeſſed object of our preſent attention. This ſyſtem is divided generally into four parts, viz. lacteal veins; lymphatic veins; conglobate glands; and finally, the thoracic duct, each of which ſhall conſtitute a ſubject of excluſive conſideration.

§ 426.

§ 426.

With reſpect to the naſcent origin of the lacteals from the inteſtines, there exiſts ſcarcely a doubt, but that this is conſtituted by the innumerable *villi* of the internal inteſtinal coat, of which we have already ſpoken. It is, however, ſtill a matter of controverſy, whether the lacteals originate immediately from thoſe villi themſelves, or only preſerve a more diſtant intercourſe and communication with them, by means of interjacent cellular ſubſtance. As far as my information has extended, no one has hitherto been able, more than myſelf, to trace the evaneſcent radicles of the lacteal veſſels to the villi themſelves, with ſuch clearneſs and definitude, as to diſcover an immediate and unequivocal connection between the parts; on the other hand, the lacteals appear here and there, throughout the coats of the inteſtines, to form trunks of conſiderable ſize, immediately after their orgin, and, (if a conjecture be allowable), to abſorb from the cellular ſubſtance of the adjacent parts, that chyle which had been originally taken up from the cavity of the inteſtines by means of the villi themſelves. This phenomenon I think I have frequently obſerved, in young puppies, into which I had poured, according to the celebrated experiment of Liſter, a ſolution of Indian blue, one or two hours before ſubjecting them to the operation of *live-diſſection*.

§ 427.

Thoſe trunks, of which we have juſt ſpoken, frequently run the diſtance of ſeveral inches, and ſometimes even wind about in angling or meander-like directions, immediately under the external coat of the inteſtine, previouſly to their entrance into the meſentery.

§ 428.

During their paſſage through the meſentery, theſe trunks make frequent entrances into ſmall *meſenteric glands*, which may be divided into two different *ſeries* or *orders*. Thoſe of the firſt order are ſituated in the vicinity of the inteſtinal tube, and reſemble, in their appearance, ſmall beans lying ſeparate from each other. The glands of the other order, lie nearer to the receptacle of the chyle, are ſuperior in magnitude, and planted in collective cluſters.

§ 429.

Both the foregoing kinds of glands appear to be in reality nothing elſe, than round compacted convolutions of the lacteal veſſels themſelves, covered and interſperſed with an infinitude of minute blood-veſſels: their deſtination appears to be, to retard the progreſſive motion of the *chyle*, in order, perhaps, that, by ſuch delay, it may be more fully and perfectly animaliſed and matured, previouſly

ouſly to its entrance into the thoracic duct, and ſubſequent admixture with the circulating volume of the blood.

§ 430.

It has been propoſed as a phyſiological queſtion, whether or not the *large*, poſſeſs alſo lacteal veins, in common with the *ſmall* inteſtines? The affirmative of this has been zealouſly advocated, and its defence attempted by arguments drawn from the influence and efficacy of ſpecific enemas, of enemas compoſed of nutrimental ſubſtances, of inebriating ſubſtances, &c. and alſo from the following well known circumſtance, viz. that the longer inſpiſſated fæces are retained in the large portion of the alimentary canal, the more indurated and inſucculent they are uniformly found. But although theſe arguments do not ſatisfactorily demonſtrate that any genuine chyle is abſorbed from the fæces after their tranſition over the valve of Fallopius, they furniſh, notwithſtanding, additional evidence in confirmation of that, which has indeed been long ſince eſtabliſhed on the teſtimony of the ſenſe of viſion itſelf, namely, that the great inteſtines abound with a ſufficiently plentiful apparatus of lymphatic veins, perfectly ſimilar to the lacteals both in their ſtructure and functions: in teſtimony of this entire ſimilarity, it may be proper to obſerve, that when the inteſtines are deſtitute

of chyle, the lacteals of the meſentery are then engaged in the abſorption of lymph.

§ 431.

Another queſtion, more important and difficult of ſolution than the former, is, whether or not the whole of the chylē, abſorbed from the cavity of the ſmall inteſtines, be conveyed to the blood through the ſame *public*, and *royal* route, as it is termed, or whether there do not exiſt certain ſecret channels, through which it may glide ſurreptitiouſly onward, to mingle its ſtreamlets with the general current of circulating blood?

It muſt indeed, be confeſſed, that moſt of the arguments, by which phyſiologiſts have endeavoured to prove a private abſorption and conveyance of chyle through the ſanguiferous veins, do not appear to reſt on a very ſolid foundation: thus the aſſertion of Ruyſch, that on the approach of old age the meſenteric glands become ſo indurated and conſtricted, as to be rendered unfit for performing their functions, has been long ſince refuted, and it has, on the other hand, been ſatisfactorily demonſtrated that, different affections of theſe glands, ſuch as ſwellings, &c. very erroneouſly paſs under the common name of *obſtructions*, while, at the ſame time, their veſſels remain in a ſtate ſufficiently pervious to afford a very eaſy entrance

trance and tranſition to injections of quick ſilver. That well known phenomenon, from which it is aſcertained, that tepid water, thrown into the inert meſenteric veins of a dead ſubject, tranſudes into the cavity of the inteſtines, appears to contribute but very little towards the ſatisfactory elucidation of any function of the human body while in a living ſtate; much leſs can we repoſe confidence in the evidence derived from that *bicrural* and *two branched* tube of copper, which was invented by Lieberkuhn, for the purpoſe of confirming the ſame opinion. As to the aſſertion, that chyle has been unequivocally detected in the red veins of the meſentery, it appears to me to ſtand in need of farther evidence for its unqueſtionable confirmation; on the whole, I have never yet been convinced, that thoſe veins convey any thing elſe than blood very highly charged with phlogiſton, deſtined for the ſecretion of bile.

§ 432.

Finally, the ultimate trunks of the lacteal veins, (with certain other tubes very ſimilar in appearance and function, which are formed by the confluence of a great number of minute lymphatic veſſels), unite and conſtitute by their junction, the *receptacle* or *ciſtern of the chyle*, which is a name given by phyſiologiſts to the inferior and larger

portion of the *thoracic duct*, called alſo the *duct of Pecquet.*

§ 433.

This duct is a membranous canal, of a delicate appearance and texture, yet ſufficiently robuſt and ſtrong, more or leſs circuitous in its courſe, and not unfrequently ſubject to very ſtriking diverſities with regard to the direction in which it runs, and the diviſions it occaſionally undergoes: it is equally deſtitute of muſcular fibres and nerves, is furniſhed here and there with ſmall valves, and, after having paſſed over the *left ſubclavian vein*, is again reflected towards, and finally inſerted into, the *ſame*, and, at the very point of inſertion, has its entrance guarded by a valve of a peculiar ſtructure.

§ 434.

The powers which produce and continue the onward motion of the chyle, both in the lacteal veins, and through the thoracic duct, are to be attributed, indeed, principally to the contractility of theſe veſſels themſelves, but, in part alſo, to the valves with which they are furniſhed, to a propulſive *vis a tergo*, and to the uninterrupted pulſation of neighbouring arteries.

§ 435.

§ 435.

It appears probable, that the principal deſtination of the valve, which is fixed, as has been already obſerved, in the entrance of the chyliferous duct into the ſubclavian vein, is not ſo much to obſtruct the lateral paſſage of blood into this duct, as to regulate the neceſſary diſcharge of chyle into the vein, and prevent its admiſſion in any other manner than by a ſlow and gradual ſtillicidium.

By this means, adequate proviſion is made againſt the ſimultaneous entrance of too large a quantity of recent chyle, into the maſs of blood. Such an exceſſive influx of this crude fluid would neceſſarily ſtimulate the *parietes* of the heart to exertions too violent and laborious, and would be blended and aſſimilated by the ſame, with the utmoſt difficulty, and in an imperfect manner; that this would be the reſult, we judge from the nature of recent chyle, which is a compound of heterogeneous elements, derived not only from the *primæ viæ*, by means of the *lacteal*, but alſo from all the other parts of the body, through the avenues of the *lymphatic veſſels*.

§ 436.

The *lymphatic veins* themſelves, which conſtitute a third part of the abſorbent ſyſtem, and bear a very

a very close resemblance to the lacteals, both in structure and in function, are so considerable, in point of extension, as to pervade, perhaps, every part of the human body; but originate, in particular, from the common external integuments, from the pleura, the peritoneum, and viscera, contained in the thorax and abdomen.

§ 437.

The manner in which they arise, is similar to the origin of the lacteals from the intestines, of which we have already spoken. Thus each radicle of each lymphatic vessel, is destined to absorb from a neighbouring portion of cellular membrane, (as from a territory of its own), the moisture it contains, and propel it onward to the general cistern of the chyle.

§ 438.

These *lymphatic vessels* are furnished in their course, sometimes more frequently, sometimes more rarely, with valves situated in *bigæ* or *pairs*. By far the greater part of them enter conglobate glands; those in the vicinity of each other frequently anastomose; and such of them as overspread the surface of certain viscera, as that of the lungs, the liver, &c. form exquisitely elegant reticular expansions.

§ 439.

§ 439.

To pass silently over certain other aids, sufficiently evident from former observations, the function of the lymphatics is greatly promoted by their remarkable contractility, and the *strength* of their delicate coats, which is sufficient, in processes for anatomical preparations, to resist the pressure from a ponderous column of quick silver: this function is also further aided, especially in the joints, by *muscular motion*, in consequence of which, the lymphatics being compressed and closely embraced on all sides, have their tone remarkably augmented.

§ 440.

With respect to the terminations of the lymphatics, various controversies have lately existed among physiological writers. Thus, while some contend, that all those vessels unite in the thoracic duct, (in like manner as the sanguiferous veins unite in the venæ cavæ), others, on the contrary, exempt from this general confluence, at least the lymphatics of the right arm, and right side of the neck, which they allege are not inserted into the same duct, but into the right subclavian vein: others again assert that in the conglobate glands, the lymphatics communicate immediately with sanguiferous veins; and lastly, others maintain (not indeed without an appearance of probability) that certain

certain lymphatic veſſels *, actually exiſt, which form a direct and free communication between the inteſtinal tube and uropoietic organs.

§ 441.

Seeing therefore, the lymphatic veſſels are extended far and wide throughout almoſt the whole ſyſtem, and, eſpecially, in as much as an immenſe profuſion of them originate on the cutaneous ſurface of the body, and may conſequently abſorb ſuch fluids as are applied from without, it is ſufficiently evident, that the lymph, when recently abſorbed, muſt be, indeed, a liquid compoſition extremely heterogeneous and diverſified as

* For a great number of truly important obſervations and highly intereſting ſpeculations on this ſubject, the reader is referred to a ſhort treatiſe, written by Charles Darwin, "On the retrograde motion of the lymphatics," and publiſhed at Litchfield in the year 1780, a conſiderable period of time after the premature death of its ingenious author. This young philoſopher and phyſician appears to have been peculiarly formed by nature, and happily finiſhed by education, to ſhed unequivocal light on ſubjects of a dark and difficult nature in the ſcience of medicine. He experimented with accuracy and definitude, he obſerved with the utmoſt attention, and he ſpeculated with the higheſt ingenuity and force. Unhappily for the *healing art*, and (perhaps I may add) for *ſcience* in all its various branches, this amiable young philoſopher was haſtily ſummoned away, ere yet his mind was perfectly expanded, or his plenitude of merit announced to the world.

to

to its nature and elementary parts: this diverſity is fully aſcertained and eſtabliſhed, by a more careful and accurate examination of dead ſubjects, where, for inſtance, the liquid contained in the abſorbents of the liver and ſpleen, appears to be evidently different from that diſcovered in thoſe which run to the uterus.

§ 442.

Of the *conglobate glands*, (which conſtitute the laſt branch of the lymphatic ſyſtem), the principal uſe and deſtination appear to be, to aſſimilate to the animal nature this ſubtle and heterogeneous fluid, eſpecially that portion of it which is abſorbed by the lymphatics of the ſkin: this aſſimilation they accompliſh by retarding and in ſome meaſure obſtructing the motion of the lymph, and perhaps alſo by the addition of a new fluid, derived from the minute arteries, with which they very plentifully abound. Hence a wiſe and adequate proviſion is made, to prevent the *humours*, while in too crude a ſtate, from effecting a premature mixture with the blood, and thus the heart is guarded in perfect ſecurity from their noxious impreſſions.

§ 443.

With reſpect to thoſe other glands of the ſame nature, which are minutely diſpread throughout by

by far the greater part of the ſyſtem, and planted here and there in collected cluſters, as in the groin, beneath the axilla, &c. they bear, in every reſpect, the moſt perfect reſemblance to the meſenteric glands, of which we have already ſpoken; like them they are compoſed, in a great meaſure, of the mazy convolutions of abſorbent veins; like them they are furniſhed with a vaſt profuſion of minute blood veſſels; and finally, they are ſubject to be readily invaded by the ſame diſeaſes that attack the glands of the meſentery.

SECT. XXXV.

OF SANGUIFICATION.

§ 444.

IT is ſcarcely neceſſary to obſerve, that by the term *ſanguification*, we mean the aſſimilation of *chyle* to *blood*, and the conſtant and uniform reſtitution made by means of the *former*, for the equally conſtant and uniform loſs which is ſuſtained by the *latter*.

§ 445.

For on this *principle* depends that diviſion of all the humours of our body, into the three claſſes

(§ 4.

(§ 4. 5.) of *crude*, *ſanguineous*, and *ſecreted*; viz. that the middle claſs embrace the whole circulating volume of blood, from which the different ſecreted humours are derived in conſtant ſtreamlets, and to which the countleſs channels of the abſorbent ſyſtem convey their chyle, and the infinitude of lymphatic tubes return their abſorbed fluids in currents equally conſtant and uniform.

§ 446.

Seeing the blood is an animal humour of ſo very ſingular and excluſive a kind, as to be wholly diſſimilar to every other fluid yet diſcovered in any department of nature, it is a propoſition ſufficiently ſelf-evident, that there muſt be a variety of aſſiſtant powers which contribute, by their joint cooperation, to incorporate and aſſimilize with the blood, the heterogeneous and adventitious humours, which it is conſtantly deriving from the thoracic duct.

§ 447.

The proceſs of ſanguification we may conſider, then, as firſt commencing under the action and influence of thoſe mazy circumvolutions (frequently ſpoken of already), which both the lacteal and lymphatic veins exhibit occaſionally in their courſes (more eſpecially in the meſenteric and other conglobate

globate glands), and which are, at the ſame time, furniſhed with conſiderable quantities of what may be called *animal* and *inquiline contagion*.

§ 448.

It is neceſſary further to conſider, that a great part of the lymph, which enters the ſubclavian vein (after having firſt effected a mixture with the inteſtinal chyle in the thoracic duct), is derived from the interior receſſes of the viſcera and other ſoft parts of the body, and was formerly ſecreted from the blood itſelf; from whence it neceſſarily follows, that ſuch portion of the lymphatic fluid muſt doubtleſs poſſeſs, already, the animal nature entire, and be very readily miſcible with the maſs of blood to which it is returned.

§ 449.

To theſe we may add another circumſtance, of which we ſpoke on a former occaſion, namely, the ſlow and ſtillicidious tranſition of the *chyle* into its reſervoir, the *blood*—that fluid not being admitted to paſs through the ultimate valve of the thoracic duct into the ſubclavian vein, in any other manner than by drops, in order that thoſe minute portions may, by this means, be more intimately mixed and incorporated with the circulating blood.

§ 450.

The internal ſtructure of the heart itſelf appears alſo to contribute, not a little, towards the important proceſs of ſanguification. Thus, by means of thoſe aſtoniſhing muſcular papillæ, with which the ventricles of the heart are plentifully furniſhed, the blood and chyle (having recently met together), are thoroughly agitated, and brought into a ſtate of more intimate combination.

§ 451.

That the *lungs*, receiving the blood, recently impregnated with chyle, perform, by the function of reſpiration, an important part in the further aſſimilation of this crude fluid, will appear ſufficiently evident to any one who conſiders the aſtoniſhing vaſcular ſtructure of theſe viſcera (§ 136.) in conjunction with the equable alternate motion to which they are perpetually ſubjected, during the continuance of human life.

§ 452.

The remaining part of the proceſs of ſanguification is finally completed by the more extenſive circuitous journey of the blood throughout the whole body, and by thoſe powers which contribute towards the continuance of the ſame, more eſpecially *muſcular motion*, &c.

§ 453.

But although potent proviſion be made, by ſuch powerful and diverſified *apparatus*, for blending and intimately incorporating the chyle with the blood, it appears, notwithſtanding, that there exiſts a certain ſimilarity between the conſtituent parts of thoſe two fluids. It is very commonly aſſerted, that a great many hours muſt elapſe before the chyle can be completely diveſted of its own milky colour, and perfectly aſſimilated to *that* of the crimſon fluid into which it is deſtined to be converted: in teſtimony of the truth of this aſſertion, medical philoſophers uſually adduce (beſides other arguments) the following ſingular pathological phenomenon, namely, that ſeveral hours after the cloſe of digeſtion, genuine chyle has been frequently obſerved to flow from an orifice made in a vein of the human body: this phenomenon I have indeed had an opportunity of obſerving myſelf; but it was at the ſame time extremely evident, that the blood was then highly charged with phlogiſton (a condition of this fluid very unfriendly to the regular aſſimilation of chyle), ſo that from hence ſcarcely any inference can be drawn relative *to the healthy ſtate* of the ſyſtem, which is alone the excluſive ſubject of the ſcience of phyſiology.

SECT.

SECT. XXXVI.

OF NUTRITION.

§ 454.

BESIDES *that function* (which we attributed to the blood in a former ſection) of diſtributing the element of *fire* throughout the whole body, and in *its* place wafting that of *phlogiſton* back to the lungs, two of its primary and leading offices appear to be, to convey to the body nouriſhment, and to the ſecretory organs the matter of thoſe peculiar fluids which they are ſeverally deſtined to extract. Of this twofold function we will next treat; and *firſt* of the function of *nutrition*.

§ 455.

Nutrition is the ſupreme privilege of nature. It is a common and leading prerogative of all organized bodies, whether animal or vegetable, by which they are inſtantly diſcovered, on firſt view, to ſurpaſs, in an immeaſureable degree, all machines and automatons conſtructed by human artifice: becauſe on none of theſe latter has any artiſt ever been able to confer a power (I will not ſay of actual *growth*, of progreſſing toward *maturity*, and of acquiring gradually higher and higher

degrees of *perfection*), but not even of preſerving themſelves in a ſtate of *ſtationary exiſtence* by their own inherent powers, nor of repairing the gradual loſſes to which they are ſubjected by attrition, by incidental caſualties, &c.

§ 456.

Nutrition is that faculty of our bodies, on which all the ſublime and aſtoniſhing functions of our nature depend. By means of this faculty we increaſe in magnitude from the earlieſt dawnings of our exiſtence, we advance through the expanding period of youth, and finally arrive at our *acme*, or point of complete maturity. It is alſo through the inſtrumentality of this ſame faculty that a competent remedy is applied, and ſufficient reſtitution made, for that uniform waſte and loſs of the body, by which (while in a living ſtate) it deſtroys and in ſome meaſure conſumes itſelf, by its own neceſſary action.

§ 457.

With reſpect to the nature and mode of this *waſting* or loſs, various controverſies have exiſted among phyſiologiſts. The more immediate point of diſputation has been, whether ſuch waſte occurs in the ſolid parts of our bodies, or whether it be not more probable, that thoſe parts, when once formed and completed, remain ſtationary, without being

being ſubject either to vitiation or change? which latter is indeed an opinion embraced and taught by ſeveral characters of the utmoſt acumen and ingenuity.

§ 458.

With reſpect to ſome particular ſolid parts of the body, ſuch, for example, as the epidermis, the nails, &c. there exiſts indeed not a ſhadow of doubt, but that they are gradually deſtroyed and again repaired; and with regard to the deſtruction or waſte and ſubſequent reparation of the bones themſelves, the teſtimony will appear equally plain and concluſive, to any one who may conſider with attention the reſult of the well known experiments made by feeding warm-blooded animals, for ſome time, on the root of the *rubia tinctorum*, or who may take the further trouble of contemplating attentively the phenomena exhibited by certain large plain bones, eſpecially thoſe of the cranium, which in extreme old age become remarkably attenuated, or diminiſhed in thickneſs, in conſequence of the ſcanty nouriſhment with which they are ſupplied at that period of life.

§ 450.

Upon the whole, if I be capable of judging rightly, thoſe ſolid parts appear to be not only gradually conſumed, and again repaired, by the

faculty of nutrition, but poſſeſs alſo a *vis reproductiva*, or power of re-production. This latter is indeed a ſurpriſing faculty, deſtined not only to make reſtitution for the uniform removal of minute atoms by the neceſſary action of the animal economy, but alſo to repair the incidental loſs of larger parts (ſuffered in conſequence of external injuries, wounds, &c.), by a perfect reſtoration of the ſubſtance of which the body has been thus forcibly deprived. That ſuch a power does unequivocally reſide in the bones, and a few other parts, of which we have juſt ſpoken, is with me too well aſcertained and ſubſtantiated to admit of a doubt.

§ 460.

But on the other hand, from a variety of obſervations and experiments which I have made both on man and other warm-blooded animals, this *power of reproduction* appears to reſide in ſcarcely any other ſolid parts of the body than *ſuch as are endowed with contractility alone, without poſſeſſing at the ſame time any of the other vital energies, ſuch as irritability, ſenſibility, or finally, ſpecific life.*

§ 461.

Of thoſe parts of the ſyſtem therefore (which poſſeſs the more exalted kinds of vital energy), the ſtaminal baſis appears to me to conſiſt of a *perennial*

rennial parenchyma, which is ſubject neither to genuine mutation nor decay, but only liable to certain *viciſſitudes* in point of bulk, that are produced in the following manner, namely, when the proceſs of nutrition is conducted with ſufficient activity and vigour, the cellular interſtices of the parenchyma, being uniformly filled with the rich and plaſtic lymph of the blood, are, of courſe, diſtended, and the parenchyma neceſſarily enlarged; but when, on the other hand, nutrition goes on leſs favourably, theſe ſame interſtices, being in a great meaſure deprived of this nutritious lymph, fall into a ſtate of collapſe, and the parts become conſequently diminiſhed in ſize.

§ 462.

With reſpect to this plaſtic lymph (of the dignity and importance of which we have ſpoken fully on a former occaſion), as it aſſumes with great facility the appearance and nature of genuine cellular membrane, ſo it appears to conſtitute generally the principal nutritious matter of the whole ſyſtem, and is conveyed to every part of the body by means of that infinitude of minute blood-veſſels, to which we have ſo often called the reader's attention.

§ 463.

During the time of the body's advancement in growth, it appears to poſſeſs certain peculiar or ſpecific powers, by the aid of which the lymph, being depoſited from the evaneſcent extremities of the ſanguiferous veſſels, into the ſurrounding cellular membrane, is duly arranged, and completely aſſimilated to each particular portion, and kind of parenchyma. To the head of theſe ſpecific powers, muſt we in part refer that particular law of affinity, by means of which the *partes ſimilares* of the ſyſtem attract and appropriate to themſelves, the homogeneous *elements* of the nutritious lymph, more eſpecially ſuch of them, as poſſeſs reciprocal and kindred propenſities; and to the ſame head may we alſo in part refer that *niſus formativus*, of which we will have occaſion to ſpeak more fully hereafter, and to which muſt be attributed, the juſt and ſpecific application of the rude, and hitherto formleſs, elementary matter, and its ſubſequent organiſation and arrangement into the form and figure of its peculiar deſtination.

§ 464.

It is, I preſume, from the joint co-operation of both the preceding powers, that we muſt principally derive the nutrition of thoſe parts of the body, which are not proximately ſupplied with any

blood

blood veſſels at all; ſuch as the nails, hairs, &c. and which are, notwithſtanding, generated at firſt, by a very powerful and truly infallible *niſus* or exertion, are afterwards advanced in magnitude, and regularly ſupported by nutriment throughout the whole of life, and, finally, if by accident removed, are again readily reſtored by the aſtoniſhing efforts of the *vis reproductiva*.

§ 465.

Although the preceding appears to be a general *breviate account* of the proceſs of nutrition, yet, on the other hand, it is evident that there exiſts, in different individuals, a great many varieties, with regard to the degrees and modes in which this function is diſcharged. Thus, for example, in proportion as a more lax or more cloſe *appoſition* and *union* of the nutritious matter are effected, the texture of the parts themſelves is rendered more denſe or delicate, and hence alſo ſeems to originate the difference between the ſpecific weight of human bodies; in which reſpect it is well known, not only that man differs from man, but even nation from nation: in teſtimony of this truth it may be ſufficient to adduce even a ſolitary example from among certain northern tribes, namely, the Jukutæ, the Buratæ, &c. people highly conſpicuous on account of the remarkable and truly ſingular levity of their bodies.

SECT.

SECT. XXXVII.

OF SECRETION.

§ 466.

BESIDES thoſe juices deſtined for the important proceſs of nutrition, there are alſo in the animal ſyſtem other humours, of a very different order and character, which are extracted for various purpoſes from the exuberant fountain of the blood. Theſe humours owe their exiſtence to the proceſs of ſecretion, than which no function is leſs underſtood by phyſiologiſts; a *truth* mentioned as a ſubject of juſt regret, both by the immortal Haller and other preceding writers.

§ 467.

The ſecreted humours, appear, in one point of view, to be ſo extremely diverſified in their natures, and, in another, to bear ſo ſtriking an affinity to each other, that it is not poſſible to reduce them to any, ſave highly arbitrary, *claſſes*. If, however, in treating of theſe humours, we found our diviſions of them on the leſs and greater changes to which their elementary parts, (contained

tained in the mass of blood), are subjected in the secretory organs, they may be aptly enough enumerated in the following order.

First, *the milk*, a fluid which we think proper to place at the head of our *census* or enumeration, because it may be considered, in some measure, as renovated chyle, and appears to be secreted, by the most simple process, from the blood, to which the chyle had been recently united.

Secondly, the *aqueous fluids;* such, for example, as the humours of the eye, and the tears: to the same head must we refer in like manner, the sweat; and also, (if our opinion be not unfounded), that halitus which is contained generally in the interstices of the cellular membrane, as well as in the cavities of the thorax and abdomen: this vapour appears to differ but very little either from the liquor of the pericardium, or from that subtle halitus by which the ventricles of the brain, and the pituitary sinuses of the cranium are preserved in a state of perpetual humidity.

Under the same head of aqueous fluids, it is likewise common to arrange the *urine*, although this is doubtless a liquid possessed of some singularly striking and peculiar properties.

Of

Of a leſs compound nature are the *ſalivary* humours, which, in office, are ſubſervient to maſtication, to digeſtion, and to chylification.

Thirdly, the *mucagenous fluids*, which inveſt and lubricate the cavities of moſt of the viſcera, that are deſtined to the performance of the natural and genital functions, and alſo the internal ſurfaces of all the aerial avenues belonging to the ſyſtem, ſuch as the *nares*, the *larynx*, and the *aſpera arteria*.

Of a nature not widely different from the foregoing, is that portion of mucus which covers the internal ſegment of the eyeball; as well as that which is ſpread immediately beneath the epidermis.

Fourthly, the *adipoſe humours* are, in particular, (beſides the common fat itſelf), the medulla of the bones, and the ſmegma or oily covering of the ſkin, to which may be added the *cerumen aurium*, or waxlike ſubſtance inveſting the external avenues of the ears.

Of a nature nearly related to the foregoing, is that unctuous ſecretion, ſo evident on the *glans penis* of the male, and about the *rima* or *os externum*, in the genital organs of the female.

Under

Under the ſame claſs may we alſo arrange that oily ſubſtance, with which the glands of Meibomius furniſh and anoint the eyelids.

Fifthly, what are commonly denominated by phyſiologiſts *gelatinous fluids*, examples of which we have in the *liquor amnii*, and *unguen* of the joints. Reſpecting the nature of theſe fluids, however, we are not yet poſſeſſed of a ſufficient number of well authenticated facts to give birth to unequivocal and ſatisfactory concluſions: a ſimilar obſervation may alſo be made, reſpecting that uninveſtigated and anonymous humour, which the female uterus diſcharges during the ardent glow of the venereal orgaſm.

We remain alſo as yet, in a ſtate of equal uncertainty reſpecting the nature of that fluid, which is lodged, during the firſt months after conception, between the chorion and amnios; of that which is contained in the umbilical *veſicula* or *pouch* of the embryo in its tendereſt ſtate; and alſo of that which is interpoſed between the three veſſels that conſtitute the umbilical cord.

The liquid encloſed in the *veſiculæ graffianæ* of the female ovary, and alſo the liquor of the proſtate gland, appear to be of a truly *ſerous* or *albuminous* nature.

Sixth-

Sixthlly, the *male ſemen* appears to be a *humour* ſo remarkably ſingular in its nature, as not to admit of claſſification, nor even of compariſon, with any other.

And laſtly, with regard to the *bile*, there is equal room for the admiſſion of a ſimilar obſervation.

§ 468.

That the foregoing ſecreted humours, ſo extremely diverſified in their natures and habits, can neither be derived from the maſs of blood by the ſame individual proceſs, nor by organs of the ſame kind, is a propoſition too ſelf-evident to ſtand in need of, or indeed leave room for, any farther confirmation. Among theſe humours, there obviouſly exiſts this memorable variety, namely, that while ſome of them are ſecreted and conveyed from the blood through a *ſhorter route*, others again, are more elaborately prepared, by being carried onward through tubes of greater longitudinal extenſion.

§ 469.

Of all the modes of ſecretion, *that* muſt doubtleſs be conſidered as the moſt ſimple, in which the ſecreted humour appears to tranſude immediately through the coats of the arteries, by what phyſiologiſts

ologiſts call *diapedeſis*. Inſtances of this mode we have in the ſecretion of the fat, and of the medulla reſiding in the bones, &c.; and, finally, it appears to be by a modification of the ſecretory proceſs, not greatly diſſimilar to the foregoing, that the gaſtric liquor, the inteſtinal liquor, &c. are prepared and diſcharged into the cavities of their reſpective viſcera.

§ 470.

The mechaniſm of ſecretion appears to be more compound, where that proceſs is performed by means of *glands*, under which denomination we generally include even *follicles* and *cryptæ* themſelves; ſuch, for example, as are eaſily diſcoverable in the fauces; and which phyſiologiſts generally deſignate by the name of *glandulæ ſimpliſſimæ*.

We beſtow, with propriety, the denomination of ſecreting glands, on thoſe bodies which, (to diſtinguiſh them from the *conglobate*, belonging to the lymphatic ſyſtem), are called *conglomerate*; examples of which we have in the ſalivary glands, in the pancreas, in the lachrymal glands, and in the *mammæ*, or breaſts of females. The foregoing glandular bodies are furniſhed with excretory ducts, which are compoſed of tubes or canals running immediately from their larger lobes: theſe

lobes,

lobes, on being ſubmitted to farther examination, are found to be made up of ſmaller lobules, reſpecting the internal ſtructure of which, there formerly exiſted very warm controverſies in ſome of the moſt celebrated ſchools of medicine. Malpighi conſidered the ſmall miliary globules, which may be readily demonſtrated in the greater part of them, to be nothing elſe than genuine *acini* or *kernels*, containing, each one, a minute cavity in its centre. While Ruyſch contended, on the other hand, that thoſe hypothetical excavated kernels were nothing more than globular convolutions of extremely fine blood veſſels; which latter opinion, is doubtleſs founded on by far the moſt unequivocal and ſubſtantial teſtimony, as we readily learn from well conducted anatomical inveſtigations, more eſpecially from ſucceſsful injections, and the aſſiſtance of glaſſes.

§ 471.

Nor does this ſtructure (if indeed we keep out of view the peculiar parenchyma of each particular viſcus), differ much from, but appears rather to ſhed a conſiderable gleam of light on, the ſtructure of certain other ſecreting viſcera, particularly on that of the liver and kidneys, in which late experimenters have been able to demonſtrate, with the utmoſt perſpicuity, certain ſpherical bodies entirely ſimilar to the globular convolutions of

Ruyſch, or the kernel-like ſubſtances of the celebrated Malpighi. For, in what is called the cortical portion of thoſe viſcera, minute ramifications emerging from the ſides of the ſmall capillary arteries, become preſently convoluted, in ſuch a manner, as to form little vaſcular balls, which thus appear to hang by thoſe ramifications of which they are compoſed, like ſo many ſmall berries or grapes ſupported by their footſtalks. From theſe minute vaſcular balls originate *firſt*, that very ſubtle and colourleſs order of veſſels immediately deſtined for the buſineſs of ſecretion. (reſpecting the origin of which, from the evaneſcent terminations of arteries, we tranſiently ſpoke on a former occaſion, (§ 79. 81.); and *ſecondly*, the incipient radicles of veins, into which the minute arteries are themſelves continuouſly reflected, and which conduct back to the venous trunks, the reſidue of the blood now deprived of thoſe elementary particles neceſſary to conſtitute the fluid recently ſecreted.

§ 472.

Finally, certain other parts of the body, appropriated entirely to the buſineſs of ſecretion, are diſtinguiſhed again by different and remarkably peculiar, ſpecies of organization; thus the male teſtes, for example, are wholly compoſed of nothing elſe than cloſe and mazy convolutions of very lengthy and numerous blood veſſels, &c.

§ 473.

We come now to the conſideration of the peculiar cauſes, by the operation and efficacy of which *thoſe* determinate and ſpecific humours are ſecreted in *theſe* correſponding determinate and ſpecific organs: this is indeed the *Gordian knot*—this is by far the moſt difficult point of diſquiſition in the whole doctrine of ſecretion—that point which numerous doubts and difficulties yet inveſt.

§ 474.

It appears indeed to be a truth aſcertained and eſtabliſhed beyond the fainteſt ſhadow of a doubt, that the leading, and what may be called the proximate cauſe of moſt of the ſecretions, muſt be ſought for in the internal ſtructure of the ſecreting organs themſelves: under this head we muſt particularly conſider, in the conglomerate glands and other ſecreting viſcera, not only the peculiar diſtribution and direction of the extreme blood-veſſels, from which the humours are ſecreted, but alſo the *parenchyma*, ſo uniformly proper to each ſecreting viſcus, that in many of them it can be inſtantly known and diſtinguiſhed at firſt ſight from all other kinds or ſpecies of fleſh (§ 27).

§ 475.

It is alſo an opinion extremely probable (in ſupport of which we have advanced, on former occaſions,

occaſions, ſeveral arguments not eaſily refuted), that the ſecreting viſcera, beſides their peculiar parenchyma, poſſeſs alſo what we have taken the liberty to call a *vita propria*, i. e. a ſpecific or excluſive kind of vital energy, eſſentially different from what we denominated the three *common energies*, namely, contractility, irritability, and ſenſibility.

§ 476.

But further, if my views of the ſubject be in any meaſure juſt, the *abſorbent ſyſtem* appears to contribute alſo a very important part towards the promotion of the ſeveral ſecretions: thus, from each of the ſecreting viſcera certain appropriate branches of this ſyſtem abſorb and re-convey to the blood-veſſels larger or ſmaller portions of each of the ſeveral humours to which theſe viſcera give origin; the uniform conſequence of which is, that the blood becomes literally impregnated with the contagion of every humour ſecreted in the different parts of the body, e. g. with *bile* from the liver, with *ſemen* from the teſtes, &c.

Thus there appears to exiſt, in the ſyſtem deſtined for the buſineſs of ſecretion, a perpetual routine or circulation, ſo that the elementary parts of the humours already ſecreted being inceſſantly conveyed from the ſecreting organs

themſelves, are united afreſh to the maſs of blood, and on their ſubſequent return to their *parent organs*, in conjunction with the ſanguineous current, are again more eaſily attracted by the ſecreting veſſels, in conſequence of a peculiar law of affinity, and have alſo a power of drawing along with them thoſe parts of the blood that are moſt homogeneous in their nature, and for which they conſequently poſſeſs the higheſt degree of attraction.

§ 477.

To facilitate the ſecretion of *certain humours* of the body, adequate proviſion is made by the production of ſpecific qualities, in thoſe particular portions of the blood from which they are to be proximately derived: thus the bile is ſecreted from the blood of the *vena portarum*, a portion of fluid highly impregnated with *phlogiſton*, furniſhed in profuſion by the abdominal ſources, from which this blood immediately originates.

§ 478.

I paſs in ſilence over certain other co-operating aids, which act in ſubſervience to particular ſecretions, as *congeſtion* and *derivation*, ſo evidently efficacious in the ſecretion of milk, with other inſtances of a ſimilar nature.

§ 479.

Among the humours thus ſecreted by the organs which we have juſt deſcribed, and by the powers or cauſes juſt enumerated, it may be obſerved that the following difference afterwards exiſts, namely, while ſome of them drop immediately from their ſecreting organs into the places of their ultimate deſtination, in which they are to perform their ſpecific functions, others again are conveyed to appropriated receptacles, in which they are retained for ſome time, and thus farther matured previouſly to their final elimination from the ſyſtem: of this laſt deſcription is the milk which ſtagnates in the lactiferous ducts, the urine, the bile, and the ſemen maſculinum, which are ſubjected to retention in their veſicular receptacles, and finally, the *ſerum*, contained in thoſe veſicles which were firſt diſcovered by de Graaff in the ovaria of the female.

SECT. XXXVIII.

OF THE URINE.

§ 480.

BESIDES the nutritious juices and the ſecreted humours deſtined for further ſervices in the animal economy (§ 4.), the blood furniſhes alſo materials for the formation of certain uſeleſs and ſuperfluous liquids, that are intended to be entirely eliminated from the ſyſtem, and are from thence vulgarly called *excrements of the ſecond digeſtion*. Theſe excrementitious liquids are of two kinds, one of which is exhaled by the proceſs of perſpiration, and has already engaged our particular attention; the other is the *urine*, a liquid ſecreted in thoſe glands denominated kidneys.

§ 481.

The kidneys are two viſcera ſituated behind the peritoneum, on each ſide of the ſpine, and in the upper part of the lumbar region: Although their figure is generally ſomewhat flatted, yet it is proper to obſerve, that both in this reſpect, and alſo in point of number, they are ſubject to more varieties than any other viſcus belonging to the human body: they hang by veſſels commonly called emulgents

emulgents (remarkably large in proportion to the magnitude of the parts on which they are distributed), and are cushioned round by fat of a sebaceous consistence (§ 38).

§ 482.

They are invested by a proper membrane, of an elegant vascular structure: each one of them, especially during the period of infancy, appears to be composed of about eight, or somewhat more, kidney-form lobes or subdivisions; each of which consists again (according to an opinion formerly entertained and taught by Ferrein), of about seventy or eighty fleshy *radii*, which that physiologist called white pyramids.

§ 483.

If the kidney be dissected or divided from its convex *dorsum* towards its concave *pelvis*, it exhibits in its composition two kinds of substance; one forming its circumference, and therefore denominated its *cortical*, the other constituting its centre, and hence called its *medullary*, portion.

Each portion abounds with sanguiferous arteries and veins; besides *which*, the external cortex is also furnished with an additional order of very minute colourless vessels, destined to *secrete* the urine: while the medulla contains also vessels of

a similar description, intended to *carry it onward* when secreted.

Those secretory ducts originate, in the manner already described (§ 471.), from the small globular convolutions of capillary arteries that are every where interspersed throughout the cortex of the kidney: those ducts constitute indeed by far the greater portion of the cortical substance of the kidney, and may be very easily distinguished by their singular meanderings and intricate mazes, from the small conducting tubes of Bellini, in which they finally terminate. These *tubuli Belliniani* (as they are frequently termed) pass by a direct route from the cortical, and enter the medullary substance, of which they constitute by far the greater part; and uniting afterwards by reiterated coalitions into a small number of narrow trunks, finally perforate, by their extreme orifices, in a sieve-like manner, the several *papillæ* contained in the renal pelvis.

§ 484.

The papillæ correspond for the most part to the number of lobes, of which we already said each kidney is composed. The urine that is secreted in the colourless vessels of the cortex, and afterwards conducted through the tubuli Belliniani of the medulla, these papillæ discharge into their corresponding

corresponding *infundibula*, which form by their subsequent confluence the common *pelvis*.

§ 485.

The pelvis is continued into the *ureters*, which are membranous canals, exquisitely sensible, and defended internally by a complete investiture or lining of mucus; they are capable of extreme dilatation; in man they are here and there uneven in the width of their cavities, and are at length inserted into the posterior surface, not far from the neck of the urinary bladder. This insertion is effected in such a manner, that the ureters do not immediately perforate the parietes of the urinary cyst, but descend a short distance between its muscular and nervous coats (which are here possessed of more than ordinary thickness), and open finally into the cavity of this organ by oblique orifices. By means of this structure, adequate provision is made to prevent the urine, that has once entered the cavity of the bladder, from being forced to return again into the ureters by an inverted or retrograde motion.

§ 486.

In an adult subject, the urinary bladder is in general sufficiently capacious to contain about two pounds of urine; its *fundus* or bottom, which in the fœtal state terminates in the *urachus*, and also

its

its posterior side, are invested by the peritoneum; as to its remaining membranes or coats, they bear a general resemblance to those of the stomach, of which we have already spoken.

The *muscular* coat consists indeed of interrupted bands of fleshy fibres, that surround the cyst, forming at the same time various irregular decussations or intersections, which are different in different subjects: this muscular coat physiologists denominated *detrusor urinæ*, while they designate by the name of *sphincter vesicæ*, those orbicular fibres that partially surround the neck of the bladder, though they are very inconstant and irregular, both with respect to their figure and origin.

The *nervous coat* bestows on this membranous viscus also the principal part of its strength and firmness.

Finally, the *internal* coat, which is considered by physiologists as a process or continuation of the epidermis, is defended by a complete covering of mucus, especially round the neck of the bladder.

§ 487.

Besides those public and well known routes of the urine, of which we have already spoken, it appears probable from several phenomena, that there

there exiſt alſo certain ſecret avenues, which lead immediately from the inteſtines to the uropoietic organs. For the ſpeedy diſcharge of certain drinks from the urinary emunctory, ſo frequently imbued with the odour, tinctured with the colour, and characterized by other ſpecific qualities of the aliments recently taken in, will ſcarcely admit the belief, that theſe liquids had performed, in ſo ſhort a time, the cuſtomary long and circuitous route through the thoracic duct and ſanguiferous ſyſtem: to the foregoing circumſtance we may add an account we have read, of the urine having been found covered with *oil*, that entered into the compoſition of an enema, which had been previouſly and recently thrown into the inteſtinum rectum. It is, on the other hand, a circumſtance well known to phyſiologiſts of the preſent day, that very ſtriking and numerous anaſtomoſes occur between the lymphatic veſſels of the inteſtines, and thoſe of the kidneys. Laſtly, it is now unequivocally aſcertained and confirmed by live diſſections, that if both ureters of a dog be tightly encloſed in ligatures, and his *bladder* perfectly evacuated of its contents, this latter organ will, notwithſtanding, in the term of three hours afterwards, contain a certain quantity of urine; while at the ſame time the uſual avenues of this fluid, namely, the ureters, are completely obſtructed, as is evident from this circumſtance, that above the ligatures

ligatures theſe tubes ſuffer vaſt diſtention from the accumulated urine.

§ 488.

But through whatever avenues the urine has been conveyed to the bladder, its gradual accumulation in that organ excites an uneaſy ſenſation, which becoming urgent and troubleſome (§ 331.) potently ſolicits its final elimination, through an emiſſary or ſewer deſtined for that particular purpoſe, namely, the *urethra*. This excretory canal is ſubjected to a variety in its conformation, founded on the diverſity of the ſexes, of which we will ſpeak more amply when treating profeſſedly of the ſexual functions.

§ 489.

In order to evacuate the bladder, it is neceſſary to overcome the contraction of its ſphincter, by the exertion of its own *detruſor* (of which we formerly ſpoke) (§ 486.), aided by the co-operation of the abdominal muſcles, and thoſe ſubſervient to the proceſs of reſpiration; to which, in males of the human ſpecies, we may add, laſtly, the action of the *muſculi acceleratores*, which forcibly ejaculate, *per ſaltum*, as it were, even the reſiduary drops of urine that may be occaſionally lodged in the bulb of the urethra.

§ 490.

As to the *nature* of the *urine* itſelf, it is ſubject indeed, to an infinitude of varieties generated by the circumſtances of age, and ſeaſon, but, above all, by the longer or ſhorter term of time, ſubſequent to the previous uſe of food and drink, the diſcharge of this fluid occurs; to which may be alſo added, the quality of the aliment previouſly uſed, &c. In general, however, when we examine the urine which is diſcharged by a healthy human adult, immediately after ſound and tranquil ſleep, we diſcover it to be a watery liquid, of a nidorous ſmell, and citron colour, containing in its aqueous medium, (as in a common vehicle) various elementary ſubſtances, eſpecially *earthy* and *ſaline*, which bear different proportions to each other in different individuals, and even in the ſame individual at different times and under the influence of different circumſtances. Of the terrene elements the moſt abundant is, in general, calcareous earth, which is not unfrequently found in the urinary paſſages under the form of *calculi*, but which is, notwithſtanding, extremely variable and inconſtant in its quantity. Of all the ſaline matters, that moſt worthy of being mentioned, is the *eſſential* and *native ſalt* of urine—called alſo, *microcoſmic ſalt*, *fuſible ſalt*, &c. This ſaline ſubſtance contains, in a greater proportion than any

other

other part of the human body, the celebrated phoſphoric acid chemically eſpouſed to the volatile alkali.

SECT. XXXIX.

OF THE DISCRIMINATION OF THE SEXES IN GENERAL.

§ 491.

THOSE functions of the human body, in the conſideration of which we have been hitherto engaged, are indeed poſſeſſed, and exerciſed in common, by the individuals of each ſex: with reſpect to the mode, however, in which ſome of them are performed, there occur between the two ſexes no inconſiderable degrees of difference. Of this difference, it may be proper briefly to enumerate the leading points, previouſly to our entrance on the conſideration of what are denominated the *ſexual functions*.

§ 492.

To ſpeak, then, in general terms, each ſex poſſeſſes and exhibits its *own* peculiar *habit*, which differs conſiderably from *that* of the other. In the

the human ſubject after birth, this difference of habit is diſtinctly obſervable; but during the tender fœtal ſtate, is ſcarcely to be diſtinguiſhed, unleſs by more cloſe and pointed attention; neither indeed, in this ſtate, can the external organs of generation themſelves be diſcriminated, on a tranſient and ſuperficial view, owing to the extraordinary magnitude and prominency of the female clitoris, and the very diminutive ſize of the male ſcrotum.

§ 493.

During the period of infancy this difference of the general habit, depending on the diverſity of ſex, makes only a ſlight impreſſion on the obſerver; but becomes gradually more and more obvious and ſtriking till the full completion of the years of *puberty*, at which period, the general conformation of the female body, its tenderneſs, its ſoftneſs, and the uſual inferiority of its ſtature, contraſted with the athletic and robuſt body of the male, exhibit this general *habitual* difference in the moſt ſtriking point of view.

§ 494.

Similar to the difference that occurs between the *external habits* of body, that characteriſe the two ſexes, is that which is obſervable in the bones them-

themſelves. Theſe ſolid portions (all other circumſtances being alike) are evidently much more ſmooth and round in females than in males; the cylindrical bones, in particular, are more ſlender and delicate, and the plane ones more attenuated or thin, in the former, than in the latter ſex; not to mention the peculiar diverſities of certain remarkable bones, particularly thoſe of the thorax and pelvis, with the clavicles, the femora, &c.

§ 495.

With reſpect to the ſoft parts of the body, we may obſerve in general, that in females, the cellular membrane is more lax, more pliable, and conſequently more readily dilatable in the ſtate of pregnancy: while the ſkin is more tender, fair and beautiful, in conſequence of the immediate ſubſtratum of fat.

The hair of the head is generally of a greater length in *females* than in *males*, while at the ſame time, certain other parts of the body which in the latter are rough and hairy, are in the former either perfectly ſmooth, as the chin and breaſt; leſs hairy, as the perineum; or planted with only a very tender and ſoft down, as the arms and legs.

§ 496.

When ſpeaking of the diverſities of particular functions, we muſt not ſilently pretermit the pulſe, which (other circumſtances being alike) is more frequent in females than in males, (§ 109). In the former, the *thorax* is ſubjected to a greater degree of motion, (eſpecially at its ſuperior part,) than in the latter; the os hyoides is much ſmaller, the larynx is leſs capacious, and hence the voice more ſhrill.

§ 497.

With regard to the animal functions, it is neceſſary to obſerve in general, that in females the mobility of the nervous ſyſtem is much greater than in males, the irritability is more exquiſite; and the propenſity to commotions of the mind, more prompt and ſpontaneous.

§ 498.

As to the natural functions, the appetite for food is weaker in the female, than in the male ſex; while, on the other hand, the increaſe of the body is more rapid in the former, and the ſtate of puberty and mature growth attained at an earlier period.

§ 499.

But by far the greateſt and moſt important diſtinction of the ſexes is derived from the genital functions themſelves, the male being furniſhed with a power of *fœcundation*, and the female with that of *conception*. A farther inveſtigation of theſe powers ſhall engage the greater part of our attention, throughout the remaining pages of this work.

SECT. XL.

OF THE GENITAL FUNCTION OF THE MALE SEX.

§ 500.

THE genital liquor of the male is prepared by the *teſtes*, two bodies ſuſpended in the ſcrotum by their *ſpermatic cords*, and (beſides the lymphatic veins with which they abound in profuſion), compoſed chiefly of *three* kinds of veſſels.

Theſe are *firſt*, the *ſpermatic artery*, which in proportion to its ſlender diameter is ſaid to be the longeſt of all the arteries belonging to the human body:

body: it in general conveys the blood immediately from the abdominal portion of the aorta itself, to the body of the testis.

Secondly, the *ductus deferens*, which carries to the *vesiculæ seminales*, the semen when once secreted from the arterial blood.

And, lastly, what is commonly denominated the *pampiniform plexus of veins*, the function of which is to receive and convey to the cava or emulgent vein, the blood that remains after the process of secretion is accomplished.

§ 501.

The testes are not, from the time of their earliest formation, suspended in the scrotum, as represented in the above description: thus in the male fœtus, while yet in a very tender and immature state, those glandular bodies occupy indeed a very different situation, the reason and successive changes of which were first accurately investigated and detailed by Haller, at Gottengen in the year 1749, but were afterwards explained by other writers on principles so different from each other, as to have given rise to various controversies of some weight and importance. Of the situation and changes of the testes in the fœtal state, I am prepared to lay before the reader a brief, though

comprehenſive account,—the ſpontaneous reſult of numerous obſervations made on nature herſelf, during a remarkable ſeries of diſſections of male embryo's, in which I engaged for the expreſs purpoſe of ſhedding light on this ſubject ſo intereſting to phyſiologiſts.

§ 502.

On opening the lower abdominal region of an immature fœtus, we diſcover in each groin, near what is called the ring of the oblique muſcles, a very narrow orifice in the membrane denominated peritoneum; this orifice is the threſhold to a ſtrait avenue or alley, as it were, that leads through the abdominal ring itſelf, and terminates afterwards in a peculiar bullous or bubble like ſack: this ſack extends without the abdominal cavity, looks towards the ſcrotum, is interwoven with cellular fibres, and deſtined for the future reception of the teſtis.

§ 503.

At the very poſterior margin of this ſmall abdominal orifice, the peritoneum ſends off another proceſs, which mounts upwards, and in the tender fœtus repreſents, in the greater part of its courſe, a longitudinal fold: from the baſis of this proceſs a ſlender cylinder, or rather inverted cone aſcends, and forms at its ſummit, which regards the

the inferior margin of the kidney, a ſmall bliſter or ſack-like termination; in this ſack the teſtis and epididymis are encloſed; ſo as to reſemble, at firſt ſight, a ſmall berry reſting on its footſtalk, and appear, at the ſame time, to hang looſely into the abdominal cavity ſomewhat like the liver or ſpleen (§ 404).

§ 504.

The veſſels which are afterwards to conſtitute the ſpermatic cord, are, at this very early period, ſeen running behind the extremely tender and pellucid peritoneum, ſo that the ſpermatic artery and vein run in a deſcending direction along the ſides of the ſpine, while the *vas deferens* bending ſomewhat inwardly towards the neck of the urinary bladder, ſtretches along the looſe cellular membrane, which is ſituated behind the peritoneum, and both enter the body of the teſtis in that peritoneal *plica* or fold of which we have already ſpoken.

§ 505.

From about the middle ſtage of pregnancy, the teſtes begin to ſink downward by degrees, ſo as gradually to approach the narrow orifice of the peritoneum, which has been already mentioned. At the ſame time, the foregoing peritoneal fold, with its cylindrical attachment, are wrapped up

by degrees, till the teſtis finally reſts on the very mouth of the preceding canal.

§ 506.

When in the fœtus, now advanced to a higher ſtage of maturity, the teſtis is fully prepared for a final deſcent, the orifice, hitherto ſo contracted or narrow, ſuffers ſuch a remarkable dilatation, that the teſtis is at full liberty to enter with facility the opening that leads out of the abdomen as well as the ring by which this opening is ſurrounded, to paſs onward through the whole length of the canal, and thus plunge headlong, as it were, into the bliſter-like ſac of which we have already ſpoken. The teſtis having finally accompliſhed its deſcent, the peritoneal opening is ſoon after cloſed in the moſt complete manner, and even ſubjected in a ſhort time to a perfect adheſion of its ſides, ſo that in the ſtage of *infancy*, ſcarcely a wreck of it is left, to point the enquirer to the place of its former exiſtence.

§ 507.

The more gradual and ſlow the movement of the teſtis (while yet in the abdominal cavity) towards the orifice of its egreſſion, the more ſudden and inſtantaneous appears to be its act of tranſition through the abdominal ring. For in the diſſections of mature fœtuſes, it is by no means uncom-

uncommon to discover the testis either as yet incumbent on the peritoneal opening, or else stationary in the groin, after having recently passed the abdominal ring: but once only was I so fortunate as to have an opportunity of observing the right testicle of a twin-fœtus (of which a complete drawing has been given), at the very moment of its passage through the abdominal ring: the gland appeared to have been very tightly embraced and strangled, as it were, by the surrounding parts, and was apparently in complete readiness to emerge from the abdomen into its destined sack; a transition already accomplished by the left testicle, that had just escaped from the ring, the orifice of which had again resumed its former impervious state.

§ 508.

This remarkable descent of the testes along the groins, does not appear to be exclusively confined to any particular period of time: it occurs for the most part, however, about the last month of pregnancy: although these glandular bodies are not unfrequently found either in the abdominal cavity itself, or in the superior part of their inguinal route, even in infants after birth. For the testicle, after its entire escape from the abdomen, has still a further stage of its journey to perform, namely, its final descent along the groin into the

ſcrotum, in company with the ſmall ſac by which it is enveloped.

§ 509.

That the foregoing is indeed a true account of the progreſſive movement of the teſtes in their deſcent from the abdomen into the ſcrotum, I have had ſufficient opportunities of aſcertaining from repeated obſervation. To develope the *cauſes* and *energies* by which this aſtoniſhing deſcent is accompliſhed, appears to be indeed attended with difficulties of the utmoſt magnitude. For I am daily more and more convinced, that neither of thoſe powers to which this deſcent has been hitherto aſcribed (ſuch, for example, as the action of the cremaſter muſcle, the action of the diaphragm, or the contractility alone of that cellular and tendinous intertexture, which adheres to the proceſſes of the peritoneum, and is uſually denominated *gubernaculum* Hunterii, &c.), is ſufficient to explain a movement of ſuch extreme ſingularity, eſpecially that part of it relating to the immediate tranſition of the teſtis through the narrow abdominal ring, to which the reader's attention has been ſo frequently ſolicited: while I am impreſſed, on the other hand, by a thorough conviction, that this whole proceſs exhibits the moſt unequivocal aud ſtriking example of what we have denominated *ſpecific life*, without the peculiar operation

tion and aid of which, it is ſcarcely poſſible to ſolve the ſeveral phenomena of a tranſition ſo extremely ſingular in its nature, and ſo widely diſſimilar to all other movements and functions that occur in the whole animal economy.

§ 510.

The involucra by which the teſtes are inveſted, after their final completion of the foregoing route, may be aptly enough divided into *common* and *proper*.

The only involucrum common to both theſe glandular bodies is the *ſcrotum*. This is a ſac, conſiſting of a tender portion of cutis expanded over a thin ſubſtratum of fat, and poſſeſſing a peculiarity that does not reſide in any other part of the common integuments of the body, namely, a power of changing, in a very remarkable degree, its uſual habit and appearance: thus, it ſometimes depends looſe and flaccid, and again (eſpecially under the impreſſion of the venereal œſtrum, or in caſe of expoſure to cold), becomes conſtricted and rigid, as it were, and is then particularly marked by furrows and diverſified rugoſities.

§ 511.

Of thoſe involucra which are proper to each teſtis, that placed immediately beneath and within the

the ſcrotum, is called the *tunica dartos :* this coat poſſeſſes a very peculiar and vivid *contractility*, by which Winſlow, Haller, and other celebrated characters have been ſo far deceived, as to beſtow on it the nature and energy of a muſcle.

§ 512.

This is ſucceeded (after a voluminous and ſoft ſtratum of cellular membrane), by three ſeparate *vaginal coverings*, which were firſt accurately traced and diſtinguiſhed by the ingenious and indefatigable Neubauer.

Of theſe vaginal coats, the exterior is *common* to the teſticle and ſpermatic cord, and has the cremaſter muſcle attached to it by ſeparate bundles of fibres.

But the two interior are *proper*, one to the ſpermatic cord, and the other to the teſtis itſelf; of theſe the latter adheres, for the moſt part, by its fundus to the common tunic, while its internal ſurface is moiſtened by a lubricant fluid, ſomewhat after the manner of the pericardium.

§ 513.

The *origin* of thoſe vaginal tunics which has given riſe to ſuch a variety of controverſies among phyſiologiſts, can, (if I be not greatly deceived), be

be without difficulty ascertained, from what has been already said, when treating of the descent of the testes.

Thus, the *tunica communis*, for example, originates from the descending (§ 502.) blister-like sac or process of the peritoneum.

The *propria testis*, from that production of the peritoneum, which mounting upward in the form of a cylinder (§ 503.), invests the testis itself from its earliest formation.

And, finally, the *propria funiculi*, from that fold of the peritoneum, of which we have already spoken, and the short cylinder in which it terminates previously to its embracing the testis itself.

§ 514.

Immediately to the testis itself the *tunica albuginea* is very closely attached, somewhat after the manner of a cortical covering. From this tunic, blood-vessels pass into the *pulp* or body of the testicle, which consists indeed entirely of innumerable vessels, about a span in length, wound up into small conglomerate lobules: these vessels, of which the substance of the testicle is composed, are both sanguiferous and secreting, the latter of which

which conduct the ſemen, when prepared, through the vaſcular net-work of Haller, and the *vaſa defferentia* of Graaf, into the beginnings of thoſe cones that form the epididymis.

§ 515.

That body which ranges along the ſide of the teſtis, namely, the *epididymis*, conſiſts indeed of a ſingle veſſel, about thirty feet in length, which at one end (that for inſtance denominated its head), is diſtinguiſhed into about twenty ſmall rolls or cones, and at its other (inferior) extremity, called therefore its tail, increaſes gradually in thickneſs, and thus forms by its continuation the *vas deferens*.

§ 516.

The two *vaſa deferentia* aſcending towards the neck of the urinary bladder, and forming a junction beneath, or near to, the proſtate gland, are from hence bent backward, and expanded into the *veſiculæ ſeminales;* in ſuch a manner, however, that theſe veſiculæ, and the vaſa deferentia themſelves, open by two common orifices into the urethra, juſt behind the *caput gallinaginis*.

§ 517.

Finally, the *veſiculæ ſeminales* themſelves, are attached to the poſterior ſurface of the urinary cyſt,

cyſt, near to the inferior extremity, or neck, of that organ: they are imbedded in a profuſe quantity of fat, and from their diverſified flexuoſities and numerous blind *appendiculæ* that ſhoot off ſomewhat in the form of ramifications, reſemble, in their general appearance, two ſmall inteſtines.

Theſe veſiculæ conſiſt of two coats, almoſt of the ſame kind with thoſe that enter, as formerly mentioned, into the compoſition of the gall bladder; thus, the firſt or external coat is more robuſt, and ſimilar in its nature to ſuch as are commonly denominated *nervous;* while the ſecond or internal abounds with minute cells and pits, and is every where divided, by means of projecting eminences, into minute purſe-like cavities, perfectly ſimilar to thoſe that are ſo conſpicuous about the neck of the gall-bladder.

§ 518.

In thoſe organs and veſſels hitherto enumerated and deſcribed, there is, even from the earlieſt years of puberty, a certain fluid ſecreted ſlowly, and retained in ſmall quantity, namely, the *ſemen maſculinum;* a liquor extremely ſingular in its nature, and of the utmoſt dignity and importance in the animal economy: it exhibits to the eye a milky colour, emits an odour entirely peculiar, poſſeſſes a mucoid viſcoſity, and is of ſuch

ſuch remarkable ſpecific gravity, as to ſurpaſs, in this reſpect, all other ſecreted humours belonging to the animal body.

§ 519.

A peculiarity of this fluid, which muſt not be paſſed over in ſilence, is, (as was firſt obſerved by Lud. Ham at Dantzic, in the year 1677), that it is peopled by a countleſs multitude of microſcopic animalculæ, belonging to the ſame order with thoſe called *infuſoria*, and poſſeſſing different figures, as they appear in the ſeminal fluids of different animals. In man (and alſo in the male aſs) the *ſeminal animalcules* exhibit oval figures, furniſhed with tails of extreme minuteneſs: theſe animalcules are ſaid not to be found in any, ſave ſound and prolific ſemen, ſo that they appear to conſtitute a certain *adventitious* criterion of the fertilizing maturity of this important fluid: we have called the criterion derived from theſe animalcules *adventitious*, and preſume it is ſcarcely neceſſary, at this enlightened period, to repeat, that they ſhould not be accounted the reſervoirs of the fecundating principle, much leſs ſhould they be conſidered as the germs of future *homunculi*, ſince ſo many, and ſuch weighty arguments and obſervations have been lately advanced in ſupport of a different doctrine.

§ 520.

§ 520.

This genital liquid being gradually collected in the veſiculæ, which we have already deſcribed, is there retained till a future act of excretion. By ſuch retention it ſuffers changes very nearly reſembling thoſe to which the bile is ſubjected in conſequence of a ſtate of ſtagnancy in its cyſtic reſervoir; thus, being gradually robbed of its aqueous portion, it is more and more inſpiſſated and approximated, as it were, towards a ſtate of concentration.

§ 521.

For as the teſtes generally, together with the cords by which they are ſuſpended, abound with an aſtoniſhing aſſemblage of lymphatic veſſels, which ſerve to re-convey from thence to the blood a portion of fluid, impregnated with the ſpermatic contagion, and by this means aid and facilitate the further ſecretion of ſemen, on the principle, and in the manner formerly laid down (§ 476.), ſo are the *veſiculæ ſeminales* themſelves alſo provided with veſſels of the ſame kind, which by abſorbing the ſubtle, though inert water, render the reſidue of the ſeminal fluid more active and efficacious.

§ 522.

§ 522.

On this ſubject I doubt much whether or not, in a healthy man, any genuine ſemen be ever abſorbed from the veſiculæ ſeminales:—more ſtill, whether or not, as is ſometimes alleged, ſemen thus abſorbed could be carried immediately into the neighbouring ſanguiferous veins:—but moſt of all, whether or not ſuch a ſeminal abſorption (admitting its real exiſtence) could poſſibly act as an antidote againſt exceſſive venereal propenſities, ſince it appears evidently, on the other hand, that this ſame abſorption would neceſſarily operate as an exciting cauſe of unbridled and almoſt infuriate luſt: in queſt of teſtimony to eſtabliſh the truth of this latter propoſition, we need only attend to the *phenomena* of ſuch animals as experience the venereal propenſity only at ſtated ſeaſons of the year, and compare them with the conſtitution of thoſe that have been reduced to the ſtate of caſtration.

§ 523.

To me indeed it appears probable, that, for the purpoſe of moderating libidinous deſires, man is endowed with a far different prerogative (not conferred on any other ſpecies of animals with which we are hitherto acquainted), namely, that of *nocturnal pollutions*: theſe *evacuations* I therefore conſider among the natural excretions of man

—*evacuations* by which (as they occur at longer or ſhorter intervals, according to the varieties of temperament and conſtitution), he is relieved from a troubleſome and otherwiſe urgent impreſſion produced by an abundant accumulation of ſemen.

§ 524.

It muſt be obſerved, however, that the ſemen maſculinum is never excreted in a ſtate of entire purity, but is always blended with more or leſs of what is uſually denominated *liquor proſtatæ* (i. e. the liquor of the proſtate). With regard to the external habit and appearance of this laſt mentioned liquid, it bears a very ſtriking ſimilitude to the albumen or white of eggs. This peculiar liquor derives its name from its immediate *birth-place* or ſource, which is a body of conſiderable magnitude, and of a ſingular and very compact parenchymatous texture, ſituated between the *veſiculæ ſeminales* and the bulb of the urethra, and is uſually deſignated by the name of *glandula proſtata*. The excretory avenues of this liquor have not yet been ſatisfactorily inveſtigated and aſcertained, unleſs (as appears probable) they communicate with the duct of the *caruncula ſeminalis*, the orifice of which opens into the urethra between the two mouths of the avenues leading from thoſe minute veſicles deſtined for the recep-

tion and temporary retention of the fertilizing ſemen, (§ 516).

525.

The *urethra* in man is deſtined as a common conduit or emiſſary duct, to three different kinds of fluids, namely, the urine, the ſemen, and the liquor of the proſtate gland. It is lined internally with a mucus which originates from an immenſe number of ſinuſes, that are every where diſperſed throughout its canal. It is ſurrounded by a ſubſtance of a ſpongy texture, to which are ſubjoined two other bodies, ſimilar in ſtructure but far ſuperior in ſize, (called *corpora cavernoſa*), that conſtitute the principal part of the *male penis;* an organ which is terminated anteriorly by the *glans*, and wholly inveſted by a very tender and pliable portion of ſkin entirely deſtitute of all appearance of fat. This ſkin forms the prepuce by its attachment round the *corona*, or circular baſe of the *glans*, and plays over this body with a free motion, ſomewhat like the palpebræ over the ball of the eye. The interior duplicature of the prepuce, having aſſumed a different appearance, is reflected over the glans itſelf, (ſomewhat like the adnata over the eye) and is furniſhed around the corona, with an immenſe number of the ſmall glands of *Littrius*, (analogous to the Meibomian glands of the

the palpebræ) that give birth to a matter of an unctuous but very ſingular nature.

§ 526.

The male penis, thus organiſed and conſtructed agreeably to the preceding deſcription, poſſeſſes a faculty of erection, *i. e.* in conſequence of an encreaſed *congeſtion* and impetuous *effuſion* (for congeſtion alone will not explain the phenomenon) of blood into the *corpora cavernoſa*, the penis ſwells, becomes rigid, and changes its former poſition, but ſuffers again a detumeſcence and collapſe by a reabſorption of the ſuperfluous portion of this diſtending fluid.

§ 527.

When the penis reſumes its flaccid condition, it ſuffers a ſingularly circuitous flexion, at the place where it originates from the neck of the bladder. In this ſtate it is, indeed, extremely well calculated for the excretion of real urine, but quite unqualified for the emiſſion of ſemen, as the beginning of the urethra forms now a more acute angle with the ſmall orifices of the veſiculæ ſeminales.

§ 528.

When a gradual intumeſcence of the penis commences, there occurs firſt an effuſion of the *liquor*

furniſhed by the proſtate gland, which is oftentimes eliminated unmixed, but ſcarely ever along with the urine. Of this liquor the primary deſtination is, to be ejected, in conjunction with the *ſeminal fluid* itſelf; either, that it may, by its albuminoid lubricity, qualify the ſluggiſh tenacity of the latter fluid, and thus facilitate and promote its ejection; or that it may itſelf contribute, in a certain degree, towards the proceſs of generation.

§ 529.

The emiſſion itſelf of the male ſemen is *excited* as well by the immediate impreſſion ariſing from an abundant accumulation of this fluid in its appropriated receptacles, as by the genuine *ſexual inſtinct*; it is *accompliſhed*, firſt, by a very ſtrong *erection* of the penis, which, while it obſtructs the paſſage of the urine, paves as it were, on the other hand, a more direct and ready way for the tranſition of the ſemen; to which we may ſubjoin, as co-operating cauſes, a certain *ſpaſmodic contraction* of the veſiculæ ſeminales, a convulſive action of the *levator ani*, and *acceleratores urinæ*, and finally, a general *ſuccuſſion*, of the whole nervous ſyſtem, gentle indeed in degree, and tranſient in exiſtence, but yet of an epileptic nature, and conſiderably depreſſing, in its effects, on the energies of the ſyſtem.

SECT.

SECT. XLI.

OF THE GENITAL FUNCTION OF THE FEMALE SEX IN GENERAL.

§ 530.

As the male organs of generation are naturally calculated to *give*, ſo are the female to *receive*, and in the two ſexes theſe organs are, in a general point of view, widely different from each other. It muſt be obſerved, however, that in the general ſtructure of certain parts, theſe two kinds of organs exhibit no ſmall degree of reciprocal ſimilitude. Thus beneath the pubes (the ſtructure of which has been already a ſubject of tranſient attention (§ 36.) the *clitoris* which lies concealed in the ſuperior commiſſure of the labia, reſembles the male penis in more reſpects than one, but is not furniſhed with a urethra, is therefore imperforate, and, (when not of a preternatural proportion,) is remarkably ſmall. It is ſaid, however, that this organ preſerves, occaſionally, even in adults, the ſame proportional ſize, which, as formerly obſerved, is ſo extremely conſpicuous in the clitoris of the female embryo, (§ 492.) Hence appears, in all probability, to have originated moſt of thoſe obſcene and fabulous

ſtories, reſpecting the exiſtence of *hermaphrodites*. This organ conſiſts alſo, like the male penis, of *corpora cavernoſa*, like it, is capable of erection, like it, is inveſted by a prepuce, and furniſhes, finally, an unctuous matter not diſſimilar to that of Littrius, (§ 525).

§ 531.

From the clitoris deſcend the *nymphæ*, acquiring, alſo, occaſionally, an enormous and preternatural magnitude, (which exceſs has, in like manner, not unfrequently given riſe to extraordinary and fabulous reports): they poſſeſs, in common with the clitoris the moſt exquiſite degree of ſenſibility; and appear to give direction to the ſtream of urine when diſcharged, as the *orifice* of the *urethra*, (a tube extremely ſhort in the female ſex, and, in the moſt highly finiſhed and perfect examples, ciliated or fringed in a very ſingular manner), lies hid, as it were, in a foſſa formed by their two baſes.

§ 532.

Beneath this orifice is ſituated the *opening* of the *vagina* itſelf, environed by *cryptæ* of various kinds, ſuch, for example, as the *urethral lacunæ* of Graaf, and the mouths of what are improperly and even abſurdly termed, the proſtate glands of Caſp. Bartholin, &c. with the unguen-like mucus of

of which, these obscene parts are moistened and lubricated.

§ 533.

Over the very threshold or entrance of the vagina is expanded a weblike production denominated the *hymen*. This is a membrane, the existence of which in an unlacerated condition, is considered as a sure badge of spotless virginity—a membrane bestowed exclusively on the female of the human species, and of which no physical destination has been yet unequivocally ascertained.

The fringes or residual fragments of this membrane, after laceration, are gradually converted into what are denominated *carunculæ myrtiformes*, bodies quite indefinite in point of number.

§ 534.

From the immediate seat of these minute myrtiform bodies ascends, between the urinary cyst and intestinum rectum, the *vagina*, a tube composed of a cellular parenchyma, interspersed with an infinitude of small blood-vessels. At its inferior extremity the vagina is encircled by a muscle denominated *constrictor cunni;* more internally it is lined by a very soft and delicate coat, which is characterised by two extremely elegant *columns* of *rugæ* or wrinkles, namely, the anterior and poste-

rior; from these columns a fine mucus is constantly discharged, destined to lubricate the cavity of this highly important canal.

§ 535.

The vagina, at its upper and interior end, receives and embraces, finally, the *uterus*, an organ attached on each side to, and thus suspended by, the *ligamenta lata*.

The cylindrical neck of this organ being thus embraced, as it were, by the vagina, is perforated by a narrow canal, which, like that of the vagina, is impressed by a singular apparatus or arrangement of rugosities, designated by the name of *arbor vitæ*: of this canal the two extreme orifices, more especially the superior or internal, are overspread, for the most part, with a quantity of tenacious mucus.

§ 536.

The substance of the uterus is altogether singular in its nature, consisting of a peculiar parenchyma, very dense and compact, and interwoven with an infinitude of blood-vessels (running in serpentine mazes of astonishing intricacy) of which, the veins are wholly destitute of valves. This organ is doubtless furnished, in like manner, with an apparatus of lymphatic vessels: it abounds with

with a countleſs number of nerves, through the medium of which, it preſerves ſuch an aſtoniſhing ſympathy with the other parts of the ſyſtem.

§ 537.

Externally the uterus is inveſted by the peritoneum, while its minute internal cavity is lined, eſpecially at its *fundus*, by a very ſoft and tender membrane, of a ſpongy texture, which, as ſome phyſiologiſts allege, conſiſts of colourleſs veſſels, while others pronounce it to be compoſed of lymphatic abſorbents.

§ 538.

With regard to the muſcular texture attributed to this organ by ſome phyſiologiſts, and ſtrenuouſly denied again by others, I muſt take the liberty of obſerving, that notwithſtanding the number of uteri which I have examined with the utmoſt care and attention, both in an impregnated and an unimpregnated ſtate, (in each of which I have had repeated opportunities of examining this organ, not only in a prepared condition, but alſo in ſubjects recently dead), I have never yet been able to detect, in them, any portion that exhibited obvious and unequivocal ſigns of muſcularity. On the other hand, I am daily more and more perſuaded, that the uterus, poſſeſſing no muſcular fibres, is deſtitute alſo of true irritability (§ 307), and

and owes entirely to a *vita propria*, or ſpecific life (§ 47.), all its peculiar motions and functions, which cannot, indeed, with the ſmalleſt ſemblance of propriety, be derived from any of thoſe energies that are common to what we formerly termed the *partes ſimilares*, or ſimilar parts of the body (§ 43, 46). So very ſingular and unaccountable did the motions and functions of the uterus appear to the phyſicians and philoſophers of ancient times, that they were led to conſider this organ as a ſmaller animal contained within a larger.

§ 539.

From the angles on each ſide of the *lacunar*, or *fundus uteri*, ariſe what are called the *Fallopian tubes*. Theſe are two very narrow and tortuous canals, that run in the ſuperior duplicature of the *ligamenta lata*: they are ſimilar in texture to the vagina itſelf, except, that being internally deſtitute of valves, they are lined with a kind of ſpongy fleſh, of a very ſoft and tender conſiſtence.

§ 540.

The extreme orifices of theſe tubes, that regard the abdominal cavity, beſides being much more capacious than thoſe which open into the uterus, are alſo edged round by fringe or finger-like *fimbriæ*, of a truly ſingular and elegant ſtructure.

The

The offices which these fimbriæ are destined to perform, in the business of conception, appear to be indeed of no small degree of importance; thus being rendered, during the venereal orgasm, equally turgid with the tubes themselves, they evidently embrace, in this state, the *ovaria* that are situated in some measure beneath them.

§ 541.

The *ovaria* themselves, or the *female testes*, as they were called previously to the time of Steno, besides a tenacious and somewhat tendon-like involucrum, consist also of a dense and decussating cellular membrane, which incloses in each ovarium about fifteen of those minute bodies denominated the *ovula*, or little eggs of Graaf: these ovula contain each a small vesicle, or rather drop of serum, faintly yellowish in its colour, and of an albuminous nature, which, if the recent ovarium be immersed in boiling water, is reduced, like the genuine white of eggs, to a state of complete coagulation.

§ 542.

An albuminoid drop of this kind appears to be indeed the principal fluid which the female contributes towards the process of conception; for it appears extremely probable, that, throughout the progressive course of what are termed the prime

or

or better years of life, these small drops arrive at complete maturity in gradual succession, so that each one, in its turn, looks as it were through the involucrum, by which the ovarium is enveloped, till it is able finally to burst the parietes of its prison, and thus be received by the abdominal orifice of the Fallopian tube.

§ 543.

But besides this minute albuminous drop that thus bursts from the volume of the ovarium, it appears that there occurs also, during the venereal œstrum, an effusion of another liquor, which ancient physiologists very improperly and erroneously denominated the *female semen*. Respecting the nature, however, the sources, and the universal presence of this humour, we are able to propose nothing more determinate or satisfactory than we can advance with regard to its destination and uses.

SECT.

SECT. XLII.

OF MENSTRUATION.

§ 544.

A VERY frequent and highly important function of the uterus in the female of the human ſpecies is, to diſcharge *monthly* a tributary effuſion (called therefore *catamenia*), during the tedious and momentous term of about thirty years. This is a painful condition of exiſtence, to which nature has not ſubjected any other genus of her ſubjects, throughout the wide and diverſified range of the whole animal kingdom; ſo that to uſe the words of the eloquent Pliny "the only *menſtruous* "animal in nature is woman." From this *condition*, on the other hand, painful as it is, nature has not exempted the females of any of the known nations of the globe, but has ſtamped it with the ſacred character of an eſſential requiſite—of a genuine *ſine qua non*, in rendering the female ſex competent to the propagation of their ſpecies.

§ 545.

The commencement of this ſingular function generally takes place, in our climate, about the fifteenth year of life, and is, for the moſt part, preceded by various and unequivocal ſymptoms of

of plethora, ſuch as congeſtion and anxiety about the breaſt, ſenſe of tenſion and weight in the lumbar region, laſſitude or wearineſs of the limbs, &c. On the firſt appearance of the catamenia, the genital organs, in the beginning of the attack, uſually diſcharge a humour of a pale reddiſh caſt; this is gradually ſucceeded by a liquid of a more intenſely florid and ſanguineous colour, which terminates, at length, in an effuſion of genuine cruor or red blood. This ſpontaneous, though gentle diſcharge of blood, is kept up for the term of ſeveral days, and is, in the mean time, accompanied by a gradual ceſſation of all thoſe diſtreſſing ſymptoms of which we have juſt exhibited a partial detail.

§ 546.

From the time of its firſt occurrence, this *conſtitutional hemorrhagy* (as it may, with ſufficient propriety, be denominated) becomes regularly periodical: thus its future paroxyſms return uniformly about the expiration of every fourth week, and at each recurrence, the evacuation continues, at a mean calculation, about ſix days; during which term, a healthy female is ſuppoſed to diſcharge from eight ounces to an entire pound of blood.

§ 547.

It is proper, however, to obſerve, that this function is ſubject, for the moſt part, to an entire intermiſſion, during the ſtate of female pregnancy, and the term of maternal lactation.

The final *ceſſation* of the catamenia occurs after their diſcharge has continued, at ſtated periods, about the ſpace of thirty years, which term of time is completed, in our climate, about the 45th year of life.

§ 548.

The *ſources* of the catamenial diſcharge have been referred by ſome to the veſſels of the vagina, and by others (with ſuperior weight of evidence on their ſide) to thoſe of the uterus: for with regard to thoſe examples commonly adduced in ſupport of the former opinion, where women, although pregnant, poſſeſſing an imperforated uterus, or diſtreſſed by a prolapſus of that organ in an inverted ſtate, have notwithſtanding menſtruated with uniform regularity, they tend to prove nothing elſe than the powerful efforts of the *vis medicatrix naturæ*, which in caſes where the main ſtreet is obſtructed, is (to adopt a vulgar mode of expreſſion) fortunately acquainted with the routes through lanes and alleys. There are on record, on the other hand, numerous *diſſections*

of

of females who died during the term of actual menſtruation, from which it was unequivocally aſcertained, that the catamenial diſcharge had been wept out of, or diſcharged in a ſtillicidious manner from, the uterine cavity of theſe ſubjects: not to mention the arguments drawn *a priori* (as metaphyſicians expreſs themſelves), from which it appears highly probable, that the end and deſtination of the menſes are, to prepare the uterus for a ſtate of future pregnancy, and render it more fit for the regular nutrition of the fœtus. For the very ſame reaſons alſo this hemorrhagy appears to be attributed, with more propriety, to the *arterial* than to the *venous* veſſels of the uterus.

§ 549.

With regard to the *cauſes* of this periodical and perennial hemorrhagy, they are ſhrouded by ſo thick a curtain of obſcurity, and their inveſtigation is attended with ſuch momentous difficulties, that in the proſecution of this ſubject, we have not a ſufficient power of evidence to conduct us over the arduous mound which divides the twilight-region of *probability* from the more luminous realm of *demonſtration*, and *certainty*.

The proximate cauſe phyſiologiſts ſuppoſe to be a certain topical congeſtion or plethora, to which

opinion, indeed, the ſymptoms of the impending catamenia, together with the profuſion and nature of the uterine blood-veſſels fitly enough correſpond, and in favour of the truth of which they exhibit a degree of teſtimony ſufficiently reſpectable.

Among its remote cauſes it will be proper to enumerate, the erect poſition of the body (a poſition that ſerves as a characteriſtic diſtinction between the human ſpecies and moſt other deſcriptions of animals); to which we muſt add, the ſingular parenchyma of the uterus itſelf, and, finally, the *vita propria* or ſpecific life of that important organ.

With regard to the cauſe of the periodical recurrence of the catamenia, it will here be better, much better to acknowledge our ignorance, than to indulge ourſelves in vague and viſionary conjectures, and ſportively range through the fair but fallacious fields of mere ſpeculative hypotheſis. For I am, indeed, perſuaded, that all thoſe periodical phenomena which occur in the animal body, whether in health or diſeaſe, *(provided their interval extend beyond the term of* 24 *hours)* muſt be ranked with thoſe *latent myſteries* of animal nature, which nothing but time, talents, and induſtry, will be ever able to develope.

SECT. XLIII.

OF THE MILK.

§ 550.

BETWEEN the female *mammæ* and uterus (the former of which were, by the philoſopher Favorinus in his communications to Gellius, elegantly and emphatically denominated, *the ſacred fountains that nouriſh the human race*, there exiſts ſuch an extremely potent ſympathetic connection, that theſe two organs may be ſaid to be indiſſolubly aſſociated, or to accompany each other hand in hand, in their phenomena and functions. Thus, during the tender period of infancy, ſo great is their imbecility and want of action, that they are capable of performing ſcarcely any function at all: as the years of puberty advance, they begin, at the ſame time, to acquire vigour and activity, ſo that on the firſt eruption of the catamenia, a ſwelling of the mammæ or breaſts becomes alſo evident to the ſenſes. Throughout the ſubſequent periods of life thoſe two organs are either ſubjected to ſimultaneous and ſimilar changes, as when the breaſts become turgid and diſcharge milk during the progreſs of pregnancy; or experience alternate and oppoſite affections,

inſtances

inſtances of which we have in the ſuſpenſion of the catamenia during the term of lactation, a more copious effuſion of the *lochia* when the ſecretion of milk does not commence at the uſual period, &c. And, laſtly, on the unwelcome acceſſion of old age, both the preceding functions fail at the ſame time, ſo that when the catamenia finally retreat, never again to return, the uterus and mammæ become *equally* flaccid, inert and wholly incapable of their former action. A great variety of pathological phenomena, eaſily obſervable in caſes of irregular menſtruation, in *fluor albus*, and other ſimilar affections, ſhall be in ſilence pretermitted, although they furniſh the moſt potent and unequivocal teſtimony in confirmation of the ſympathy now under conſideration, namely, that which exiſts between the uterus and mammæ.

§ 551.

Nor will this intimate ſympathetic connection, which ſubſiſts between the uterus and mammæ, appear in any meaſure extraordinary or ſurpriſing, when we conſider, that all thoſe diverſified *ſources* of phyſiological conſent, particularly enumerated on a former occaſion (§ 54), jointly co-operate in the eſtabliſhment of ſuch connection between theſe organs of the female thorax and abdomen.

§ 552.

The anaſtomoſis obſervable between the internal mammary and epigaſtric arteries, was formerly eſteemed a circumſtance of the higheſt importance in the explication of the foregoing conſent. Although phyſiologiſts have hitherto attributed by far too much to this remarkable anaſtomoſis, yet that it ought not to be entirely excepted from the number of co-operating cauſes will appear extremely probable to any one who conſiders the obvious and wide difference which exiſts between the diameter of the epigaſtric artery in a ſtate of pregnancy, and that of the ſame veſſel during the period of lactation.

§ 553.

The two preceding organs, namely, the uterus and mammæ, poſſeſs alſo, in common with each other, this further property, that they both retain and exhibit a friendly affinity or attraction for the chyle, by which means they ſolicit that fluid to themſelves, eſpecially during the term of pregnancy, and thus convert it to peculiar uſes.

§ 554.

The female mammæ conſiſts of a placentoid congeries of ſmall conglomerate glands, diſtinguiſhed by numerous *ſulci* into lobes of conſiderable magnitude, and completely embedded in a maſs of adipoſe

adipose substance. On the anterior part, in particular, a protuberance is formed by a more firm sebacious cushion, which is covered and protected by a cutis of a very tender and delicate texture.

§ 555.

Each one of these lobes is composed of a number of inferior lobuli, and these again of what are denominated *acini* or *kernels*, in which the incipient radicles of the *lactiferous ducts* originate, and from the extreme *ramuli* or branches of the internal mammary artery extract a chyliform fluid, which they are particularly destined to convey.

§ 556.

The fine filiform radicles uniting successively in their onward passage, terminate finally in leading trunks, corresponding in number to the principal lobes; so that they generally amount, in each mamma, to about fifteen or perhaps a few more. These trunks are frequently dilated into more spacious sinuses, but never appear to be connected by genuine anastomoses.

§ 557.

These trunks terminate in excretory canals of exquisite delicacy and tenderness, which, being collected and closely approximated towards the centre of the mamma, form, by the co-operation

of cellular membrane, the *papilla* or nipple. This projecting papilla being interſperſed and minutely pervaded by an infinitude of blood-veſſels and nerves of extreme fineneſs and ſubtlety, is ſubject to a very ſingular ſpecies of erection on the acceſſion of certain external ſtimuli.

§ 558.

The nipple is ſurrounded by an *areola* or ſmall circle, which is conſpicuous, as well as the papilla itſelf, on account of the ſingular colour of the *reticulum mucoſum* expanded immediately beneath the epidermis or cuticle. This areola is further diſtinguiſhed by ſmall ſebaceous follicles, and likewiſe by a few minute lactiferous ducts with which it is in ſome inſtances pervaded.

§ 559.

The *human milk* which is ſecreted in the glandular organs hitherto deſcribed, is a fluid of a well known colour, ſomewhat watery, and containing alſo a ſmall portion of oil: this liquid is ſweetiſh to the taſte, extremely mild, and reſembles, in its general properties, the milk of domeſtic animals belonging to the claſs mammalia, except that it is not, like the latter, ſubject to coagulation from the action of acids, nor does it exhibit, to the moſt attentive obſervation, the ſlighteſt veſtige of *volatile alkali*.

§ 560.

§ 560.

When coagulated, however, by the influence of ſpirits of wine, it exhibits the ſame component elements of which the milk of thoſe other animals already mentioned is known to conſiſt. For beſides the *watery* halitus which human milk emits when recently drawn, and yet in a tepid ſtate, its *ſerum*, ſeparating from the *caſeous* or cheezy portion, contains alſo the ſugar of milk, which is compoſed of the ſaccharine acid united to a calcareous earth, together with certain additional parts oily and mucaginous in their natures. Laſtly, it contains alſo a *cream* or butter-like portion, the globules of which are extremely various and changeable in their magnitudes, thus vibrating in their diameters from the $\frac{1}{200}$th to the $\frac{1}{800}$th part of a line.

§ 561.

The analogy which is obſerved to exiſt between chyle and blood, and between each of theſe liquids and milk itſelf, renders it ſufficiently probable, that this laſt humour, (which conſtitutes at preſent the more immediate object of our conſideration), is a ſpecies of chyle renovated from the volume of *blood*, or rather ſeparated from this crimſon fluid (with which it had juſt formed a junction) previouſly to its final and complete aſſimilation. This opinion, beſides other arguments

which might be advanced in its favour, derives powerful teſtimony from the ſpecific taſtes of ſeveral kinds of aliment being not unfrequently perceptible in the milk of nurſes; and alſo from the chyle-like habit and conſtitution of that watery milk, which not unfrequently exudes from the breaſts of females during the term of pregnancy, and for a ſhort time after the period of parturition.

§ 562.

The reaſon why, during the progreſſive continuance of lactation, this bland food of the fœtus becomes gradually more and more inſpiſſated, rich and oily, muſt be referred chiefly to the lymphatic veins, with which the mammæ plentifully abound: Thus the more profuſe the afflux of *milk*, and the greater length of time this afflux has continued, with the more power and uniformity do theſe lymphatics abſorb its ſerous parts, and convey them back to the maſs of circulating blood, by which means they furniſh the moſt effective aid to the whole proceſs of this ſecretion (§ 476).

§ 563.

During the firſt days after parturition, a very profuſe ſecretion of milk occurs, and (provided the mother *lactates*, i. e. ſuckles her child) is promoted and kept up by the ſuction of the infant itſelf,

itself, until the catamenia return, which had for a long time ceased to flow (§ 547). The existence of milk in the breasts of virgins truly inviolate, in the breasts of new-born infants of each sex, and even in the breasts of men themselves, as well as in those of other male animals belonging to the class mammalia, is a phenomenon which not unfrequently presents itself to our observation.

§ 564.

A profuse quantity or accumulation of milk in the breasts effectually solicits its own final excretion, whence a spontaneous discharge of that fluid is observed frequently to occur; this discharge is further promoted by the external pressure of the mammæ, as well as by the suction of the tender infant.

SECT.

SECT. XLIV.

OF CONCEPTION AND PREGNANCY.

§ 565.

HAVING hitherto conſidered the ſtructure of the genital organs peculiarly belonging to each ſex, we come now to treat of thoſe *functions* or proceſſes which conſtitute the immediate end and deſtination of theſe organs, namely, *conception* and the propagation of the human race. In the order and progreſs of our enquiries into theſe abſtruſe and intereſting ſubjects, we will firſt give a plain and ſimple narrative of the ſeveral phenomena obſervable in this admirable and truly divine proceſs; and then attempt an inveſtigation of the energies from which theſe phenomena appear to originate.

§ 566.

It is, in the firſt place, neceſſary to obſerve, that the ſubjects of the human race have not, like moſt other animals (all thoſe, if I be not deceived, belonging to the claſs mammalia, man alone excepted), any peculiar ſeaſon of the year in which they are unuſually prone to venereal enjoyments, but

but are equally liable to experience, at every period and under every varying temperature, the gentle glow of love's diffusive fires.

§ 567.

When therefore, the female of the human species admits the embraces of the male, and while they are thus mutually enwrapt in the ardour of that animal instinct which far surpasses every other both in the *universality* and the *potency* of its sway, the uterus (if we be not greatly deceived) being rendered turgid by a species of inflammatory orgasm, and animated at the same time by its own specific life, (§ 538.) drinks in, as it were, the *seminal fluid* emitted by the male, and effects a synchronous discharge of *that* which is proper to itself (§ 543); the fallopian tubes become at the same time rigid, and with their fimbricated extremities embrace the adjacent ovaria: in one or the other of these ovaria one of the vesiculæ Graaffianæ is lacerated or burst, somewhat after the manner of an abscess advanced to a state of complete maturity, and the albuminoid liquid which this ruptured vesicula contained, being absorbed by the orifice of the embracing tube, is thus conveyed onward into the cavity of the uterus.

§ 568.

§ 568.

This *liquid* being discharged from the ovary, the external lips of the small and recent wound through which it was emitted, are again united by a fine cicatrix, while the remaining delicate vascular membrane in which the liquid had been enclosed, constitutes what is called *corpus luteum*. This body appears to be at first hollow and filled with a quantity of plastic lymph, that in process of time is converted into a fleshy nucleus, invested by a firm cortex or membrane, which is interspersed by a variety of minute, yet remarkable blood-vessels.

§ 569.

The uterus being thus impregnated, the canal leading through the *cervex* or neck of that organ, especially towards its superior or internal orifice, (§ 535.) is completely obstructed, in such a manner, that according to the common course of nature there is no room left for superfœtation.

§ 570.

The internal superfices of the uterus appears to be invested with a slight inflammatory crust of plastic or coagulable lymph, (§ 19.) which forms the *membrana caduca*, (called also *membrana decidua*), of Hunter.

This

This membrane-like cruſt phyſiologiſts diſtinguiſh into two laminæ or layers; one of which, denominated *lamina craſſa*, inveſts the whole internal cavity of the uterus, except the immediate openings into the fallopian tubes, and the internal orifice of the cervical canal; while the other is the growth of a later period, and appears to be generated in the following manner, viz. after the formation of the *ovulum* is fairly commenced, and this minute body begins to ſtrike its roots into the *decidua*, already mentioned, this ſecond lamina begins gradually to expand, and is thus *continued* from the place where thoſe minute roots begin to pullulate, over the remaining ſuperficies of the ovum, whence it has been diſtinguiſhed by the name of *caduca reflexa*.

§ 571.

Although the *ovulum* be formed itſelf at an earlier period than the embryo which it is deſtined to contain, yet the real organization of the former ſeldom commences earlier than the termination of the firſt week after conception. For I very much doubt, whether or not, at an earlier period than this, any unequivocal veſtige of an organiſed body has been ever obſerved in the impregnated uterus of the human ſubject.

§ 572.

This ovulum, or little egg, is compoſed of two proper membranes, beſides that external *adventitious* covering, which it derives from the *caduca* of Hunter.

The proper membranes are, *firſt*, an external one, apparently deſtitute of blood-veſſels, which forms the *chorion* of modern writers. From the earlieſt origin of this membrane a great part of its external ſuperficies is beautifully ſet with knot-like flocculi or minute *piles* of inconceivable elegance, from whence it has been called, *chorion muſcoſum ſeu frondoſum*, i. e. the *moſs-like*, or *leaf-like*, *chorion*. By means of thoſe delicate piles, which conſtitute the rudiments of the fœtal part of the future placenta, the ovulum is inſerted (as if by roots) into the *decidua uterina*. (§ 569.)

The other membrane, lying interiorly, is denominated the *amnion*, which is alſo deſtitute of blood-veſſels, (§ 5.) it is indeed delicate and tender, but yet of remarkable tenacity and ſtrength.

§ 573.

For a few weeks after the firſt formation of the *ovulum*, its two proper membranes differ very widely from each other in point of ſize, the chorion exhibiting the appearance of a *larger* bladder,

bladder, to the inside of which the amnion adheres under the form of a *smaller* one, and is attached in particular to that part which is opposite to the centre of the external floccose superficies of the chorion.

The interstice which then exists between the *chorion* and *amnion* is filled with a very subtle chrystaline water, of doubtful origin, and transient continuance.

For when the *amnion* begins, during the first months after conception, to increase with greater rapidity than the chorion, and to gain on the latter membrane in point of magnitude, this chrystaline liquor must necessarily undergo a synchronous, and perfectly correspondent, diminution.

§ 574.

The internal membrane of the ovum, from the earliest period of its formation (§ 570), till the final close of parturition itself, is constantly filled with a fluid, denominated by physiologists, *liquor amnii*. This liquid is aqueous, and of a pale yellowish colour; it emits scarcely any odour, and is to the taste *bland*, with a slight saline impregnation hardly perceptible; physiologists generally suppose it to be a source of nourishment, and compare it to the white of an egg, from which it notwithstanding,

notwithſtanding, differs in a very obvious and eſſential manner, as may be eaſily demonſtrated by an attentive experimental inveſtigation.

The ſources of this fluid are as yet doubtful: It is certainly, however, neither derived from the fœtus nor the umbilical cord, as it is not unfrequently found in abortive ovula, which contain neither of theſe bodies.

The quantity of this fluid is in an inverſe proportion to the bulk of the fœtus. Thus the ſmaller and more tender the embryo, the more profuſe is the volume of *liquor amnii*, and vice verſa.

Hence we are at liberty to hazard a conjecture reſpecting the primary uſe of this liquor, which appears to be ſubſervient, not ſo much to the nutrition, as to the protection and defence of the minute body of the tender embryo, as yet in a gelatinous ſtate, and, therefore, wholly unable to bear the violence of external injuries. With reſpect to that ſmall portion of the *liquor amnii*, which has been ſometimes (though ſo rarely as to deſerve to be eſteemed a preternatural occurrence) found in the ſtomach of the fœtus, it cannot poſſibly be deſtined for the purpoſe of its *nutrition*, as will be obvious to any one who conſiders how

extremely inert and empty the chyliferous ſyſtem of even a more mature fœtus appears, how unfit for, and even how averſe from, the arduous and important proceſs of chylification. To the foregoing circumſtances we might (if neceſſary) ſubjoin various examples of fœtuſes deſtitute of heads, with diverſe other arguments of a ſimilar nature, and tending to the eſtabliſhment of a ſimilar reſult.

§ 575.

The *embryo* itſelf, which (ſuſpended by the umbilical cord, as fruit appended to its foot-ſtalk), floats in this liquor, begins to be formed about the third week after conception: it appears firſt under the very ſimple globe-like figure of a ſmall bean or kidney, to which the rudiments of the extremities are gradually ſubjoined, the ſymmetry and ſpecific form farther completed, &c.

§ 576.

According to the uſual courſe of nature, the female of the human ſpecies is *uniparous*, and conceives only one fœtus at a time. She not unfrequently, however, bears *twins*, the proportion of which to ſolitary births is, according to the calculations of Suſſmilch, as one to ſeven. In a caſe of twins each fœtus has its own amnion, but they are both enveloped in a common chorion.

§ 577.

That medium, by the aid of which a reciprocal intercourſe is preſerved between the embryo and mother, are the umbilical cord, and the placenta through which this cord is minutely diſtributed.

§ 578.

The umbilical cord, which appears to be coeval with the embryo itſelf, is indeed very ſtrikingly diverſified, not only in point of length and thickneſs, but alſo with reſpect to the place of its inſertion into the placenta, its varicoſe protuberances, &c. In general, however, it is formed of the ſpiral contortions of three blood-veſſels, namely, a vein running to the liver of the fœtus, and two arteries which originate from the internal iliacs or hypogaſtrics. Theſe veſſels are ſeparated and diſtinguiſhed from each other by cellular partitions, running in various directions, and have their *lights* or diameters frequently ſtraitened by the ſmall nodes or valve-like bodies of Hoboken.

Theſe veſſels are collected and compacted together into a cord by means of cellular membrane, which being filled with a ſingular and very limpid humour, exhibits the appearance of jelly, but is inveſted externally by a continuation of the amnion.

§ 579.

§ 579.

At the place where the *fœtus* is attached to this *cord*, the latter is joined by a peculiar body, which originates from the bottom of the *veſica urinaria* (§ 486.), and purſues a middle courſe between the two umbilical arteries, namely, the *urachus*. This body is, in the human ſpecies, pervious, for at leaſt a ſhort ſpace, and afterwards totally diſappears; but in other animals belonging to the claſs mammalia, leads onward to what is called the *allantois*. Of this allantois the human fœtus appears to be entirely deſtitute, unleſs we be inclined to deſignate by this name that myſterious and tranſient *veſicula umbilicalis*, uniformly obſervable in the human ovula, between the chorion and amnion, which (if I be not greatly deceived) Iſbr. de Diemerbroek firſt diſcovered long before it was ſeen by Albinus or Zinn. But in more modern times it is diſcovered too frequently, and with too uniform an aſpect in unvitiated and fruitful human ovula, (even to ſo late a period as the third month after conception), to be any longer conſidered as an accidental, a morbid, or a monſtrous conformation of the part.

§ 580.

The blood-veſſels of the cord, of which we have already ſpoken, paſs into the *placenta*, which was formerly ſaid to originate from the leaf-like

ſuperficies of the chorion, a membrane attached to, and even inſerted in, the *decidua craſſa*: Hence we perceive that the placenta is a body compoſed of two different kinds of ſubſtance, received from an equal number of ſources. Thus, for example, one kind called the *uterine*, from its immediate appoſition to that organ, is derived from the decidua, and conſtitutes the ſpongy parenchymatous portion of the placenta; while the other belonging to the fœtus, and therefore called the *fœtal* part, is derived from the umbilical veſſels diſtributed throughout the chorion.

At this time the increaſe of the tender ovum is unequal, ſo that the growth of the ſmooth portion of the chorion is greater and more rapid than that of the *muſcoſum* or moſs-like; hence it is evident, that the relative magnitude of the placenta to that of the whole volume of the egg, is greater in proportion as the conception is more recent, and leſs, on the other hand, accordingly as the period of parturition is nearer.

As pregnancy gradually advances, the placenta becomes more and more cloſe and compact in its texture; it is impreſſed with grooves, and diſtinguiſhed into lobes on its *external* ſurface which reſpects the uterus, but is ſmooth and highly poliſhed on its *internal*, which, looking towards the fœtus,

fœtus, is invested or lined by the amnios. With regard to magnitude, thickness, figure, and situation or point of *cohesion* to the uterus, it is subject to a multitude of diversities; it is attached, however, for the most part, to the fundus or bottom of that organ; and is, upon the whole, equally destitute of both sensibility (§ 205.) and genuine irritability (§ 307).

§ 581.

Although all physiologists uniformly concur in this, that the *placenta* is the principal organ through the medium of which the tender fœtus is supplied with nutriment, yet various controversies have latterly existed among them respecting the genuine mode of *its* official action, and its reciprocal relation, as well to the uterus as to the fœtus. From an attentive and impartial consideration of all the testimony that can be collected on this subject, the result appears to be, that there exists no direct anastomosis between the blood-vessels of the maternal uterus and those of the umbilical cord; but the arterial blood which passes by a continuous route from the uterus of the mother to that portion of the placenta that owes its origin to the decidua crassa, is there absorbed by the incipient radicles of the umbilical veins, that are distributed throughout the moss-like portion of the chorion, and thus conducted into the

venous trunk of the *funis umbilicalis*: while, on the other hand, the blood which is conveyed back from the fœtus by the umbilical arteries, being in like manner effuſed into the parenchyma of the placenta, is taken up by the venous radicles of its uterine portion, and thus finally re-conveyed into the ſubſtance of the uterus itſelf.

The foregoing opinions receive additional confirmation from the many well guarded but fruitleſs attempts that have been made by different phyſiologiſts to inject the veſſels of the umbilical cord through thoſe of the uterus, or, on the other hand, to fill the *veſſels* of the latter organ by injections forced through *thoſe* of the former. As a further evidence in ſupport of the ſame principles, we may mention the difference which is obſerved to exiſt between the pulſe of the mother and that of the fœtus before their final diſengagement from each other; and laſtly, it may not be improper to add, as a circumſtance tending to the eſtabliſhment of the ſame reſult, the obſervations which we formerly delivered reſpecting the difference between the nature of the fœtal and that of the maternal blood (§ 147).

But further, it appears probable that a portion of chyle is alſo conveyed to the fœtus along with the blood of the mother. For beſides the conſideration,

ration, that the blood of the mother is not at all times equally pure and unmixed, but, for some hours after every meal, carries along with it, in an unassimilated state, that portion of chyle recently received from the thoracic duct, it has been demonstrated, on a former occasion, that the uterus itself possesses a singular and strong affinity to the chyle and milk (§ 550. 553.); and there are also on record a great variety of observations, from which it appears, that a milky juice has been actually discovered in the uterine portion of the placenta.

§ 582.

During the progressive advancement of pregnancy, while the fœtus and secundines increase so very remarkably in magnitude, it is obvious that the uterus must be also subjected to striking and remarkable changes. Besides the augmentation of its bulk, so extremely evident at first view, these changes respect also its *situation* and *figure*, but affect more especially the *texture* of this singular and important viscus. Thus, in consequence of the uniform and weighty congestion of humours which the gravid uterus is obliged to sustain, it is likewise subjected to extreme alteration, both with regard to the state of its blood-vessels, and also

alſo with reſpect to that of its parenchymatous portion, throughout which thoſe veſſels are interwoven.

On the preſent occaſion it may not be improper to obſerve, that in proportion as the impregnated uterus advances in magnitude, its blood-veſſels loſe that mazy and convoluted appearance, for which they are at other times ſo very remarkable, and aſſume courſes much more rectilineal or direct; while at the ſame time they are ſubjected to a conſiderable extenſion of their diameters, and a conſequent increaſe of their real capacities. Thus, even the uterine veins have become ſo extremely capacious and prominent, as to have been miſtaken by numerous anatomiſts for true ſinuſes.

With regard to the parenchymatous portion of the impregnated uterus, it becomes gradually more and more lax and ſpongy, eſpecially where it is in contact with the ovum contained; ſo that towards its fundus or bottom it becomes conſiderably thick, and in a living and healthy female, is greatly diſtended with blood, and poſſeſſes the powers of life in a very high degree. This organ is, notwithſtanding, ſoft at the ſame time, and very widely different in its general habit and appearance from the firm and compact fleſh of the uterus

uterus in an unimpregnated ſtate: this difference is ſtill more ſtriking if the ſubject containing the gravid *uterus* be dead, in which caſe, provided pregnancy be conſiderably advanced, this organ falſely aſſumes in its texture (as was formerly well obſerved by Arantius), a lamellated appearance.

It may not be amiſs, on the preſent occaſion, briefly to enumerate a few more of the moſt important changes to which the gravid uterus is ſubjected, together with the moſt remarkable ones that occur in the ovum and fœtus. Theſe changes we will conſider in the ſucceſſive order in which they appear throughout the ſeries of *ten lunar* months, which period of time is now, with ſufficient propriety, ſuppoſed to conſtitute the moſt natural term of pregnancy.

§ 583.

As we uniformly obſerve the uterus beginning to ſwell ſhortly after the time of impregnation, (§ 567.) ſo being from that period increaſed both in bulk and weight, it deſcends a little deeper into the ſuperior part of the vagina; notwithſtanding this deſcent it ſtill retains its former figure in all, except the following, reſpects, viz. its fundus becomes a little more convex, its *anterior paries* or wall, recedes a little farther from the *poſterior*, and its cavity, which was before very narrow and almoſt

almoſt triangular, now accommodates itſelf to the globoſe figure of the ovulum it encloſes.

About the end of the firſt month, the ovulum itſelf amounts to the ſize of a pigeon's egg, and has the two deciduæ ſeparated from each other, and alſo the ſmall amnion ſituated at a diſtance from the larger chorion: about the termination of the third month it attains the ſize of a gooſe's egg, the caduca reflexa becomes approximated to the craſſa, and the amnion approaches nearer to the chorion. The amnion abounds, at this time, with a profuſe volume of fluid denominated *liquor amnii*. In this liquor the embryo, as yet very tender, and extremely ſmall in proportion to the quantity of the ſurrounding fluid (being at this time ſcarcely equal in magnitude to a ſmall mouſe) appears to fluctuate in a looſe and unſteady manner, and is even now in a precipitate poſition.

§ 584.

About the fourth month after conception, the uterus begins to aſſume more of an oval or ſomewhat globe-like appearance; its neck being more and more ſoftened, gradually ſhortened, and as it were, deſtroyed, or rather latterly diſtended, it again protrudes upwards, and begins to aſcend from the ſmaller into the larger pelvis. At the ſame time the fallopian tubes themſelves, with the convex

convex bottom of the uterus being elevated or borne upwards, are thus extended and elongated; these tubes are, however, attached and connected so closely to the sides of the uterus, that they cannot recede from them, more than one half of their own length; hence, when only viewed superficially, they appear to originate and proceed from the middle of the uterus, which has given birth to a very erroneous opinion respecting the astonishing increase of the *fundus uteri*.

From this time also the fœtus acquires by degrees such an increased magnitude, as renders it more proportionate to the capacity of the ovum, and begins about the same period to fix itself in a more steady and firm position, which it preserves till the very close of parturition: in this position its head is placed in a downward direction, and and its face turned towards the lumbar region of the mother, inclining, for the most part, somewhat obliquely towards the left side.

§ 585.

In the middle stage of pregnancy, which occurs about the end of the fifth month, the uterus has attained such a magnitude, that its fundus is elevated to a point half-way between the *pubes* and *umbilicus*, and the pregnant state becomes now observable

obſervable from the external appearance of the abdomen.

About the ſame time, the fœtus becomes more perceptible to the mother from the agitative motion of its body, though we are not able to determine, with accuracy and definitude the preciſe period of time at which this motion takes place. It appears now, however, to be more vigorous and active, ſo that, according to the common uſe and acceptation of ſpeech, it may be ſaid to be the unequivocal action of life.

§ 586.

Throughout the five remaining lunar months the uterus, with the fœtus which it contains, make gradually ſtill farther advancements in point of magnitude. Thus, at the end of the ſixth month they reach nearly to the umbilicus or navel; and about the termination of the eighth approach even the ſcrobiculus cordis, in conſequence of farther protruſion upwards. The *cervix uteri* is in the mean time more and more obliterated, reduced nearer to a level with the adjacent parts of that organ, and its parietes or walls conſiderably diminiſh in thickneſs.

§ 587.

§ 587.

Finally, about the end of the tenth month after conception, the uterus being oppreſſed and overpowered as it were, by its own bulk and weight, (its longitudinal axis, amounting in general to 11, and its tranſverſe to 9 inches in length) begins again to ſubſide, and as the period of parturition approaches, its *oſtium* or mouth is gradually expanded, and thus exhibits an orbicular or ring-like opening.

Each membrana caduca, more eſpecially the reflected one, which adheres to the chorion, having been gradually attenuated for ſeveral months immediately preceding, exhibits now a kind of net-like appearance diſtinctly marked by ſhort fibres of a whitiſh colour.

Such is the ſize of the placenta at this advanced period, that its greateſt diameter or breadth amounts to about 9 inches, its leaſt diameter or thickneſs to about one inch; and its weight to about one pound, and ſometimes more.

The length of the umbilical cord for the moſt part equals, and ſometimes even exceeds, eighteen inches.

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The weight of a mature and well grown fœtus is nearly ſeven pounds, its length about twenty inches.

The quantity of the liquor amnii is ſo extremely variable, that it cannot poſſibly be aſcertained with any degree of definitude; in general, however, it ſcarcely amounts to a pound, provided the fœtus be healthy and robuſt.

SECT. XLV.

OF THE NISUS FORMATIVUS.

§ 588.

HAVING thus enumerated and deſcribed, in a plain and ſimple manner, the moſt obvious and unequivocal phenomena of conceptions, together with ſuch changes as are diſcovered by attentive obſervation to ſucceed each other, during the progreſſive courſe of pregnancy, not only in the human ovum itſelf, but alſo in the fœtus which it embraces, and contains, we now proceed to an inveſtigation of thoſe phyſical powers, by the influence and efficacy of which the ſublime

sublime and truly astonishing process of generation appears to be most probably accomplished.

§ 589.

There are not wanting certain characters of high celebrity and distinction who attempt, even in our own times, to explain the divine process, in the following brief and summary manner; they contend that the genuine work of *actual generation* has not, at the present time, any real existence at all; on the contrary, they allege, that the whole human race possessed, under the form of original germs, a joint pre-existence in the genital system of one or other of our first parents, and that these germs have ever been, and are yet, subjected to gradual *evolutions*, according as the progressive lapse of time, aided by the co-operation of specific causes, has contributed to awaken them to the enjoyment of open and actual life.

Unfortunately, however, for the advocates of the foregoing hypothesis, an essential difference of opinion prevails among them on a point of considerable magnitude and importance; thus, while some of them are anxiously in quest of those *original germs* among the animalculæ that people the semen of the male; others are searching for those microscopic animals with no less industry and zeal in the ovaria of the female.

§ 590.

§ 590.

To the latter of these *sects* in physiology, I must acknowledge that I myself was formerly an adherent. I was lead to adopt the *opinion* of this learned body not only by the respectable authority of its numerous advocates, but also by the want of *another* more rational and satisfactory. At present, however, I am obliged to repudiate this doctrine entirely, to confess my errrors, and endeavour if possible to correct them; having been fully convinced, from a more close and minute attention to the phenomena of generation, that nature performs this process in a manner quite different from that contemplated and embraced in the theory now under consideration.

§ 591.

For I am indeed daily more and more convinced, that all living organized bodies possess, from their earliest effort at organization to the closing glass of their existence, a peculiar power perpetually active, perpetually efficacious, the immediate destination of which is, first, to mould the bodies in which it resides into their native and specific forms by the mysterious process of *generation*, to preserve them afterwards from destruction by the ceaseless function of *nutrition*, and, in case of accidental mutilation, to restore their parts again, as far as consistent with the regular esta-

bliſhments of nature, by the proceſs of *reproduction*. That this energy may not be confounded with the other kinds of vital energy, let it be diſtinguiſhed by the name of *niſus formativus*. By this name, however, we mean to deſignate not ſo much a cauſe as a perpetual and uniform effect, the exiſtence and reality of which are deduced from actual obſervations made on the conſtant and univerſal occurrence of certain phyſical phenomena. It is thus, with views, and on principles entirely ſimilar, that we make uſe of the terms *attraction* and *gravitation*, to denote certain energies or ſources of action, the *cauſes* of which are notwithſtanding ſtill involved in more than cimmerian darkneſs.

§ 592.

To me it appears, indeed, highly probable, that a ſtated period of time is requiſite for accompliſhing the intimate mixture, the union and complete concoction or maturity of thoſe various inquiline humours, belonging to each ſex, (§ 518. 524. 542. 543.) which are doubtleſs diſcharged into the cavity of the uterus, during every act of fruitful coition. This term of preparation having at length elapſed, and the liquors being fully matured and brought into the moſt perfect ſtate of union and reciprocal influence, the niſus formativus is forthwith excited into action, by means of which the

ſpermatic maſs, hitherto formleſs and chaotic, is partly arranged and organized into the elegant and beautiful envelopes of the naſcent *ovulum*, and partly moulded into the figure of the living embryo which this minute bodie encloſes. From this theory we can aſſign a ſatisfactory reaſon, why the uterus, for the two firſt weeks after conception, appears to contain a maſs of crude and ſhapeleſs humours alone, and does not exhibit, even to our beſt glaſſes (now brought to very high perfection), the ſmalleſt veſtige of an organized embryo, which, notwithſtanding burſts into view almoſt inſtantaneouſly about the end of the third week, and is, even on its firſt appearance, of conſiderable magnitude.

§ 593.

Of the *niſus formativus* we are preſented with more remote veſtiges throughout every department of natural bodies, not excluding even the moſt ſimple elements of matter, where original germs cannot poſſibly be ſuppoſed to have the ſhadow of an exiſtence. Thus, the clouds themſelves aſſume their own determinate forms, and even the ſtreaming torrents or veins of the electric fluid preſerve ſpecific figures. There are, again, in the mineral kingdom, ſpecimens of metallic chryſtallization, which, if indeed the form alone be conſidered, and

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the prerogative of life kept entirely out of view, bear the moſt ſtriking reſemblance to truly organized bodies.

In teſtimony of the truth of this, we need only mention the curious hypniform cryſtals into which refined or depurated copper ſhoots when firſt reduced to a ſtate of fuſion, or that exquiſitely beautiful ſpecimen of native peruvian ſilver which they call *filicinum* or *fern-like*, from the reſemblance of its figure to that of the plant denominated fern.

§ 594.

In like manner both the animal and vegetable kingdoms afford numerous examples of organized bodies, in which, from their magnitude being ſufficient to render them viſible, from their beautiful and unclouded tranſparency and from the extreme rapidity of their progreſſive growth, the whole proceſs of generation is completely unmaſked as it were, and may be ſubjected to the examination of the naked eye. The reſult of attentive and minute obſervations made on this proceſs in ſuch ſubjects as theſe, will be ſufficient to evince, on the authority of the moſt indubitable teſtimony that, at leaſt in theſe bodies, no germs pre-exiſt. In illuſtration of the above poſition it will be ſufficient to mention

from among the different individuals of the vegetable kingdom, the *conferra fontinalis*. And from those of the animal, the *hydra viridis*.

§ 595.

I should far exceed the limits prescribed to these institutions were I to attempt a minute and circumstantial detail of the various arguments which, in my view, nature herself furnishes to prove the potent influence of the nisus formativus in the process of generation. It may be proper, however, briefly to state a few of them, the force and efficacy of which will appear sufficiently evident on the slightest examination.

§ 596.

The first argument I shall further propose on this subject is taken from the history of those curious and interesting subjects of organized nature denominated *hybrids*. From a very beautiful and celebrated experiment it appears, that, if prolific female hybrids be successively through several generations impregnated by males of any given species different from the species of the females, the new offspring will gradually deviate so widely from the original form of the mother, and make such evident and effectual strides towards that of the father, as to lose at length every vestige of similitude to the former, and become finally, (by a

species

ſpecies of arbitrary metamorphoſis) completely aſſimilated to the external figure and appearance of the latter.

§ 597.

There exiſts a phenomenon or fact relative to the hiſtory and production of *monſters*, (the truth of which is too well aſcertained and eſtabliſhed to admit of a doubt), that merits our attention while on the conſideration of the preſent intereſting and intricate ſubject. It is a circumſtance well known to naturaliſts, that thoſe animal productions denominated *monſters* (moſt of which are ſuppoſed, by the advocates for the celebrated doctrine of *evolution*, to have pre-exiſted in a monſtrous *germiform* ſtate from their original creation)—it is, I ſay, well known, that ſuch preternatural productions, though very frequent among certain ſpecies of animals in a ſubjugated or domeſtic ſtate (more eſpecially among ſwine), are notwithſtanding very rarely found among the original and free-born animals of the very ſame ſpecies, that have never been reduced to an humble ſtate of domeſtication, but ſtill range the commons and wilds of nature, wholly exempt from the tyrannic controul of man.

§ 598.

It is neceſſary further to obſerve, that not only monſtroſities co-eval with the birth of animals, but alſo ſubſequent adventitious *mutilations* and other *ſpecies* of *deformity*, whether produced on the animal ſyſtem by accident or deſign, become now and then completely *hereditary;* and thus, what was at firſt the effect of art alone, may be ſaid to become at length the actual work of nature herſelf.

§ 599.

The phenomena of *re-production* in general are much more eaſily and rationally accounted for, by conſidering them as the reſult of a niſus formativus, than by referring them to the pre-exiſtence of partial or local germs. This obſervation is more fully and clearly illuſtrated, and its truth more forcibly exhibited by an application of it to ſome particular inſtances of re-production, as that of the nails, for example, which after the entire loſs of the *firſt*, are well known to be frequently regenerated on the *ſecond* phalanx of the fingers.

§ 600.

Again, in certain parts of the body where no pre-exiſtence of germs can poſſibly be ſuſpected, we not unfrequently ſee organic parts of a pre-

ternatural

ternatural order produced by the *vis medicatrix naturæ*, when roused into action in consequence of *accidental diseases*: As an example, and in illustration of this, we may mention those small ossifications known by the name of *ossicula Wormiana*, which, in cases of *hydrocephalus internus*, are formed by the provident powers of the animal system, for the purpose of arching over and thus completely closing the enlarged *fontanel*.

§ 601.

Finally, on comparing with candour, and weighing with impartiality, the various arguments on each side of the question, it very evidently appears, that besides a *power of exciting* to motion and action, which the advocates for the pre-existence of germs attribute to the *male semen*, in order to render their favourite theory more specious and plausible, they must also bestow on that fluid *plastic* or *formative* powers of the utmost extent and influence: Whence it is obvious, that the doctrine for which they so zealously contend, is of itself wholly inadequate to the explanation of the numerous and intricate phenomena of generation, unless it be aided by the powerful concurrence of a *nisus formativus*: Whereas, on the other hand, the system which we have just proposed on the subject is, without the bold presumption of *pre-existent germs*, fully sufficient to explain all the multiplicity of phenomena attend-

ant on this divine process. Let us then on the present, as we should on every other point of controversy, adhere to that doctrine which is most simple in its nature, and most conclusive in its end, from a thorough conviction, that an unnecessary multiplication of entities or causes is no less repugnant to real and practical utility, than to the tenor and spirit of sound philosophy.

SECT. XLVI.

OF PARTURITION, AND ITS CONSEQUENCES.

§ 602.

THE fœtus being regularly formed and fashioned by the energies of which we have hitherto treated, and advanced through the progressive stages of its subsequent growth, till it be brought to a state of fœtal perfection, must, after arriving at this particular period of maturity, be finally ushered into the enjoyment of light and entire life, by the painful business of *parturition*.

§ 603.

This critical and important *period* arrives, agreeably to the usual order of spontaneous nature, (which is the only object contemplated in physiology),

logy), about the termination of the tenth lunar month, i. e. about the 39th or 40th week after conception.

§ 604.

When a pregnant female finally arrives at this eventful criſis, ſhe is forcibly impelled to the labour of parturition by an inſuperable *neceſſity*, already ſaid (§ 295.) to be leſs ſubject to the controul of the will than that which urges to the performance of any other function belonging to the human body.

§ 605.

With reſpect to the *cauſes* of a revolution ſo determinate and ſudden, different and even oppoſite opinions have been entertained by different phyſiologiſts. When we view, and take into attentive conſideration, all the attendant circumſtances, it appears neceſſary to refer the cauſe, which immediately impels to parturition, to an eternal law of nature, which has hitherto received no better explanation than has been given to a great many other phyſical phenomena, which take place in like manner at regular and *ſtated periods*; ſuch, for example, as the metamorphoſis of inſects, the progreſſive ſtages of eruptive fevers, their criſes, &c. &c. Without ſubjecting themſelves to the juſt charge of fancifully entering on an abſurd

ſpeculation,

ſpeculation, certain phyſiologiſts have compared a mature ovum, in the uterus of the human ſubject, to the healthy fruit of vegetables, which when completely ripened, fall ſpontaneouſly from their parent plants, in conſequence of a *ſelf-conſtriction* of the veſſels through which their nouriſhment was conveyed. It has been in like manner obſerved, that as the period of parturition approaches, the human placenta ſuffers a ſlight degree of conſtriction, and becomes thus prepared, as it were, for its impending ſeparation from the ſurrounding uterus.

With regard to the *opinion* entertained on this ſubject by phyſiologiſts in general, namely, that the amazing expanſion to which the impregnated uterus is ſubjected, with a multitude of other impreſſions or impulſive powers of a like nature, act as the genuine exciting cauſes of parturition, it appears to be very clearly and effectually invalidated by a great variety of *arguments*, which may be fairly deduced from the unequivocal phenomena of the animal economy itſelf: of theſe arguments we think proper to mention the following, namely, in numberleſs genuine caſes of extra-uterine conception, where the fœtuſes have been contained, for example, in the Fallopian tubes, or in the ovaria, the uterus has notwithſtanding been attacked by painful and convulſive throws, about

the

the termination of the tenth lunar month after the occurrence of such preternatural conception.

§ 606.

Besides the *exciting*, it is evident that there must be also the joint co-operation of very powerful *efficient* causes, arising from the nature and properties of the uterus itself, and of the contents which it encloses.

The *proximate* or immediate and primary cause must be doubtless referred solely to the *vita propria*, or specific life of the uterus itself (§ 47.)

Of the remote causes the leading and most considerable appear to be, the powerful efforts which are made by the assistance of the process of respiration, and the extensive consent or co-operation of the intercostal nerve with the other portions of the nervous system.

§ 607.

When finally the labour of genuine parturition is excited, its *phenomena* observe a determinate and regular order with regard to their commencement and subsequent progressive course. In consequence of this, they have been divided by accoucheurs into different *stages*, of which four have been enumerated by the latest writers on the obstetric art.

§ 608.

§ 608.

In the *first* ſtage, the parturient patient experiences a ſlight attack of thoſe peculiar and well-known pains, called in that ſtate *precurſors* or *warnings*, which ſhoot in a direction from the loins to the lower parts of the uterus, and which are indeed felt at intervals, (though with diminiſhed frequency and force), throughout the whole period of parturition: the orifice of the uterus begins, at the ſame time, to be conſiderably dilated, the abdominal tumor ſubſides, an inclination to paſs urine becomes urgent and troubleſome, and a copious diſcharge of mucus takes place from the genital organs, now in a ſtate of diſtenſion and laxity.

§ 609.

In the ſecond ſtage, the pains increaſe, and are now diſtinguiſhed by the name of *preparantes*, or preparatory efforts: the inferior ſegment of the coverings or membranes of the ovum are, at the ſame time, protruded through the uterine orifice into the vagina.

§ 610.

In the third ſtage the pains ſtill continue greatly augmented in their violence, and are now denominated *dolores ad partum* *. They act againſt the

* i. e. The genuine pains of parturition.

uterus

uterus with a more violent impetus, and thus potently protrude it downwards, while, at the same time the uterus presses with such astonishing force on the encarcerated fœtus, as to occasion a rupture in the membranes by which it is inclosed.

§ 611.

During the *fourth* and last stage of parturition, while the patient is agitated with convulsive throws, and tortured with the most excruciating pain, she makes, at length, a violent exertion, (not unfrequently accompanied with horripilation, grinding of the teeth, trembling of the knees, &c.), by the impulsive force of which, the head of the emerging infant is urged forward, and finally protruded quite through the external orifice with its face foremost: in this unlooked for position it is forced to advance, in consequence of the vertex or crown of the head becoming lodged against the arch of the pubes, while its other parts are urged onward, and obliged to revolve on the stationary vertex, as on an *axis*, or centre of motion. Thus, amidst a profuse discharge of blood, the infant is finally excluded from its place of confinement, and introduced to the enjoyment of light and life.

§ 612.

The fœtus being thus happily excluded, the *birth of the* secundines succeeds, after a short interval,

terval, accompanied, in like manner, with painful, though much leſs violent, throws: this latter birth is, as well as the former, followed by a diſcharge of blood, from that part of the uterine cavity to which the placenta adheres by means of the *craſſa* or *groſs membrana decidua*.

§ 613.

The uterus, being thus, at once delivered of its two-fold birth, by which it had been encumbered and oppreſſed, is now contracted by little and little, till it is finally reſtored to its former figure, and reduced almoſt to its former ſize.

§ 614.

During the firſt week after the birth of the child, there exiſts, from the genital *organs* of the mother, an uninterrupted effuſion of the *lochia*, a diſcharge very much reſembling the catamenia, except that it is more profuſe in quantity, eſpecially when not in any meaſure checked or diminiſhed, by the commencement of lactation. The bloody or florid colour of the liquid diſcharged by this evacuation is, notwithſtanding, changed about the fourth day to a pale red, and from thence paſſes on to aſſume a white appearance.

As ſoon as the uterus is thoroughly cleanſed of all remaining fragments of its deciduous membrane,

brane, and has thus finally completed the painful and tedious task of propagation, it may again resume the natural process of *menstruation*, or even return to the performance of fresh immolations on the altar of conception itself.

SECT. XLVIII.

OF THE DIFFERENCES BY WHICH THE HUMAN SUBJECT IS CHARACTERISED BEFORE AND AFTER BIRTH.

§ 615.

FROM what has been already said respecting the mode of life enjoyed by the fœtus, while yet encarcerated within the parietes, and immersed in the warm-bath of the maternal uterus, it is extremely obvious that an immense difference must exist, between the functions of the animal economy in this state, and that which shortly succeeds, when the infant is finally introduced, by birth, into entire life, and is possessed of a power of spontaneous motion. An enumeration and statement of the leading points or circumstances of this difference, constitutes the design of the present section.

§ 616.

To begin then with the circulation of the blood, it muſt be obſerved, that the *route* of this crimſon fluid is different in the *fœtal* ſtate, from what it is in *that* which immediately ſucceeds paturition or birth. During the continuance of the former ſtate, the *fœtus* is connected, and preſerves a circular intercourſe with the uterine placenta, by means of the umbilical cord; it has never, as yet, inſpired air for the purpoſe of ſupplying the blood with that vital pabulum, a proceſs which immediately commences and is uniformly continued after birth, when this reciprocal connection between the mother and child, is finally deſtroyed.

§ 617.

The umbilical vein originating from the placenta of the mother, and paſſing through what is called the umbilical ring of the fœtus, directs its courſe towards the liver, where it diſcharges its blood into the ſinus of the vena portarum; from thence the blood is diſtributed in part, by the ramifications of this memorable vein, throughout the liver, and in part, conveyed by a direct route through the *ductus venoſus Arantii*, to the *inferior* or aſcending vena cava.

The two foregoing canals, namely, both that portion of the umbilical cord which is contained

in the abdomen of the fœtus, and also the ductus venosus mentioned above, suffer after birth an entire obliteration of their cavities, and assume the nature and appearance of solid cords, insomuch that the former constitutes what is denominated the *round ligament* of the liver.

§ 618.

When, in the fœtus, the blood is conveyed from the inferior vena cava to the right side of the heart, the greater part of it is denied a passage from thence through the lungs, and is therefore directed towards the left or posterior auricle of the heart, by the valve of Eustachius, and admitted into that cavity through the *foramen ovale*.

§ 619.

For over the mouth of the inferior vena cava, after its ascent from the cavity of the abdomen in the fœtal state, a valve of alunated figure is extended, which, in honour of its immortal discoverer, has been called the valve of Eustachius. This luniform body is, for the most part, gradually obliterated as life advances, although in the fœtal state it appears to perform the important office of directing the blood, emerging from the abdominal cavity, towards an *orifice* to be spoken of presently, which penetrates the septum situated between the two auricles of the heart.

§ 620.

The orifice referred to in the preceding paragraph is called the *foramen ovale*, through which by far the greater part of the aſcending column of blood, derived immediately from the inferior vena cava, is conducted into the left *auris* of the heart during each diaſtole of the auricles: of this blood the regurgitation is effectually prevented, by the elegant falciform valve formerly mentioned, which is cloſely ſpread over the foramen, and appears to cloſe that orifice completely, during each ſyſtolic motion of the auricles. During the firſt years of infancy the *foramen ovale* is in part cloſed by means of this ſmall valve, and partly obliterated by the gradual but ſlow adheſion of its ſides: in correſpondence to ſuch adheſion, the valve of Euſtachius itſelf undergoes alſo a ſlow and gradual diminution in point of ſize, till ſcarcely a wreck of it is left behind.

§ 621.

Of that blood which, at the ſame time, enters the right auricle of the heart from the ſuperior vena cava, a very ſmall portion only can be received by the lungs of the fœtus, as yet in a weak and inactive condition: it is therefore taken up by the *ductus arterioſus*, from the trunk of the pulmonary artery (of which this duct is indeed the leading branch) and conveyed by a direct and ſpeedy route

to

to the arch of the aorta, without paſſing through the lungs at all. Within the courſe of a few weeks after the birth of the infant, the cavity of the ductus arterioſus is, for the moſt part obliterated, and its parietes or walls converted into the nature and appearance of a denſe and firm ligament.

§ 622.

The blood being propelled through the trunk of the aorta, that portion of it, deſtined to be re-conveyed to the ſyſtem of the mother, enters the *umbilical arteries* (§ 578.) which paſs through the *annulus umbilicalis*, on each ſide of the *urachus*, and are, in like manner, after the birth of the infant, converted into ſolid imperforated cords.

§ 623.

As the lungs perform in the fœtus ſcarcely any function at all, their general *habit* and *appearance* differ very materially from thoſe which they aſſume after the infant has commenced the proceſs of reſpiration. Thus, their bulk is proportionably much leſs, their colour more dark, their ſubſtance more compact, and hence their ſpecific gravity ſo much greater, that when immerſed, recent and free from putrefaction, into a veſſel of water, they ſink inſtantly to the bottom; whereas, on the other hand, if the infant has been born in a living ſtate, and taken in air by inſpiration, theſe viſcera,

for the moſt part, float on the ſurface of water, or of any other fluid equally ponderous. The right lobe of the lungs appears to poſſeſs the peculiar prerogative of being dilated a little ſooner than the left by the incipient influx of air in the firſt act of inſpiration. With regard to the other phenomena of this new function of life, they were enumerated formerly, when we were treating particularly of the proceſs of reſpiration.

§ 624.

From the obſervations which were formerly propoſed on the nutrition of the fœtus (§ 574, 581.), it may be very eaſily perceived that the ſtate and condition of the *alimentary tube* and *chylopoietic ſyſtem*, are extremely different before, from what they are after, the birth of the infant, theſe viſcera being in the firſt caſe inert and wholly incapable of action. Thus, for inſtance, in the tender embryo of only a very few months exiſtence, the *larger*, are perfectly ſimilar in habit and appearance to the *ſmaller*, *inteſtines;* but during the cloſing months of pregnancy the *former* portion of the inteſtinal canal (being conſiderably diſtended with *meconium*) appears to merit unequivocally that name by which it is afterwards diſtinguiſhed from the *latter*.

§ 625.

The *meconium* is a peculiar ſpecies of ſaburra, of a green colour, ſhaded with more or leſs of a browniſh caſt. It is doubtleſs derived from the inquiline humours of the fœtus itſelf, more eſpecially from the bile: that it is indeed of a bilious origin we are induced to believe from the following conſiderations:—*Firſt*, becauſe the earlieſt appearance of this excrementious ſubſtance correſponds exactly, in point of time, with the commencement of the biliary ſecretion; and, *Secondly*, becauſe we learn from accurate obſervation, that ſuch monſters as are deſtitute of a liver, have their inteſtines ſupplied with nothing elſe but a ſmall quantity of colourleſs mucus inſtead of the more common and natural meconium.

§ 626.

In the new-born infant the form of the cœcum is alſo very widely different from what it is in the future periods of life; and this inteſtine is then continued in a direct line with the *appendicula vermiformis*.

§ 627.

Several other differences and peculiarities, of a ſimilar nature, we have already ſpoken of on particular occaſions, and ſhall here, therefore, only

glance on them in the moſt brief and tranſient manner:

They are the *Urachus* (§ 579.) the membrana pupillaris (§ 259.) and, in the male fœtus, the *deſcent of the teſtes* (§ 501.)

A few additional peculiarities will be ſpoken of with more propriety in the following ſection. Others, as being of leſs importance, we voluntarily pretermit in perfect ſilence.

§ 628.

The preſent appears to be indeed a very fit and favourable opportunity for calling the attention of the reader to three parts of the human body, altogether peculiar in their nature and obſcure in their deſtination, which are of a greater proportional ſize in the fœtus than in the adult, and appear to be in a ſpecial manner ſubſervient to the economy of the former. The true and unequivocal uſes of the parts now in contemplation have not as yet, however, been clearly and ſatisfactorily aſcertained, although, anxiouſly ſought after by the combined labours of numerous and very reſpectable anatomiſts. Theſe parts are deſignated by the name of glands, although their *parenchyma* is far, very far, different from the *glandular*, and they have never been diſcovered

to

to poſſeſs the fainteſt veſtige of an excretory duct. They are denominated the *thyroid gland*, the *thymus*, and the *renes ſuccenturiatati*.

§ 629.

The *thyroid gland* is ſituated on the anterior ſide of a cartilage of the ſame name, which enters into the conformation of the larynx. It conſiſts of two lobes, and is of a lunated or falciform figure; in the fœtus it is diſtended with a lymphatic fluid, but, as life advances, becomes gradually more and more ſpoliated of its diſtending liquid.

§ 630.

The *thymus* conſiſts of a maſs of ſhining and very tender fleſh, is, in like manner with the preceding ſubſtance, *bilobular*, now and then divided into two diſtinct portions, and contains alſo occaſionally a cavity of conſiderable dimenſions. This body is ſituated beneath the middle and upper part of the ſternum, and aſcends on each ſide even to the throat itſelf; in the fœtus it is large, irregular in its figure, and abounds with a juice of a milk-like nature; but as youth advances it gradually diminiſhes in ſize, until, finally, on the acceſſion of old age, it is ſo completely obliterated as to exhibit ſcarcely a ſhadow of its former exiſtence.

§ 631.

Lastly, The *Renes succenturiatali*, (called likewise *glandulæ suprarenales*, *capsulæ atrabiliariæ*, &c.) are situated beneath the diaphragm, resting on the upper extremities of the kidneys. In adults they are not only diminished in size, but are also removed to a small distance from the contact of the kidneys, and contain a dark coloured fluid, which in the fœtus is more inclined to a pale red.

SECT. XLVIII.

OF THE INCREASE, MATURITY, AND DECLINE OF MAN.

§ 632.

HAVING hitherto minutely considered the human economy, in detail, agreeably to the several classes into which its physical functions are divided, nothing further remains at present than to take a general, brief, and comprehensive survey of man in his transit over the diversified stage of life, and thus accompany him, from his earliest vital pulse in an embriotic state, throughout the leading,

leading *revolutions* and *æras* in his economy, down to the final termination of his exiſtence.

§ 633.

Firſt, then, about the third week after conception, the rudimental organization of the embryo appears to take place (§ 575.): about the fourth week afterwards, while the embryo ſtill enjoys an extremely low and languid degree of life, bordering even on that of a vegetable, it is ſupplied with the firſt portion of genuine red blood (§ 13.) The motion of the *corculum* or minute heart, has been but very ſeldom obſerved by phyſiologiſts in the incipient human embryo, but was long ſince diſcovered by Ariſtotle in the incubated chick, and has been, from that period, deſignated by the name of the *punctum ſaliens*.

§ 634.

About the ſeventh or eighth week after conception, the momentous proceſs of *oſteogeny*, or the generation of bone, commences in the human ſubject. Thoſe parts where oſſeous, or bony matter makes the firſt depoſitions for the formation of its *nuclei*, are the clavicles, the ribs, the vertebræ, the long cylindrical bones of the extremities, the mandible or lower jaw, and certain other bones of the face, &c. Thoſe parts again where the oſſeous depoſitions are ſecondary in point of time,

time, are ſome of the plain bones of the ſkull, ſuch, for example, as the frontal and occipital:—while the bones of the neck, &c. are formed at a ſtill later period.

The younger the embryo is, in particular, or to proceed on a more extenſive and general ſcale, the younger the human ſubject is, whether before or after birth, with the greater rapidity does its growth advance, and *vice verſa*.

§ 635.

About the middle period of pregnancy, the fœtus becomes what may be called a genuine ſubject of *vitality* or life, agreeably to the rule of diſcrimination laid down on that particular point in a former part of this work (§ 585.) About the ſame time, the ſecretion of certain humours make their firſt appearance, ſuch, for example, as the fat (§ 38) and the bile.

§ 636.

As the fœtus advances towards maturity the tender *hair* begins to pullulate, the *nails* emerge into view, the *membrana pupillaris* gives way (§ 260), and in the male ſex the *teſtes* begin to deſcend (§ 505).

§ 637.

§ 637.

About the close of the tenth lunar month, the *infant* is finally released from its imprisonment by means of parturition (§ 603); after which, besides the astonishing revolutions in almost the whole economy of its system, detailed more amply and minutely above, it is also subjected to various changes in its external habit and appearance; thus, for instance, that delicate lanuginous hair, with which the face of the new-born infant is overspread, disappears by degrees, its wrinkles are gradually obliterated, its anus retires within the *nates*, which now begin to be slowly protruded, &c. &c. &c.

§ 638.

The infant also learns, (though indeed by very slow degrees), the exercise of the various *faculties* of the *mind*, such, for example, as those of *perception*, of *attention*, of *reminiscence*, of *desiring*, &c. &c. from whence, in a very few months after birth, it is subjected to dreams, &c.

§ 639.

The organs of the *external senses* undergo also gradual or progressive improvements, and are advanced to still higher and higher degrees of perfection, such as the external ears, the internal

nares,

nares, also the coverings of the eyes, such as their *supra-orbital* arches, their supercilia, &c.

§ 640.

The bones of the cranium acquire, in the mean time, an augmented degree of firmness. The *fonticuli* or chasms between the different bones are gradually arched over, and about the eighth month the process of *dentition* commences.

§ 641.

The infant is now ready to undergo *ablactation* or *weaning*, being furnished with teeth for the express purpose of subduing more solid food, and not to injure the *papilla*, or nipple of the mother.

§ 642.

About the close of the first year, the infant learns to stand alone, and support itself *in an erect position*, the greatest and most enviable prerogative with which the human body is dignified.

§ 643.

The infant being thus removed from its mother's breast, and possessing the use and command of its feet, makes daily advances in growth, and improves in the power of spontaneous motion, while it acquires, at the same time, another very important privilege conferred on the human race, namely, the use of *speech*. Ideas which have become familiar

familiar to its mind it now begins to make attempts to expreſs by the aid of that important organ the *tongue*.

§ 644.

About the ſeventh year of life, the *milk-teeth*, or firſt ſet, being twenty in number, drop out by degrees, and are replaced in a ſeries of years by a ſecond dentition, conſiſting of thirty-two perennial or permanent teeth.

§ 645.

During this period of infancy the *memory* far ſurpaſſes in ſtrength and *perfection* the other powers of the mind, and appears to be indeed in a very peculiar manner adapted for receiving and retaining the *ſigns* of things; whereas after the fifteenth year of life, the glowing powers of the *imagination* uſually gain the aſcendency.

§ 646.

This ſuperior ſtrength and activity of the imagination very happily manifeſts itſelf throughout thoſe years of life in which the human ſubject is, by a variety of ſtriking and very important changes in the body, gradually prepared for the future performance of ſuch functions as conſtitute the characteriſtic diſtinctions between the two ſexes.

§ 647.

§ 647.

Shortly after this period the mammæ or breasts of the female subject begin to swell, the chin of the male becomes clothed in a mantle of coarser down, and a variety of other phenomenon occur in each sex, which serve in like manner to announce the gradual approach of puberty: thus, in the female the *catamenia* begin to flow; while in the male the secretion of a true *semen* commences, which is uniformly accompanied by a more luxuriant crop of *beard*, and a very striking change in the voice from a shriller to a graver tone.

About the same time the *sexual instinct* (§ 289.) that spontaneous and potent call of nature, is first awakened into action, and man, now in the blossom of life, is fitted and inclined to venereal enjoyments.

§ 648.

The *crisis* or precise *period* of puberty cannot by any means be accurately ascertained. It is much varied by diversities of climate and of temperament. In general, however, it occurs earlier in the *female* than in the *male* sex; thus, in our climate females may be said to have arrived at this interesting period against the fifteenth, but males not before the twentieth year of life.

§ 649.

§ 649.

Shortly after the above period the human body finally ceaſes to increaſe in *ſtature;* this particular is alſo influenced and greatly diverſified by difference of climate, not to mention the countleſs varieties that are exhibited relative to this point, not only by different individuals, but even by whole families.

§ 650.

About this period alſo the *epiphyſes*, which had been hitherto diſtinguiſhed from the bones to which they were attached by very viſible lines of ſeparation, become ſo intimately united to, and ſo completely coaleſce with theſe bones, that not a veſtige is left to ſerve as a memento of their former diſtinction.

§ 651.

With reſpect to the term of perfect *manhood*, which conſtitutes indeed the moſt lengthy, as well as moſt uſeful and important period of human life, we find it characteriſed by the higheſt degrees of *vigour* and *uniformity*, when we examine the functions of the body, and by that moſt invaluable prerogative, *maturity* of *judgment*, when we take into conſideration the faculties of the mind. Throughout this intereſting period the

lamp

lamp of human life blazes with the higheſt degree of intenſity and ſplendor.

§ 652.

The *heralds* which unerringly announce the intruſive approach of *old age* are, in *females*, the ceſſation of the catamenia, (§ 547.), in *males*, a languid propenſity to venereal gratifications, and in both an invaſion of what is called the *rigidity* or *dryneſs* of old age, with a ſlow but ſenſible declination of the *vis vitæ*, or aggregate power of performing the various functions of life.

§ 653.

Finally, the frigid reign of the ultimate degree of old age is ſtrongly characteriſed by the following concomitant phenomena, namely, a ſluggiſhneſs and increaſing dulneſs of the *ſenſes*, both external and internal, an irreſiſtible call for longer indulgence in ſleep, and a torpidity and languor in all the functions of the animal economy. The hairs aſſume a ſilvery gray, and fall in part from their exalted ſituation. The teeth themſelves drop ſpontaneouſly from their declining ſockets. The neck is no longer able to ſupport the head, nor the tottering legs to ſuſtain the weight of the incumbent body. Even the bones themſelves, thoſe indiſpenſible *fulcra* of the whole machine,

 are

are obliged to bear a part in this irremediable and universal decay.

§ 654.

We have thus arrived at length to the remote *ultimatum* of physiology, namely, *death without disease*, or the *euthanasia of old age*. To conduct and protract human life to this only natural termination (the *causes* of which are sufficiently obvious from what has been already laid down) constitutes indeed the *alpha* and *omega*, i. e. the sole and exclusive end and object of the healing art.

§ 655.

The *phenomena* of this *natural death* (as observed in man when about to resign himself to its potent grasp), are, a coldness of the extremities, a loss of the brilliancy of the eyes, a very small and slow pulse, accompanied with intermissions progressively increasing in frequency, and lastly a slow respiration, which by a more forcible act of exspiration, is at length closed for ever.

In the live-dissections of animals belonging to the class mammalia, there is a convenient opportunity for observing the last exertions of the heart, from which it appears, that the right ventricle and auricle of that viscus resist the encroachments

of death longer, and continue the motions of life to a later period, than the left.

§ 656.

Coldneſs accompanied by rigidity, a cadaverous ſtench, but more eſpecially a flaccidity of the cornea, and a hiatus or gaping of the anus aſcertain in the moſt unequivocal manner the complete death of the body. When in the corpſe an *aggregate collection* of all theſe ſigns occur at once, not even the ſceptical Pliny himſelf could find room to interpoſe the ſhadow of a doubt reſpecting the complete extinction of animal life.

§ 657.

To aſcertain with definitude the natural *term* of the life of man, (or to point out that period which may be conſidered as the more frequent and regular *goal* or *ne plus ultra* of human exiſtence), is, indeed, a matter attended with the utmoſt difficulty. I have notwithſtanding learnt, from examining with care and comparing with accuracy, a great number of bills of mortality, that a conſiderable proportion of ſuch Europeans as are advanced in years reach, but that very few of them paſs, the *eightieth and fourth* year of life.

§ 658.

§ 658.

We may obſerve upon the whole, that in conſequence of the weakneſs and tender ſuſceptibility of infancy and childhood, the intemperance and irregularity of an infinitude of adults, the incontrolable violence of diſeaſes, and a countleſs multitude of fatal caſualties, not more of mankind than ſeventy eight in a thouſand reſign their lives to that ſpecies of *death* now under conſideration, namely, *death* without *diſeaſe*. Notwithſtanding the truth and authenticity of the preceding obſervation, yet on making a genuine eſtimate of *human longevity* and comparing it, under ſimilar circumſtances, with *that* of the other ſubjects belonging to the claſs mammalia, whoſe *natural term* of exiſtence is known to us, it will evidently appear, that, except the baſeleſs declamations of *ſophiſts* regarding the *miſeries* of *human life*, nothing can be more unfounded and irrational than *their* ſplendid and verboſe effuſions reſpecting *its brevity*.

APPENDIX,

IN WHICH IS EXHIBITED A

Condenſed and Summary View

OF THE

EXISTING DISCOVERIES AND SPECULATIONS

Relative to the Subject of, what is uſually denominated,

ANIMAL ELECTRICITY.

STEADY and uniform as the lapſe of time itſelf, are the exertions made by the enterprize and induſtry of man, to ſhed light on the *arcana* or *ſecret proceſſes* of nature. In proportion as ſuch laudable attempts are proſecuted with boldneſs and crowned with ſucceſs, *revolutions* and *improvements* take place in the various branches of phyſical ſcience. Revolutions derive birth from the detection of error, while improvements reſult from the diſcovery of truth. On the repudiation of falſe principles in ſcience, as well as on the developement of new ones deduced from the reci-

procal concurrence of numerous and unequivocal facts, it is not without the ſanction of reaſon and propriety that new ſyſtems are forthwith compiled, digeſted and uſhered into the world.

For, to be complete and ſatisfactory, a ſyſtem in any branch of ſcience, ſhould embrace and arrange in order all the well authenticated principles ſpontaneouſly reſulting from facts already aſcertained and obſervations already made, relative to that particular branch. A ſyſtem leſs general and comprehenſive in its ſcope than this, ſhould be deemed, at beſt, but defective and partial, and received as the abortive production of a mind deficient in point of information.

Of the former deſcription was the famous phyſiological ſyſtem of Baron Haller, at the time its illuſtrious author firſt ſubmitted it to the eye of the world. That excellent phyſician and philoſopher graſped in his acute and comprehenſive mind, and detailed at large, in the work to which I here allude, all the authentic and well defined principles reſulting from the infinitude of facts with which the ſcience of phyſiology was at that time enriched.

But all ſyſtems are ſtationary and have been as yet imperfect, while, happily for the intereſt of man,

man, improvements in ſcience are progreſſive and advancing towards perfection. In the courſe of a few years, ſuch a blaze of phyſical light was diffuſed abroad by the induſtry and ingenuity of philoſophers in general, but of phyſicians and chemiſts in particular, that the deficiencies and errors of the Baron's elaborate ſyſtem were rendered obvious to the moſt weak and inattentive obſerver. In the important *doctrines* reſpecting the *cauſes* of *animal heat* and the *nature* and *purpoſes* of reſpiration, in particular, entire revolutions were effected by the numerous and ingenious diſcoveries of chemiſts in that branch of ſcience denominated aerology.

To ſupply, as far as poſſible, the deficiencies of this ſyſtem of Haller, and to circumvent the errors which the authority of ſo celebrated a character might tend to diffuſe throughout the minds of his numerous readers, became *deſiderata* of no ſmall moment in the ſcience of phyſiology.

The moſt effectual method of accompliſhing theſe deſirable ends was too obvious to eſcape diſcovery. For as violence is moſt effectually repelled by counter violence, and one diſeaſe not unfrequently removed from the animal ſyſtem by the impetuous invaſion of another, ſo in like manner, in ſcience, the defects of one ſyſtem are moſt advantageouſly

ſupplied, and its errors moſt effectually controverted and expoſed, by the plenitude and unequivocal certainty of the principles of a rival ſyſtem.

This truth did not eſcape the obſervation of that learned and acute profeſſor, of Goettingen, who now fills the chair which was formerly rendered vocal by the eloquence of the immortal Haller. Need I add, that profeſſor Blumenbach is the man to whom I allude—a man, for the completion of whoſe greatneſs and utility in phyſical ſcience, nature and art appear to have all but exhauſted their abundant reſources! For induſtry and perſeverance in the collection of materials, for powers to combine and arrange materials when thus collected, and for ingenuity and acumen to deduce and ſpeculate from ſuch combination and arrangement, the preſent age certainly boaſts few—too few phyſiologiſts who may be ſet in competition with the illuſtrious Blumenbach.

For this phyſician and philoſopher was reſerved the honourable and important taſk of collecting, digeſting and conſigning to publicity, a ſyſtem of phyſiology deſtined to ſupply the deficiencies and correct the errors of that which had already reſulted from the labours of his celebrated friend and predeceſſor. The ſyſtem of profeſſor Blumenbach was, like that of Baron Haller, perfect and complete

complete at the time in which it was handed to the world. There existed not, at that period, an established principle, nor scarcely even a probable conjecture in physiology, with which he was not minutely acquainted, and which he did not draw into the extensive and powerful *vortex* of his system.

Had the science of physiology been finally complete at the time in which professor Blumenbach wrote, the industry, the immense resources and the comprehensive talents of that philosopher would, no doubt, have quite precluded the necessity of future systems in this branch of science. But in the unfathomed depths of the animal economy more *arcana* yet existed—more *terra incognita* lay yet unexplored, and further researches of enterprise were therefore essential.

By the combined labours of experimental physiologists in different parts of the world, this branch of science was at length matured for giving birth to another *discovery*, which will probably be found of equal importance, in explaining the phenomena, and in removing the diseases of the animal system, with that which consigned to immortality the name of the illustrious Harvey. The discovery to which I wish at present to direct the attention of the reader is that of, what is usually called *animal electricity*,

electricity, or, of the existence and operation of a fluid extremely similar to electricity in the living animal system. For the fortunate Galvani professor of anatomy at Bologna, was reserved the honour of lighting *by accident* on this beautiful and divine discovery—a discovery which entitles its author to be ranked with the great promoters science and the essential benefactors of man.

That such a fluid did actually exist in the bodies of animals, had been long suspected by physiologists and other speculative philosophers. The matter rested however on pure conjecture alone, and was yet unsanctioned by the tests of experiment and observation. The apparent intricacy of the subject depressed the hopes of the boldest experimenters, and the subtlety of the investigation seemed to throw an insurmountable bar in the road to success. But *accident* not unfrequently does more for the real advancement of science, than boasted genius and industry are able to accomplish. It was accident that first suggested to the celebrated Gallileo the construction and use of that optical instrument denominated the *telescope*—It was accident which first led the immortal Newton to the original conception of that principle of *gravitation*, by which he afterwards explained, with such facility, the movements and exquisite balance of the material universe. And it

was,

was, in like manner, accident—fortunate accident, that first suggested to the industrious and acute Galvani the mode of experimenting, with effect, on the intricate subject of *animal electricity*—a subject which may possibly be destined as the only proper clue to conduct future physiologists to the genuine springs and principles of life itself.

"Whilst the professor (alluding to Galvani) was engaged in dissecting a frog in a room where some of his friends were amusing themselves with an electrical machine, one of them drew a spark from the conductor, at the same time that the professor touched one of the nerves of the animal. In an instant the whole body of the frog was shook by a violent convulsion. The professor was astonished at the phenomenon, and believed it owing to his having wounded the nerve; to assure himself whether this was really the case, he pricked it with the point of his knife, without any motion of the body being produced; he now touched the nerve with the instrument as at first, and ordered a spark to be taken from the machine, on which the contractions were renewed. The experiment was repeated a third time, but the animal remained motionless; however, upon perceiving he held his scalpel by the handle, which was of ivory (a bad conductor), he changed it for

for a metallic one, and re-excited the movements, which he conſtantly failed of doing whilſt uſing an electric ſubſtance.

"After having made a number of experiments with the electrical machine, he reſolved to proſecute the ſubject with atmoſpheric electricity. To this end he raiſed a conductor upon the roof of his houſe, from which he brought an iron wire into his room, and to this attached metal conductors, connected with the nerves of the animals deſtined to be the ſubjects of his experiments, and to their legs he tied wires, which reached the floor. Conſiderable movements were obſerved in the animals, whether of cold or warm blood, whenever it lightened. Theſe preceded thunder, and correſponded with its intenſity and repetition, and even when it did not lighten the movements took place when any ſtormy cloud paſſed over the apparatus."

"Profeſſor Galvani one day ſuſpended ſome frogs, perhaps with ſimilar views, on metal hooks, fixed in the ſpine of the back, upon the iron railing of his garden; ſeveral times he remarked that theſe animals contracted, and appeared to receive ſhocks; at firſt he conceived the movements were owing to changes in the atmoſphere, but a more

ſcrupulous

ſcrupulous examination undeceived him. Having placed a prepared frog * upon an iron plate in his room, and happening with his diſſecting forceps to preſs it againſt the plate, he obſerved the movements to take place. This experiment ſucceeded with all metallic bodies, but more particularly well with ſilver; non-conducting ſubſtances were not proper for it. From this period our author began to ſuſpect the animal poſſeſſed an electricity of its own; and in this ſuſpicion he was further confirmed by the following circumſtance:—He held

* That the reader may not be entirely ignorant of what is meant by a prepared frog, I take the liberty of preſenting him with the following brief extract from the firſt experiment detailed in Dr. Valli's publication: "My firſt experiment was made on a frog, in the following manner: I opened the abdomen in order to lay bare the ſpine of the back, and diſcover the crural nerves which iſſue from it; a few lines above this point I cut the animal in two, and by paſſing my ſciſſars immediately under the origin of theſe nerves, removed the remaining portion of the vertebral column, ſo as only to leave the vertebræ which united the bundle of nerves. Having enveloped this portion of the vertebræ with a piece of ſheet lead, with one end of a metal conductor, I touched the coated part, and with the other the ſurface of the thighs, which had been previouſly ſtripped of the ſkin. The movements were violent, and continued for a long time," &c. In general, throughout the whole of this phyſician's expertmental treatiſe, when one or more of the nerves of an animal are coated with ſheet-lead or any other metal, that animal is ſaid to be *prepared*.

to

a prepared frog by a hook with one hand, ſo as to let its feet reſt upon the bottom of a ſmall ſilver cup, which he happened unintentionally to ſtrike with the other; at the inſtant the body of the animal fell into violent convulſions. If one perſon held the prepared frog, and another touched the cup, no movements were excited. The profeſſor being now aware of the neceſſity of a communication, undertook a ſeries of experiments for the farther inveſtigation of this ſubject. He firſt placed a prepared frog upon a non-conducting ſurface, and brought one end of a conductor in contact with the hook which ſecured the animal, and with the other touched its feet, on which the contractions took place. When the conducting arch was interrupted by a non-conducting ſubſtance, the frog remained motionleſs, &c."

No ſooner had profeſſor Galvani publiſhed to the world his experiments on animal electricity, than their fame diſpread, ſwift as the intangible fluid which they regarded, throughout the different parts of Europe. Animal electricity became, in a ſhort time, a ſubject of very intereſting ſpeculation to medical philoſophers. Among the ſeveral phyſiologiſts who entered the liſts in this inveſtigation, the moſt diſtinguiſhed whoſe writings have fallen into my hands, are Dr. Valli, an Italian phyſician, from whoſe publication the preceding account

account respecting the first discoveries of Galvani is extracted, and Mr. Fowler, a native of the island of Great Britain.

Doctor Valli appears to have led the van of those philosophical characters who first co-operated with the celebrated Galvani in investigating that animal fluid, the existence of which had been so long suspected, but so lately realised by actual experiment. After repeating most of the experiments of his predecessor in this branch of physics, the Doctor proceeded to a series of new experiments, mostly conceived and instituted by himself.

The objects which he appears to have kept steadily in view throughout the whole course of his experiments and observations were, to ascertain the *nature* of the animal fluid discovered by the professor of Bologna, and to determine its *influence* and *medium* of operation in the animal economy. In the prosecution of these ends the Doctor has doubtless displayed all that industry and patient perseverance, so essentially requisite in the character who would successfully inquire of nature, through the medium of experiment. I am sorry, however, to observe, that all his experiments were not conceived and instituted with equal ingenuity, and perhaps I may add, not executed with equal accuracy and definitude. Many of

many

them appear to have been inſtituted without a direct reference to any ſpecific or particular end—Equally unhappy with regard to conception, indefinite with reſpect to their nature, and inconcluſive in point of reſult, they leave no *impreſſions* on the mind of the reader, ſave thoſe of *diſappointment* and *regret*—regret that a character of ſuch learning and induſtry ſhould, notwithſtanding, interrogate nature with ſo little meaning, and (I am ſorry to add) with ſo little ſucceſs.

The preceding obſervations muſt be conſidered only in the light of *general rules*, and as ſuch, are liable to numerous exceptions. Many of the experiments of Dr. Valli are, doubtleſs, both ingenious and valuable; and I even entertain the utmoſt confidence, that the period will yet arrive, when the whole of them, that are aſcertained and related with juſtneſs and definitude, will be made ſubſervient to the eſtabliſhment of general and uſeful reſults. At preſent, however, they ſtand in an *inſulated* ſtate, completely detached from practical concluſions, and diſconnected from all known principles in phyſical ſcience.

After a ſeries of experiments ſufficiently lengthy and tedious, the Doctor conceived himſelf unequivocally authoriſed to conclude, that the animal fluid of Galvani, was entirely the ſame with the

ſubtle matter of electricity. This concluſion he alleges to be the ſpontaneous and neceſſary reſult of the following poſitions, which he delivers as ſubſtantiated and confirmed by actual experiment.

" Firſt, ſubſtances which conduct electricity, are conductors likewiſe of the nervous fluid."

" 2*dly*, Subſtances which are not conductors of electricity, do not conduct the nervous fluid."

" 3*dly*, Non-conducting bodies, which acquire by heat the property of conducting electricity, preſerve it likewiſe for the nervous fluid."

" 4*thly*, Cold at a certain degree, renders water a non-conductor of electricity, as well as of the nervous fluid."

" 5*thly*, The velocity of the nervous fluid is, as far as we can calculate, the ſame with that of electricity."

" 6*thly*, The obſtacles which the nerves, under certain circumſtances, oppoſe to electricity, they preſent likewiſe to the nervous fluid."

" 7*thly*, Attraction is a property of the electric fluid, and this property has been diſcovered in the nervous fluid."

Having enumerated and detailed the foregoing arguments, the Doctor, in an effusion of triumph, subjoins, "We here see the greatest analogy between these fluids; nay, I may even add, the characters of their identity."

As an additional support to the same opinion, Dr Valli adduces the peculiar and striking phenomena exhibited by the *torpedo*, the *gymnotus electricus*, the *silurus*, &c. which proceed, as he alleges, from a fluid in every respect the same with that which was discovered in frogs, by the professor of anatomy at Bologna. As the Doctor, however, has advanced nothing in confirmation of such entire sameness, save a certain remote analogy which he says he has discovered between the muscles of animals, and the *electrical apparatus* of the torpedo, the gymnotus, &c. it is obvious that this latter argument will but very slightly impress the philosophical physiologist, who founds his belief of principles on *facts*, rather than on vague and visionary *conjectures*.

Having thus, as he supposed, satisfactorily ascertained the identity of the *nervous* with the electric fluid, he next proceeds to speculations on its influence in the diversified movements and functions of the animal economy. To me, however, I must confess, the greater part of this speculative investigation, appears to be rather the effervescent effusions

effusions of an *imagination*, heated to excess in a favourite pursuit, than the solemn *decisions* of a tranquil and unbiassed *understanding*. I acknowledge myself unable, in many instances, to discern the necessary nexus or affinity between his conclusions, and the facts from which they are deduced:—or perhaps I may speak my sentiments more fully when I say, that the learned author appears not unfrequently to have substituted mere *hypothetical allegations*, for fair and logical *conclusions*—the vacant results of his own conjectures, for genuine principles developed by experiment, and ascertained by observation. It very often happens, that by attempting to embrace too much under a single cause, we extend the tortured principle beyond its natural limits, and thus, to appearance, weaken or render doubtful its influence, even on those phenomena which it immediately regards. This observation applies with too much propriety and force, to the speculations of the indefatigable Valli. By attempting to explain *all*, he has in fact explained *none*, of the phenomena of the animal economy, by that subtle fluid on which he so patiently experimented. Many of his physiological facts and speculations are indeed ingenious and interesting, but, in my view, they are equally deducible from any other series of experiments, as from that by which they are preceded in the Doctor's publication. Many of the learned author's facts may be, no doubt, true and well

defined, and ſome of his principles and reſults to a certain degree intereſting to the phyſician and philoſopher, but, taken in the aggregate, they are too diſjointed to conſtitute any thing like a ſyſtem, too diſconnected to form a regular chain of inveſtigation. On my mind, his *ſpeculations* on the cauſes of *muſcular motion*, *ſenſation ſecretion* and *nutrition*, impreſs no more ſolid conviction than do *thoſe* of Stahl on the ſubject of his *anima medica*, of Van Helmont reſpecting his ſubtle *Archeus*, or of the airy Paracelſus with regard to his *planetary influence*. Notwithſtanding the apparent ſeverity of the foregoing obſervations, I am ſtill obliged to declare it as my opinion, that the novelty and importance of the ſubject on which Dr Valli has experimented and written, entitle his work to the particular attention of the learned and ingenious of every nation.

For the want of ſyſtem and requiſite deciſion in the writings of the preceding author, compenſation is, in a great meaſure, made by a ſubſequent publication of the accurate and ingenious Fowler. The experiments and ſpeculations of this young philoſopher, on what he terms, the "*influence diſcovered by Galvani*," made their firſt public appearance at Edinburgh, in the courſe of the year 1793: they are not, indeed, ſo numerous as thoſe of the Italian phyſician, but they appear to have been conceived

conceived with more design, and executed with more judgment. Mr. Fowler seems to have been among the first who controverted the opinion of Galvani and Valli, respecting the identity of the nervous and electric fluids: and he has, doubtless, controverted it with ability and effect.

Mr. Fowler preliminates his observations, with a lucid and forcible statement of a certain previous combination of circumstances, which he alleges, must have strongly prepossessed the mind of professor Galvani, with a belief of the sameness of the preceding fluids.

That such a prepossession must have had, indeed, a powerful effect on the subsequent deductions and conclusions of the Professor, will be readily acknowledged, by every one who has experienced the influence of preconceived opinions—an influence pregnant with error, and leading countless evils in its train.

Mr. Fowler proceeds then to mention the first object which engaged his attention, in the commencement of his interesting inquiry, and which appears well calculated to pave the way, for the more easy and effectual accomplishment of his experimental course. This, to make use of his own words, was, "to ascertain, as well the va-

rious circumſtances, eſſentially requiſite to the production of theſe new phenomena, as thoſe in which they can be rendered moſt obvious." The iſſue of his enquiry on this ſubject, I will alſo lay before the reader in his own words. "After" ſays he, "a great variety of experiments, of which it wonld be unneceſſary here, to relate more than the reſult, I found, that I could not excite in an animal the appearances deſcribed by Galvani, with any ſubſtances whatever, whether ſolid or fluid, except the metals: and that the mutual contact of two different metals with each other, ſo far as I was able to determine, was in every caſe neceſſary to the effect."

After a ſatisfactory attainment of this object, the ingenious author next proceeds to a judicious ſeries of experiments, with a view to diſcover the genuine nature of the animal fluid, firſt realiſed by the fortunate profeſſor of Bologna. Of thoſe experiments he does not give us a minute ſpecification, but only furniſhes ſtatements of their moſt obvious and ſtriking reſults. Theſe ſtatements he alſo occaſionally interſperſes with intereſting and important remarks, and ſome very ingenious ſpeculations.

Having finiſhed his ſeries of experiments, (a ſeries ſufficiently numerous and diverſified for the eſtabliſhment

ſtabliſhment of general principles) relative to the nature of the nervous fluid, and its affinity to the matter of electricity, Mr. Fowler at length favours us on this ſubject with the following concluſions, which I ſhall take the liberty of preſenting to the reader in the words of their ingenious anthor.

After having ſtated a few analogies between the animal fluid of Galvani, and that poſſeſſed by the *torpedo*, he then reverſes the compariſon, and lays down ſeveral points of eſſential difference, not only between the two preceding fluids, but alſo between the former of them, namely the fluid of Galvani, and the matter of electricity.

" This influence, (ſays he, referring to the nervous fluid of animals) differs, both from that of the torpedo, &c. and from electricity, in producing no ſenſation (in man at leaſt) at all ſimilar to that of an electrical ſhock."

" ——That ſome kind of diſagreeable ſenſation is occaſioned by it, even in frogs, independent of that which muſt neceſſarily ariſe from irritation and the contractions of their muſcles, is evident from their reſtleſſneſs and expreſſions of uneaſineſs. In other animals, as I ſhall afterwards have occaſion to ſhew, theſe expreſſions are ſtill leſs equivocal: and in man we can aſcertain both their

degree and their kind. That they differ conſiderably from ſuch as are produced by electricity will be proved when I come to ſpeak of the effects of this influence upon our ſenſes."

"But the moſt important, and characteriſtic difference which I have yet been able to diſcover, between this new influence and electricity, conſiſts in their effects upon the contractile power of animals and of plants. The contractions of animals excited by electricity have a tendency to deſtroy that power upon which contractions depend. But the contractions excited, by the application of the metals, have, in all my experiments, had the directly oppoſite effect. The more frequently contractions have been in this way excited, the longer do they continue excitable: and the longer are the parts upon which ſuch experiments are made, preſerved from putridity. An influence, capable of exciting contractions without occaſioning exhauſtion, was a thing I ſo little expected to find, and ſo contrary to the character which had been given of this both by Galvani and by Doctor Valli, that I at firſt diſtruſted my own obſervation of the fact: but the number of comparative experiments which I had afterwards occaſion to make, though with views different from that of aſcertaining the point in queſtion, convinced me that this influence, ſo far from deſtroying

deſtroying the contractility of muſcles, has a tendency to preſerve it. Oxygene is, ſo far as I know, the only ſtimulus in nature, whoſe effects are at all analogous."

"When a frog has been long dead, I have been ſometimes more than a quarter of an hour without being able to excite a ſingle contraction by the application of the metals: but after this, without at all varying the means employed, contractions have appeared, and have become gradually more and more vigorous."

"It is ſaid (for I have never had an opportunity of making the experiment), that a ſtream of electricity, paſſed through a ſenſitive plant, produces an almoſt immediate collapſe of its leaves. But the influence diſcovered by Galvani produced no ſuch effect in the following experiment. Having ſeparated the leg of a frog from its body, I freed its crural nerves from ſurrounding parts, and with one hand held it ſupported upon the end of a probe. An aſſiſtant placed a piece of ſilver under its foot, and held the zinc with which it was to be touched. A ſenſative plant formed the medium of communication between us. He held the bottom of its ſtem between his fingers, while I held the top; ſo that when the ſilver was touched by the zinc, the influence paſſed up the plant, and through

through the whole of its ſtem. The frog's leg inſtantly contracted, and repeated its contractions every time the ſilver and zinc were brought in contact: but the leaves of the plant did not collapſe; neither did they when any of its branches formed part of the circuit."

I muſt however, confeſs that the plant, upon which this experiment was made, had been kept through the winter. With a young one the reſult might poſſibly be different; but ſuch an one I have not yet had in my power to procure.

"The torpedo does not appear at all affected by the influence which itſelf produces. Animals in which Galvani's phenomena are produced, are ſtrongly affected."

The very ingenious author paſſes on next to report the reſult of certain experiments which he inſtituted, in order to refute the opinion of thoſe, who allege, that the fluid of Galvani proceeds entirely from the metallic ſubſtances uſed, and does not reſide at all in any part of the animal ſyſtem. In his enquiry reſpecting this point he diſplays the ſame fertility in deviſing, the ſame ſagacity in judging, and the ſame ingenuity in deducing, which ſo forcibly impreſs the reader throughout every part of his experimental inveſtigation.

gation. He alſo farther ſhows, that the nervous influence of Galvani, and the ſubtle fluid of electricity differ very materially from each other in the following particular, namely, that againſt the effects of the former, animals are able to guard themſelves by means of a certain voluntary exertion, whereas the operation of the latter is not in the ſmalleſt degree ſubject to the controul or influence of the will.

Having finiſhed the conſideration of the *nature*, Mr. Fowler proceeds to make ſome uſeful *applications*, of the influence diſcovered by the profeſſor of anatomy at Bologna. In his attempts to ſhed light on certain controverted points, and to ſolve certain abſtruſe queſtions, in phyſiology, by means of this fluid, he appears no leſs ingenious and ſatisfactory than in the former parts of his enquiry.

He appears peculiarly happy and concluſive in his reſearches after the *ſource* from whence the nerves and muſcles derive their reſpective powers. I beg leave to lay before the reader two of the author's experiments, inſtituted for the purpoſe of aſcertaining this intereſting particular—a particular which has ſo long furniſhed a ſubject of controverſy among ſpeculative phyſiologiſts. The latter of the two experiments, (to which the former

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ſerves only as a neceſſary introduction) is of itſelf more than equal to all that has ever been advanced on the oppoſite ſide of the queſtion.

Experiment I.

"I divided (ſays Mr. Fowler) the ſciatic nerve of one leg, and tied the crural artery of the other in a large frog. Scarcely any blood was loſt in doing either. Two days after this I ſtrangled it. During the firſt 24 hours, the leg in which the nerve had been divided, appeared to contract with the moſt vigour; after this period the difference between them became more doubtful; but the contractions were at no time ſtronger in the leg whoſe artery was tied, than in that whoſe nerve was divided.

Experiment II.

"The ſame operations were performed upon a large female frog full of ſpawn. Four hours afterwards ſhe was covered by a male, who had been treated in a ſimilar manner. I mention this circumſtance, as it tends to prove, that the pain occaſioned by the operation was probably not ſo great as to produce much fallacy.

"On the day following, ſhe had ſpawned, and on the ſixth day from the operations, ſhe was ſtrangled. When laid upon a plate of zinc, and excited

excited by means of a rod of ſilver, the contractions were found extremely feeble in the leg whoſe artery had been tied, and ceaſed altogether in about twenty-two hours after her death.

In the leg, whoſe nerve had been divided, they appeared as vigorous as they uſually are in legs to which no injury has been previouſly done, and continued excitable upwards of two days after they had ceaſed to be ſo in the other."

It may be proper on the preſent occaſion briefly to obſerve, that the influence diſcovered by Galvani was the teſt uſed by Mr. Fowler to determine the exiſtence or ceſſation of irritability in the muſcles of the animals ſubjected to the preceding experiment. For this influence, as our author judiciouſly obſerves, appears to be indeed by far the beſt and moſt delicate teſt that has ever yet been diſcovered for aſcertaining the loweſt poſſible degrees of muſcular irritablility. After having become wholly inſenſible to the impreſſions of all other ſtimuli, muſcles ſtill continue to vibrate to the kindred touches of this ſubtle fluid, to which nature appears to have given them ſuch a nice, and, perhaps I may ſay, ſpecific correſpondence.

Mr. Fowler, after having tranſiently glanced on the ſubject of inflammation, paſſes on to the attack

attack of a phyſiological doctrine, propagated with zeal, and ſupported with ability by that celebrated experimentaliſt, the Abbe Fontana. The doctrine alluded to, embraces the exiſtence or reſidence of a certain vital principle in the volume of the blood. On this principle, as the induſtrious Abbe alleges, poiſons produce their inſtantaneous effect, when introduced into the vaſcular ſyſtems of living animals. To all the different parts of this phyſical *doctrine* I could never yet be induced to ſubſcribe, notwithſtanding the reſpectability of its learned and numerons advocates.

By attacking and vanquiſhing one of its moſt powerful champions, Mr. Fowler has doubtleſs contributed much to its final demolition. For, in the conteſt now under our immediate conſideration, I muſt confeſs, that to me the laurels of victory appear to be fairly wreſted from the ſilvered temples of the *Italian*, and planted over the youthful brow of the *Britiſh* Philoſopher.

I have thus exhibited a view, ſomewhat general indeed, though confeſſedly very ſuccinct, of the reſults laid down, and of the opinions entertained, by the ingenious Fowler, on the ſubject of the animal influence diſcovered by Profeſſor Galvani. To lay before the reader a full account of all that is uſeful and important in the obſervations of this intereſting

interesting author, would be to transcribe and reprint his whole publication.

The only productions in the English language, which this country now furnishes, professedly on the subject of the animal fluid discovered by Galvani, are (as formerly observed) those of Fowler and Valli. On the comparative merit of those two authors I will here take the liberty of advancing a few general, and, I flatter myself, impartial, observations:

The experiments of Doctor Valli are more numerous and pompous—those of Mr. Fowler more definite and intelligible. The former author appears *often*, the latter, *never*, to have experimented without some determinate end in view. The experiments of the Italian may be compared to the promiscuous plants of the forest, strewn at random by the sportive and irregular hand of nature—those of the young Briton, to choice and valuable collections, arranged with order and elegance, in a well regulated and beautiful garden. The experiments of Valli appear to throw into *shade*, those of Fowler into *light*, the objects which they immediately regard. From the former, the reader collects information with difficulty, from the latter, without labour or painful attention.

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In their deductions and ſpeculations, the two preceding authors are no leſs diſſimilar, than with regard to their experiments themſelves. Valli is more diffuſe and often hypothetical—Fowler more pointed and generally concluſive. Valli appears to give looſened reins to a glowing imagination—Fowler to be conſtantly under the ſteady guidance of a powerful and well-cultivated underſtanding. The former makes a greater diſplay of learning, and, therefore, too frequently views objects through the more obſcure *media* of previous publications—the latter exhibits a higher degree of ingenuity, and derives the principal part of his information, not from pages, ſanctioned only by the names of celebrated, yet fallible, authors, but from the great *folio*-volume of *nature*, impreſſed with her own ſignature. On the whole, Valli has experimented and written in the moſt lengthy and profuſe—Fowler in the moſt definite and concluſive manner. In many parts of the writings of the former, nothing elſe than the *fiat* of an almighty genius would be able to bring *order* out of *confuſion*—in thoſe of the latter, lucidity, connection, and regularity, ſhine pre-eminent through almoſt every page.

Having thus, without reſerve, delivered my ſentiments on the *publications of others*, I hope I may be allowed to treſpaſs on the reader's attention

while I make a few obſervations relating to *my own.*

Nothing could have induced me thus haſtily to forſake the humble, but ſecure, retreats of obſcurity, and riſk myſelf before the eye of the world in the hazardous character of an author, ſave a ſolicitous wiſh to contribute to the advancement of medical ſcience, and thus aid in acquiring for man a more effectual exemption from miſery and pain. I ſaw with regret the literary treaſures of a Blumenbach concealed from the view of my fellow-citizens beneath the drapery of an ancient and an obſolete language. I was anxiouſly deſirous to ſee the phyſiological ſyſtem of that illuſtrious character completely clothed in the language of my country. I engaged in the tranſlation of this work, not becauſe I conceived myſelf better qualified for its execution than others, but becauſe others appeared to me unpardonably remiſs with regard to the undertaking. The execution proved laborious and difficult beyond my expectations. The difficulty of detecting an author's preciſe meaning through the duſky medium of a Latin expreſſion, can be fully underſtood and realiſed only by him who has made the arduous experiment.

Even after the ideas and opinions in the original are fully embraced and completely comprehended, another difficulty of no ſmall magnitude ſtill remains, namely, to convey them to the reader with unequivocal definitude, through the indefinite medium of a different language. It is well known how extremely liable we are to miſapprehend the preciſe meaning of an author who even writes in our own vernacular tongue, much more ſo of one who publiſhes in a language but little uſed in converſation, and, at beſt, but imperfectly underſtood by any man living.

Should the foregoing tranſlation ever fall into the hands of the celebrated profeſſor of Geottingen, I hope he will receive, with candour and indulgence, a well meant attempt to extend the empire of his utility and his fame, by increaſing the number of his admiring readers. If the tranſlation be in any part erroneous, in any part deficient, ſtrictures and corrections will be thankfully received, and punctually attended to in a ſecond edition of the work, ſhould a ſecond be demanded by a patroniſing public.

To preſerve as far as poſſible the firm and energetic ſpirit which characterizes the writings of the illuſtrious profeſſor of Goettingen, and to convey

convey to my readers the facts, the principles, the ſpeculations, and the opinions contained in his original work, without even the ſhadow of alteration, diminution, or addition, has been my ſteady and uniform aim throughout the whole of the foregoing tranſlation. Owing, however, to the different *conſtitutions* or *idioms*, as they are more generally termed, of the Latin and Engliſh languages, my tranſlation is in many places far—very far from being ſtrictly literal. *Phraſeology* I conſider, at beſt, as the mere trappings or drapery of *compoſition*, while *facts* and *principles* conſtitute its more ſubſtantial and important part. To preſerve the latter, therefore, inviolate, and to communicate them with the utmoſt definitude, is the indiſpenſible duty of a tranſlator, from a principle of juſtice to the original author, to the public, and to himſelf; but in my opinion, he is not bound, by any principle whatever, to make an entire ſacrifice of all *elegance* and *beauty*, to mere punctilious *literality* of expreſſion. Impreſſed with the propriety and truth of theſe ſentiments, I have, throughout the whole of the foregoing work, been ſometimes *literal* and ſometimes *free*, accordingly as the one or the other mode of tranſlation gave birth to a phraſeology or ſtile moſt agreeable to my ear, and moſt accordant to the ſpirit of the original compoſition.

With reſpect to the appendix itſelf, it may not be amiſs to make it the ſubject of a few tranſient obſervations. The *principle* which theſe additional pages regard, and are intended to communicate, is juſtly becoming, among medical philoſophers, an object of primary importance. This principle opens to the view of the ſpeculative mind a rich and ſpacious field, never yet printed, ſave by the adventurous ſteps of a few pre-eminently active and enterpriſing phyſiologiſts—A field, the ſalutary fruits of which will, no doubt, at a future day, ſerve to elucidate the nature, to develope the compoſition, and to alleviate the complicated miſery of man.

My whole deſign in this appendix is to give a condenſed, but ſomewhat general view, of this principle or influence diſcovered by profeſſor Galvani.

By far the greater number of medical characters in the immenſe tract of country embraced within the limits of the *United States*, are, in conſequence of their diſtances from literary inſtitutions, excluded from acceſs to public libraries, and ſituated quite beyond the free circulation of phyſical ſcience. To ſuch my appendix will ſerve the humble purpoſe of a *literary chronicle*; it will convey to them a brief account of the diſcoveries

which are now going forward in the delightful and important ſcience of phyſiology.

On the ſubject of the influence diſcovered by Galvani I have myſelf inſtituted and performed a conſiderable number of experiments * ; ſome of

* That the reader may be acquainted with an eaſy, cheap and familiar method of experimenting on this ſubject, without having his feelings hurt by the agonizing pangs of tortured and dying animals, I will here take the liberty of inſerting, in form of notes, a few extracts taken from a communication tranſmitted to Mr. Fowler, by his learned friend Mr. Robiſon, profeſſor of natural philoſophy in the univerſity of Edinburgh.

I. "I find (ſays the profeſſor) that if a piece of zinc be applied to the tongue, and be in contact with a piece of ſilver, which touches any part of the lining of the mouth, noſtrils, ears, urethra, or anus, the ſenſation reſembling taſte is felt on the tongue. If the experiment be inverted, by applying the ſilver to the tongue, the irritation produced by the zinc is not ſenſible, except in the mouth and the urethra, and is very ſlight.

II. "If the zinc (finely poliſhed) be applied to the ball of the eye, the brightneſs of the flaſh ſeems to correſpond with the ſurface of contact of the ſilver with the tongue, palate, fauces, or cheek. The ſame thing happens when the ſilver is applied to the eye."

III. "When a rod of zinc and one of ſilver are applied to the roof of the mouth, as far back as poſſible, the irrita-

tions

my reſults have appeared ſtriking and new, but my experiments have been neither ſufficiently numerous nor varied to warrant the deduction and eſtabliſhment of general principles. My preſent intention is (ſhould heaven indulge me in life and health), to proſecute to ſome extent this highly

tions produced by bringing their outer ends into contact, are very ſtrong, and that by the zinc reſembles taſte, in the ſame manner as when applied to the tongue."

IV. "I had been paring my toe-nails with ſciſſars, and had cut off a conſiderable portion of the thick ſkin, ſo that the blood began to *ooze* through in the middle of the wound. I applied the zinc there, and an extenſive ſurface of ſilver to the tongue. Every time I brought the metals into contact, I felt a ſmart irritation by the zinc at the wound," &c.

A variety of other experiments of a ſimilar nature are contained in the ſame communication from Mr. Robiſon to Mr. Fowler; but a further detail of them I conceive unneceſſary, as the ingenious reader, being acquainted with the foregoing, can with facility deviſe other experiments for himſelf. Thus I have frequently conveyed to my eye the luminous flaſh mentioned by Mr. Robiſon, not only from the internal veſtments of the mouth, the noſe, the urethra, &c. but alſo from between my fingers, from the cubital flexure of my arm, and from various other parts of my body, where the texture of the cuticle and ſkin is more fine and ſoft than ordinary; always taking care, however, to moiſten the part previouſly to the application of the metals.

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intereſting ſubject. Should my inveſtigation be favoured with the diſcovery of any thing curious in ſcience, or uſeful in practice, a detail of it may be expected in a future communication.

To my ſolemn audit before the bar of the public, I now haſten in tremulous anxiety, "with all my imperfections on my head,"—imperfections which will no doubt awaken the cenſure of the critic, but receive, I flatter myſelf, the indulgence of the liberal and candid. The approbation of the former I neither court nor regard; that of the latter it ſhall be my conſtant ambition to deſerve. The profeſſed buſineſs of moſt modern critics appears to be, to condemn—promiſcuouſly condemn, too frequently without the faineſt ſhadow of either inclination or talents to diſcriminate merit from its reverſe.

In my view the *approbation* of a profeſſed critic is perfectly ſynonymous with the *cenſure* of the liberal and the ingenious, to whoſe candid examination the preceding pages are ſubmitted with all that reſpect and deference due from an inexperienced writer.

THE END.