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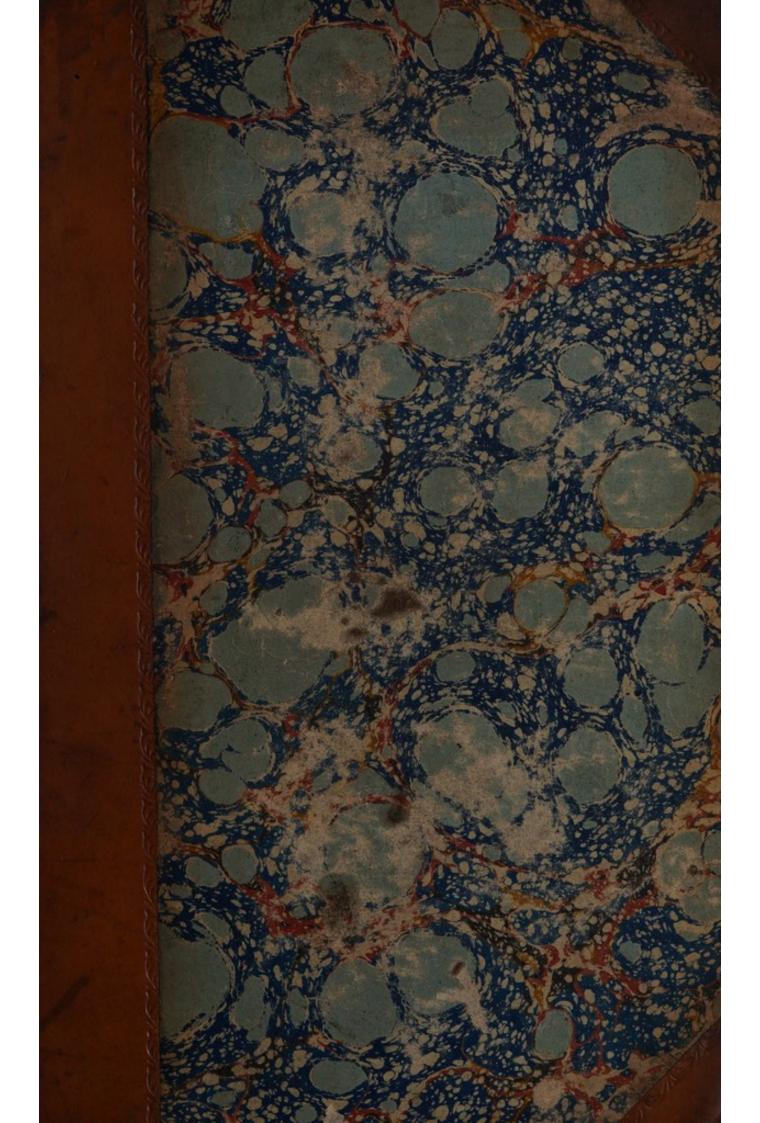https://wellcomecollection.org/works/un5d2jby

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A TREATISE

ON

PATHOLOGICAL

ANATOMY,

By G. ANDRAL,

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ROYAL ACADEMY OF MEDICINE, OF THE COUNCIL OF HEALTH,
ETC. ETC.

TRANSLATED FROM THE FRENCH

BY

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AUTHOR'S PREFACE.

At no other period has Pathological Anatomy been so generally studied; it has in some degree suggested the idea of the great works that have been undertaken for these last thirty years, and accordingly it has almost exclusively reaped the profit of them. It engages the general attention to such a degree, that our Periodicals are filled with facts relating to it, and every day brings forward new ones. We have reason to congratulate ourselves on the great assistance this will be to the science; but, more than this is needed, and people are now beginning to feel the necessity of works which, by collecting the scattered facts, presenting them in their various lights, and comparing them with one another, shall recapitulate what has been done,

and prepare for what still remains to do. It appears to me, however, that it is not at a period when every one, so far from looking back on past researches, or even pausing to consider those of the present day, is anxiously engaged in new ones, that such a work can well be published: it would soon become obsolete, and it could never give but an imperfect view of the state of the science. I do not, then, pretend to offer to the public a complete treatise on Pathological Anatomy, but only an account of the method I have followed in the study of that science, with a view to determine its connexion with the practice of medicine.

In the first part of this work I have endeavoured to set forth, under the title of *General Pathological Anatomy*, all that the lesions of the body have in common, in their external form, their internal disposition, and their mode of production. In the second part, to which I have given the title of *Special Pathological Anatomy*, I have attempted to apply to the history of the diseases of some apparatuses the method pursued in the first. I have chosen those of which the diseases, being more espe-

cially within the province of the pathology of the interior, have been also more especially the objects of my study.

I have endeavoured to ascend to the causes of the lesions described, and to discover their relations, and their modes of connexion and succession. I have discussed the importance of the part they play in the production of diseases, and have inquired how far an acquaintance with them can assist us in determining the seat and the nature of these diseases. Lastly, I have examined what kind of influence pathological anatomy should have over therapeutics. I have considered it scarcely necessary to dwell upon the services it has rendered to medicine; for nobody now dreams of contesting the point: but, at the same time, I thought it of great importance to establish the limits beyond which it can afford us only insufficient or uncertain light. I had to shew that pathological anatomy is but one of the many points of view in which we may consider the science of disease.

I have not described inflammation, because, that being a complex morbid state, I judged it preferable to describe separately each of the

lesions, the assemblage of which constitutes the inflammation of authors. I have not even em-ployed this antiquated expression, as it seemed to me fit only to make the language of the science vague and confused. Without troubling myself, therefore, about the various significa-tions successively attached to the words *enteritis, pneumonia, hepatitis, splenitis, nephritis, ence-phalitis, carditis, &c.*, I have described the lesions of the organs such as they are found on examination, and I have at the same time in-quired into the laws of their production.

I am indebted to the kindness of M. Rey-naud for some of the most important facts brought forward in this work; and I cannot pass over in silence the generosity with which he has neglected his own fame by allowing me to make free use of the results of his labours. He must allow me to take this opportunity of testifying my gratitude, and declaring what assistance I have had from his extensive infor-mation, and uncommon acuteness of intellect.

TRANSLATOR'S PREFACE.

As this translation is a joint production, it devolves upon me, as Editor, to explain the circumstances which have led to its being so, and to state what share my colleague and myself have had in it respectively. Dr. Townsend, who undertook it at the request of the author himself, had proceeded as far as the commencement of the article on tubercle, when, being obliged to go to the continent, he transferred it to me to complete and publish. At the same time, he left me at liberty to revise and correct his part of the translation as far as I might think it necessary; which I have done accordingly.

The first volume being in a manner complete in itself, I have considered it expedient to publish it at once, without waiting for the second, which shall appear as soon as my professional avocations will permit.

W. W.

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PART I.

GENERAL MORBID ANATOMY

AND

PATHOLOGY.

A TREATISE

ON

MORBID ANATOMY

AND

PATHOLOGY.

PART FIRST.

GENERAL PATHOLOGICAL ANATOMY.

PRELIMINARY OBSERVATIONS.

In every part of organized living matter, three grand fundamental actions are uninterruptedly going forward ; namely, *Capillary circulation, Nutrition*, and *Secretion*. These phenomena, though presenting an almost infinite variety in their numerous degrees of simplicity or complication, are nevertheless constant and uniform in their ultimate results.

I. *Capillary circulation.* A fluid under the different denominations of *Blood, Lymph,* or *Sap*, deposits in the various tissues, and subsequently retakes from them, the materials of which all the solids and fluids are composed. In

the intimate structure of every tissue, there exist a series of currents directed in their movements by forces independent of those which, in the human subject, serve to propel the blood through the arterial system. In this intimate structure (*trame*) of the tissues, the fluids and solids come into contact, and become as it were blended together and amalgamated ; and in it also the blood, or analogous fluid, is abstracted from the circulation, and becomes organized and endowed with vitality. Such is the *capillary circulation :* as widely diffused throughout the kingdom of nature as life itself, it is found in full force, after the heart, arteries, and veins, have disappeared, and in fœtal life is accomplished long before the development of these vessels. In some cases the nutritive fluid, when arrived at the parenchymatous substance of an organ, continues to circulate in distinct vessels, whilst in others it merely oscillates in simple areolæ of cellular tissue.

II. *Nutrition.* This process consists in the several solids alternately receiving from, and returning to, the nutritive fluid, a succession of particles similar to those of which their structure is already composed. The blood which circulates through the system of capillary vessels has, when viewed with a microscope, been by many observers compared to a sort of whirl-

pool, from which various particles were constantly thrown off to the different solids, whilst others were detached from the solids, and flung back into the vortex of the circulation.

III. *Secretion.* In the intimate structure of every tissue, as well as on its surface, in short, wherever a particle of the nutritive fluid comes into contact with a particle of living matter, there is a serous fluid produced without the aid or intervention of any peculiar secretory apparatus, such as is required for the production of all the other secretions, which are furnished each by a distinct glandular apparatus.

These three phenomena just enumerated comprehend the fundamental principles of organization common to vegetables and the lower orders of animals; but in man, and those animals occupying a place near him in the zoological scale, a fourth action is superadded, which exercises a powerful influence and control over the others. The nervous system is the seat and instrument of this action, which I shall denominate *innervation;* its influence over the acts of circulation, nutrition, and secretion, is the more absolute and indispensable the more elevated the rank the animal occupies in the scale of existence.

Finally, since all the materials of nutrition and secretion are derived directly from the blood,

and since the blood contained in the capillary
system differs in no respect from the general
circulating mass, of which indeed it is only a
fractional part, it follows that the qualities of
the general mass of blood must exercise a very
material influence over all the phenomena of
nutrition and secretion.   Hence it is, that in
the beings which have centres of nervous influ-
ence, and a systemic circulation, the life of
each part is involved in the life of the whole,
and there arises that relation of so many dif-
ferent actions to the whole and to each other,
which constitutes the unity of the living system.

The human body, considered in the state of
disease, presents only various modifications of
those actions which have already been enume-
rated as essential to man in health.   Thus,

1. The supply of blood usually received by an
organ in the healthy state of the system may be
altered in its quantity ; from such alterations
arise the *lesions of the circulation.*

2. The component particles of the different
solids are liable to various alterations in their
arrangement, their number, their consistence,
and their nature ; hence arise the *lesions of
nutrition.*

3. The different secretions which are sepa-
rated from the blood in the parenchymatous
structure of the organs, or on their surface, may

be altered either in their quantity, or in their quality ; and hence the *lesions of secretion.*

Moreover, inasmuch as the state of the nervous system, and the composition of the blood, exert a powerful influence over the capillary circulation, nutrition, and secretion, in the healthy state, it is evident, that as they continue to exert the same influence in disease, many of the derangements of these actions must proceed from various alterations of innervation and sanguification.

In conformity with these views, I propose dividing into five sections the various morbid alterations, to which the human body is liable.

SECTION I.
Lesions of Circulation.
    Increase of quantity of blood.
    Diminution of quantity of blood.

SECTION II.
Lesions of Nutrition.
    Alterations of the arrangement of the elementary particles. { Malformations.
    — of their number. { Increase. { Hypertrophy,
        Diminution. { Atrophy. Ulceration.
    — of their consistence. { Softening. Induration.
    — of their nature. { Transformation.

SECTION III.
Lesions of Secretion.
    Alteration in the quantity of the secretions. { Increased quantity. { Effusion. Flux.
        Diminished quantity.
    — in their situation. - - - { Development in an unusual situation. } In substance.
        Translation to an unusual situation, } In elements.
    — in their qualities. - { The natural secretion modified in its composition. A new secretion.

SECTION IV.
Lesions of the Blood.
    Alterations in the Physical properties of the Blood. - - - - - } Primitive.
    — of its Chemical properties- - -
    — of its Physiological properties, } Consecutive.

SECTION V.
Lesions of Innervation.
    Primitive.
    Consecutive.

The derangements of the capillary circula-
tion, secretion, and nutrition, may be divided
into two distinct groups, according as they pro-
ceed from some local modification of the part
affected, (as for instance erysipelas from expo-
sure to the sun, or suppuration in the neigh-
bourhood of a foreign body,) or as they are de-
pendent on some peculiar alteration of the blood,
or of the nervous influence, (e. g. scorbutic pe-
techiæ and scrofulous abscesses.)   In this latter
case the alteration that an organ suffers in its
secretion, nutrition, or circulation, is merely the
translation or the external manifestation of some
more general derangement which produces a
series of local affections.   Thus, for example,
the various lesions of nutrition which occur in
scrofulous individuals are assuredly not inde-
pendent of each other ; on the contrary, they are
all effects of the same cause, only rendered sen-
sible to us by producing those modifications of
secretion and nutrition which, taken together,
constitute what we denominate " *the scrofulous
diathesis.*"

A question here naturally suggests itself :
Can we in all cases assign the cause of these
morbid alterations ?   Are they all produced (as
has been confidently advanced) by the simple
modification of the natural excitability, which,
although sometimes diminished, is much more

frequently augmented, for their production ? As a period may be observed in almost every disorder, during which some phenomena occur, that seem to indicate a local or general increase of the natural excitability, some pathologists have been led to consider this increased excitability, or rather the state of increased excitement itself, termed *irritation*, as the cause of the greater number of disorders, both functional and organic, to which the human body is liable. But it should be remembered, that the frequent occurrence of a phenomenon by no means infers the necessity of its existence ; and that the coincidence of two circumstances does not prove the one to be the cause of the other.

On the other hand, those pathologists who denied that irritation was the source from which the various lesions of nutrition and secretion were derived, would, in my opinion, have been more correct, had they maintained, that irritation *alone and unassisted*, was incapable of producing them ; for to me it appears indisputable that there is not one of these lesions to the production of which irritation may not in some degree contribute.

When a tissue has once been the seat of irritation, it is thereby rendered susceptible of every variety of alteration of secretion and nutrition ; of hypertrophy or atrophy, indura-

tion or softening ; cancer and tubercle, or car-
tilage and hydatid, &c. ; but in all these cases,
irritation can only be considered as one of the
elementary principles of the phenomenon ; as
contributing more or less towards its production,
but unable of itself to produce these lesions, or
to account for the individual peculiarities of
each morbid production.

In some cases where the presence of irrita-
tion is not directly proved, we are authorized
by the laws of legitimate induction, to infer its
existence : many cases however occur, in which
even this proof is inadmissible ; but in such
cases we often have no better evidence of the
existence of atony.   All that we can observe
is, a modification or perversion of the functions
of nutrition or secretion ; beyond that, all is
mere conjecture.

The effect of irritation in such cases appears
to me exclusively confined to the production of
a *derangement* in the phenomena of secretion
and nutrition ; but in theory we can conceive
such a derangement taking place without the
necessary pre-existence of any increase of the
natural excitability. What necessary connexion
is there, for instance, between an increase of
excitement, and the deposition of tubercle or
cartilage in the cellular tissue, in place of the
serous vapour that usually fills its areolæ ?   In

theory, irritation should be considered as being frequently, but not necessarily, the precursor of the different organic alterations ; such is precisely the conclusion which an impartial observation of facts leads us to adopt.

The part played by irritation in the state of disease, has been compared to that of excitation in the state of health : let us then endeavour to ascertain the nature and limits of the influence which this excitation exerts on the phenomena of health. The atmospheric air is justly considered as an excitant of the mucous membrane of the bronchia ; but the influence of the air is by no means confined to this alone : it acts on the blood, produces in it certain peculiar modifications, both vital and chemical, and at the same time, many of its constituent principles are directly absorbed and replaced by others. In this series of phenomena, excitement performs a very secondary part, and is utterly insufficient to account for their production. In the same manner, food, when taken into the stomach, occasions by its presence an increase of vitality, and a determination of the fluids ; in short, it *excites* the stomach ; but in this case, as in the preceding, excitement is only one of the elements of the phenomenon, and no more explains the process of digestion in the stomach, than of the aeration of the blood in the lungs.

The same remark is applicable to the different secretions ; in stating, that a gland when excited by the blood, produces its peculiar fluid, just as a muscle when excited by some irritating substance, produces motion, we merely offer an hypothesis : but even admitting that the process of secretion is uniformly connected with an excited state of the secreting organ, it by no means follows that this irritation constitutes *per se* the whole phenomenon of secretion. These remarks are sufficient to show, that in the state of health, the hypothesis of excitement does not afford an explanation of any one vital phenomenon, or of the manner in which it is accomplished ; that in many cases the existence of this excitement is gratuitously assumed ; and that it is no more capable of explaining the phenomena of the healthy state, than its excess or deficiency is of accounting for those of the state of disease.

When the augmentation of the natural excitability is attended by pain, redness, and swelling, it is termed inflammation. This metaphorical expression, invented in the infancy of the science, was originally intended to represent a morbid state in which the parts affected appeared as if they had been actually submitted to the action of fire. As it was originally adopted into medical language without having any precise or well defined idea attached to its

signification, either as regards its intimate nature, the symptoms that indicate its existence, or the morbid lesions that characterize its progress, it has now become so vague in its signification, and in its interpretation so arbitrary, that it has really lost all value as a term of science ; and, like an old coin, from which the original impression has been effaced, should be forthwith withdrawn from circulation, as calculated to produce constant error and confusion. In fact, inflammation can now only be considered as the expression of a complex phenomenon, comprehending under it several other phenomena, which have neither a necessary nor even a constant dependence on each other. In this treatise I shall omit all description of inflammation, as my object is, not to determine whether such or such a group of morbid alterations should or should not be referred to this term or to another term, but to study carefully and attentively each of these alterations, and to endeavour to investigate their nature, and ascertain their causes.

SECTION I.

LESIONS OF CIRCULATION.

THESE lesions may be divided into two principal classes. In the first, the quantity of blood in the capillary system is preternaturally increased; while in the second, it is diminished below the healthy standard. I shall employ the term *Hyperæmia* to designate the increased quantity of blood, without any reference to the cause which produces the accumulation; and I shall apply the term *Anæmia* to the diminished quantity of the fluids circulating in the capillary vessels.

CHAPTER I.

Hyperæmia.

HYPERÆMIA consists in a preternatural accumulation of blood in the capillary vessels; it may be subdivided into the four following species :—

1. Active or *sthenic* hyperæmia, produced by irritation.

2. Passive or *asthenic*, resulting from diminished tone in the capillary vessels.

3. *Mechanical*, from an obstacle to the venous circulation.

4. *Cadaveric*, or *post mortem*, being the result of those physical and chemical laws, to which all inorganic matter is subject, and to which all organized bodies are also subjected, when the vital spark has ceased to animate them.

ARTICLE I.

Active or Sthenic Hyperæmia.

SOME local congestions are perfectly compatible with the physiological, or healthy state of the system; such are the accumulation of blood in the capillaries of the cheeks, under the influence of moral emotions, and the general red state of the skin, succeeding to violent exercise. Again, in other cases similar congestions, though not actually amounting to disease, cannot properly be considered as healthy phenomena. Thus, the skin, when exposed to too high, or too low a temperature, or to the action of irritating substances, becomes red and congested; if these excitants be slight, and their application transient, the congestion occasioned by them does not interfere with the functions of the part

congested, or of the general system ; but if the
energy of their action be increased, or the time
of their application prolonged, a true patholo-
gical congestion is gradually formed, attended
with pain, and more or less of functional de-
rangement, giving rise to different alterations of
nutrition, and calling various morbid sympa-
thies into action.

As the physiological or healthy congestion,
as it may be termed, passes by insensible gra-
dations into the pathological, so this latter state
passes insensibly into inflammation. No line
of demarcation can be drawn between these
affections ; at least anatomy does not enable us
to decide where the one ceases, and the other
begins ; for instance, under the influence of vio-
lent passion, the vessels of the conjunctiva be-
come injected, and the eyelids grow red : from
the presence of a grain of sand precisely similar
effects are produced ; gradually and almost im-
perceptibly the hyperæmia advances from the
slightest degree of congestion, in which only a
few vessels are visible on the conjunctiva, to the
most intense inflammation, when all the capil-
laries are minutely injected, and the conjunctiva
assumes that uniformly red and tumid appear-
ance termed chemosis. Observe also, that the
same degree of sanguineous congestion, which,
when occurring in certain organs, occasions no

alteration of function, or other morbid change, may, in another tissue or organ, be productive of the most serious consequences; how frequently has a simple congestion of the brain given rise to an attack of apoplexy; or a congestion of the lungs, to violent and even fatal attacks of dyspnœa.

The formation of active congestions by no means infers an excessive proportion of the general mass of blood circulating in the system. On the contrary, morbid anatomy has clearly proved that active hyperæmia occurs as frequently in debilitated individuals, whose blood is neither abundant in quantity, nor rich in quality, as it does in persons of the most plethoric temperament; the only apparent difference consisting in the local and general symptoms attendant on those congestions. The same remark is applicable to the influence of age; with this difference however, that, at different periods of life, the seat of the hyperæmia varies as well as the symptoms by which it is attended, but at all ages the frequency of the formation of active congestions is nearly equal.

When a hyperæmia is formed in any one organ, it has a remarkable tendency to extend and establish itself in other parts of the system; for they are all closely and intimately connected. The capillary system, when deranged in any

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one point, is liable to become generally disordered, in which case it presents one of two phenomena : either the original congestion is propagated to other parts, or, at the same time that one or more organs are in a state of hyperæmia, some other parts of the body (by virtue of a species of compensation established between the circulating forces of the capillary system) receive less blood than natural, and fall into a state of temporary, or even permanent anæmia. Thus when the mucous membrane of the stomach is affected with hyperæmia, the cutaneous surface is sometimes minutely injected, while in other cases it is discoloured, and in others again, pale as death : the brain and its investing membranes may likewise, in one case, present unequivocal marks of violent congestion, and in another be found almost exsangueous, and decidedly paler than natural.

These pathological observations afford satisfactory explanations of several morbid phenomena. Thus, for instance, they enable us to understand how the delirium, convulsions, and other nervous disorders, so frequently supervening during attacks of acute gastro-enteritis, are in some cases produced by the repetition in the cerebro-spinal system, of the congestion originally formed in the mucous membrane of the intestinal canal ; whilst in others, the same

symptoms depend on the exsangueous state of the nervous system, resulting from the circumstance of the blood's accumulation in the organ originally congested.

When a hyperæmia is formed in any part of the system, if any one organ be at the time in a state of disease, or have previously been so, it is that organ, which the hyperæmia has the greatest disposition to affect secondarily ; hence it is, that, when, from any cause whatever, a local congestion is formed in any part of the body, we observe as secondary phenomena, palpitations, dyspnœa, hæmoptysis, gastric symptoms, hæmaturia, or menorrhagia; according as the heart, lungs, stomach, kidneys, or uterus, are, or have been, diseased, and thus rendered more susceptible of secondary hyperæmia.

If, however, previous disease has not predisposed some particular organ to attacks of secondary hyperæmia, there is a determinate order in the disposition which the different organs possess to be thus affected secondarily. In the first rank should be placed, as most disposed to sympathetic congestions, the brain and spinal cord, that portion of the alimentary canal situated below the diaphragm, the lungs, the heart, and lastly, the cutaneous system. I may also remark that the organs most susceptible of attacks of secondary hyperæmia, are like-

wise those which, when themselves primarily congested, have the strongest disposition to excite the secondary affections of other organs.

There are certain organs never affected with secondary hyperæmia, unless when some one particular organ has been the seat of the primary affection. The tongue, for instance, although, like all other parts of the body, liable to attacks of idiopathic hyperæmia, is never thus affected sympathetically, except when the stomach is primarily affected.

All these circumstances are liable to be considerably modified by individual peculiarities of constitution; so that in one person the hyperæmia of one organ shall be sympathetically communicated to almost every other organ in the body; whilst in another the primary hyperæmia shall run its course without producing any secondary affection. Several varieties are likewise observed in the form of the secondary hyperæmias, which may in general be referred to peculiarities of constitution.

When the primary hyperæmia is rapidly developed, those secondarily formed are generally acute likewise; and, from the rapidity of their formation, or the number of parts which they simultaneously affect, they not unfrequently produce as urgent and dangerous symptoms, as could result from a much more serious organic

disease. Thus, the violent dyspnœa, almost threatening instant suffocation, which not unfrequently supervenes in an acute attack of gastroenteritis, often leaves no other trace of organic derangement, than a slight sanguineous congestion of the pulmonary tissue, insufficient to prevent the access of air; in like manner, notwithstanding the host of nervous symptoms, which complicate the progress of almost every attack of acute inflammation, the body frequently presents, on examination after death, no morbid appearance except a slight congestion of the vessels of the brain, so slight indeed, that it may in some cases fairly be questioned, whether this congestion be really the cause of the great derangement of the cerebral functions, or whether it be not rather an effect resulting from the deranged action of the nervous system, especially as all those nervous symptoms are sometimes observed when no such congestion can be discovered.

The secondary hyperæmias formed in different organs during the progress of a chronic disease, may, from their commencement, assume the chronic character of the original hyperæmia; yet, though their progress be slow, and their symptoms insidious, their effects on the system are not the less fatal. Sometimes, after having long continued stationary in their chronic form,

they suddenly burst forth with all the violence of an acute and newly-formed disease ; in other cases, during the progress of the chronic affection, a new and acute hyperæmia seizes on an organ which till then had remained free from disease.

This supervention of acute hyperæmia is one of the most frequent causes of the sudden deaths which occur during the progress of various chronic affections ; the lungs and alimentary canal are the parts most liable, in chronic affections, to both these species of hyperæmia, namely, aggravation of the chronic, and the supervention of the acute form.

When a secondary hyperæmia is formed, one of the following consequences ensues ; either the primary hyperæmia is not at all affected by it, as is most commonly the case when it is violent, or of long standing ; or else it is considerably aggravated by the newly formed hyperæmia reacting upon the entire system, and more especially on the organ primarily affected ; or, lastly, the primary hyperæmia ceases altogether when the secondary is formed. This, however, seldom happens, unless when the primary affection is slight, of small extent, and but recently formed : under such circumstances we sometimes see a hyperæmia of the brain take the place of that affection of the stomach, or a de-

termination artificially produced to the surface of the body remove the congestion of some internal organ.

When a patient has lost a large quantity of blood in a short space of time ; when, during convalescence from a tedious illness, he has been long kept on low diet ; or when, after an attack of acute inflammation, he continues to labour under the disease in a chronic form ; whenever, in short, the system has been much exhausted without adequate means being taken to recruit its losses, it frequently happens that the sensibility of the nervous system to impressions is increased, in the same proportion as the muscular strength and quantity of blood are diminished. Under such circumstances, a hyperæmia attended with the least degree of pain, may excite the most alarming derangement in the functions of the nervous system. I have seen, in a case of this kind, the bite of a single leech produce symptoms of tetanus ; it is scarcely necessary to add, that the application of more powerful irritants, such as cupping glasses, blisters, or sina-pisms, is still more decidedly contraindicated in such cases. To this morbid sensibility of the nervous system must be attributed the injurious effects so frequently observed to follow the application of revulsives to persons debilitated by copious venesection or protracted abstinence

from nutritious diet; not that the hyperæmia attended with more or less pain, that is produced by the revulsives, directly aggravates the original hyperæmia, but that it produces a violent effect upon the nervous system, which in its turn, reacts upon the primary disease, and thus aggravates those symptoms which it was intended to relieve.

This exquisite sensibility of the nervous system is not exclusively confined to persons labouring under chronic disease, or reduced by tedious convalescence; there are some individuals in whom this state of the nervous system is constitutional : they are generally persons of a delicate frame, and whose muscular system is imperfectly developed. In such cases, all our attempts to remove local congestions by abstraction of blood, only give an increased predominance to the nervous symptoms, the repetition of the blood-letting serving but to increase the convulsions, coma, delirium, &c.

Hence it is obvious, that, in our treatment of this class of diseases, the local congestion should not engross our whole attention; for the symptoms by which these congestions are attended not unfrequently depend on some peculiar state of the blood or nervous system, which preceded and favoured their development, and consequently it is only by taking all these circum-

stances into account, that our treatment can be either judicious or successful.

From what has been said, appears the importance of studying the various modifications, which the nervous system may undergo in consequence of the formation of even the most simple hyperæmia: but this system is also liable to be primarily affected, and, when deranged in its functions, and in the influence which it exerts over the other systems, may, in its turn, derange the circulation in those systems, and produce in them either temporary or permanent congestions, and thus lay the foundation of every species of organic disease. In this way an affection at first purely nervous, may subsequently be transformed into a hyperæmia, and finally produce an extensive alteration in the texture and organization of the part; changes which, we may remark *en passant*, are by no means uniformly characterized by a corresponding alteration of symptoms.

When several hyperæmias are formed simultaneously in different organs, they are sometimes produced one by the other, in the manner I have endeavoured to explain; sometimes again their development, though simultaneous, is independent; to these may be added a third class of hyperæmias, which have a necessary co-existence, being constantly connected as the product of one

and the same morbid cause. Thus, in measles and scarlatina, two congestions uniformly exist together; one, on the cutaneous surface, the other, in certain portions of the mucous membrane. It would be absurd to say that, in these diseases, the cutaneous produced the mucous hyperæmia, or *vice versa :* they are both necessary effects of one and the same cause ; the manifestation, as it were, of the morbid state of the system produced by the introduction of the contagious poison.

This co-existence of several hyperæmias appears to be one of the most constant effects of the introduction of any deleterious principle into the circulation. It is constantly observed in all contagious and infectious diseases, termed typhoid, or pestilential ; and likewise in animals that have been made to swallow poisons susceptible of absorption, or when putrid substances have been injected into their veins. The poison, when conveyed into the circulation and mixed with the blood, produces three grand effects, which may either exist singly or in combination. 1. It alters the blood itself, and renders it to a greater or less extent unfitted to support the nutrition and life of the different organs. 2. It modifies the functions of the nervous centres. 3. It produces irritation, alteration of nutrition, and hyperæmia, of the organs to which it is

distributed in its vehicle, the blood. This last effect is however the least constant of the three, and great functional derangement may be produced independently of it. Hence it follows, that if we would form a correct and precise idea of the nature and treatment of those diseases which are produced by miasmata or other poisons, we must consider the hyperæmia formed in the mucous membrane of the intestines, or elsewhere, as simply one of the elementary ingredients of these diseases; an ingredient which may be absent and yet the disease be neither less rapid in its progress, nor fatal in its termination on that account.

A hyperæmia developed under the influence of any irritating cause, which produces an unusual determination of blood towards some particular organ, may have a very brief duration, and disappear completely in a short time after its formation. There are several of these acute hyperæmias, the duration of which is circumscribed within certain determinate limits, and which uniformly observe the same period of increase, decline, and final disappearance. In other cases the hyperæmia continues for an indefinite period; this most generally occurs when it has not originated in a simple, mechanical, or chemical cause. Again, in another class of these affections, the hyperæmia quickly disap-

pears, but has a peculiar tendency to re-appear in those organs where it previously existed, and, accordingly, does recur at longer or shorter intervals, sometimes under the influence of manifest causes of irritation, and not unfrequently without the apparent agency of these causes.

There are certain forms of hyperæmia both of the acute and chronic type, which may be reproduced at pleasure in their original form and character. Thus, if the skin be exposed to a high temperature, or irritated by a mechanical stimulus, a cutaneous congestion will constantly be produced, varying only in its duration and intensity. But there are many other forms of hyperæmia which we cannot artificially produce; these are generally dependent on some internal cause, with the nature of which we are totally unacquainted.

Sometimes a hyperæmia exists for a considerable period in an organ without producing any alteration in its nutrition or secretions, except perhaps some increase or diminution in their quantity. In other cases, the organs which have been the seat of hyperæmia, undergo various alterations in their nutrition and secretion. Such alterations have this peculiarity, that they cannot be produced at pleasure, in the same manner as the hyperæmias by which they were preceded ; neither can any constant

connexion be traced between the nature and extent of the organic alteration, and the intensity or duration of the preceding hyperæmia. On the contrary, let us vary those circumstances as we please, let us increase or diminish the intensity of the hyperæmia, protract or shorten its duration, we cannot thereby determine the hypertrophy or atrophy, the softening or induration of the organ affected, alter its natural thickness, produce ulcers on its surface, or modify their form, size, or depth ; neither can we, by subjecting the tissue of an organ to any determinate degree of irritation, produce thereby the development of any particular accidental production, whether pus, melanosis, or tubercle, &c. The slightest hyperæmia is in some cases sufficient to produce all these alterations of nutrition ; whilst in others, the most intense or indefinitely protracted hyperæmia may not be followed by any of these changes of structure. For these reasons it is, that whilst we admit that a determination of blood to the part is a condition more or less indispensably requisite for the production of these alterations, we also maintain, that this local determination, or hyperæmia, is not of itself sufficient to produce their development, and that it is perfectly inadequate to account for the individual peculiarities of all the various alterations of texture ; other

conditions, which shall hereafter be considered, being indispensably requisite for their production.

When hyperæmia is followed by the development of any of these various alterations of texture, the antecedent congestion may either continue, or cease to exist ; this latter case is by no means uncommon ; the tissue remains altered, to a greater or less extent, in its texture and organization, but no longer receives a larger supply of blood than in its healthy state, and in some cases receives actually less ; thus the cellular tissue, when indurated or converted into scirrhus, is often remarkable for its extreme paleness, and thus, in like manner, the bottom and margins of some intestinal ulcers are colourless and exsangueous.

Congestions of different degrees of intensity and duration occasionally assume an intermittent type, and recur, at longer or shorter intervals, in the immediate vicinity or in the substance of a tissue which has already undergone some chronic alteration in its structure and organization. The recurrence of those attacks of hyperæmia often renders evident the existence of organic lesions, which, during the absence of the sanguineous congestion, were either wholly latent, or only revealed by the most obscure and equivocal symptoms : every

return of the hyperæmia in such cases invariably aggravates the organic disease, and accelerates its progress. The knowledge of this fact explains the utility of blood-letting in such circumstances; the effects of the newly-formed hyperæmia are thereby diminished, and although the original organic disease be not removed, or even diminished, it is relieved from the acute symptoms induced by the supervention of the hyperæmia, and is thus brought back to its original stationary condition.

We must not, however, suppose that local congestions may uniformly be removed by blood-letting. It is a fact established by every day's experience, that a hyperæmia may exist singly and independent of any organic alteration, and yet refuse to yield to either local or general abstractions of blood, however copiously employed, or judiciously timed. By the employment of blood-letting, the organ congested is relieved of a part of its superabundant fluid, the general mass of blood in circulation is diminished, and a powerful cause of excitation is thus withdrawn from the system ; but neither by local nor general bleeding can we remove the unknown cause, under the influence of which the hyperæmia was originally developed. If, however, this cause be not particularly active or violent in its operation, its influence may be

considerably diminished, or even completely paralyzed by sanguineous abstractions ; as the blood is thus withdrawn from the seat of irritation as often as it tends to accumulate there, and the hyperæmia is thus prevented from establishing itself in the part. But if the exciting cause of the congestion (the thorn of Van Helmont) be more violent in its action, we shall in vain attempt to remove it by blood-letting ; though we leave but one drop of blood in the body, that drop will, in despite of all our bleedings, obey the summons of the irritating cause, and fly to the part affected. It is therefore this exciting cause which we should endeavour to investigate and counteract, and not exclusively confine our attention to the local congestion, which is merely an effect, an elementary part of a very complex phenomenon. The modern Italian school has fully recognized the truth of this principle. Convinced of the inefficacy of blood-letting for the removal of the primary cause of congestions, it has endeavoured to discover remedies capable of directly combating this cause. How far the *contra-stimulant* medicines really fulfil this indication, it is neither consistent with the object of this treatise, nor important for our present purpose, to determine ; my only object being to establish the primary indication, which should present itself to our

consideration whenever the hyperæmia does not depend on a simple irritating cause, externally applied. This indication, I repeat it, consists in combating the cause by which the congestion was produced. Experience alone will enable us to decide whether this indication can be accomplished. We may however remark, as connected with this subject, that observation has already led us to discover, in cinchona, a remedy eminently adapted to prevent the recurrence of intermitting hyperæmias ; and that the writings of Tommassini, and his followers, contain many strong facts in favour of the contra-stimulant doctrine ; facts which we are by no means entitled to reject, because we cannot reconcile them with our preconceived ideas, and which must eventually be decided by the test of experience, and not by their conformity with any particular theory. These observations may serve to prove that all our therapeutical indications cannot be derived from morbid anatomy, and that in many important questions connected with this subject, no information whatever is to be derived from that source.

The phenomena of hyperæmia both in the healthy and morbid states, prove incontestably that the blood in the capillary vessels is withdrawn from under the influence of the heart, and that its movements and local determinations

are regulated by forces inherent in the capilla-
ries themselves. The nervous system often
modifies the action of these forces, as is exem-
plified in the act of blushing. May not the
nervous system in like manner exert an influ-
ence over the production of various pathologi-
cal congestions?

The only modification appreciable to our
senses which an organ affected with simple hy-
peræmia undergoes, is the change in its colour.
This alteration is often produced by an increased
quantity of blood circulating in the part; but,
on other occasions, proceeds from the gradual
accumulation of this fluid, which is retarded in
its course, and eventually becomes perfectly stag-
nant. The following facts will illustrate these
assertions. If we irritate the mesentery of a frog,
or any other part which is supplied with trans-
parent vessels, and observe with a microscope
what follows, we shall soon perceive the blood
flowing from all points, and in every direction,
towards the part irritated. This experiment
was lately repeated by M. Broussais among
others. " We have ascertained," says he, " that
the globules of the circulating fluids hurry from
all parts to converge, even across the veins,
towards the point irritated by the prick of the
pin, and accumulate there so as to form a con-
gestion; and that subsequently those at the

circumference can disengage themselves, and take a reverse direction, if a new point of irritation be established in the neighbourhood of the first."—(Article *Irritation*, in the *Encyclopédie Progressive*, 1st Part, page 143.)

Dr. Wilson Philip relates, that, in his experiments performed on the thighs of frogs, the fins of fishes, and mesentery of rabbits, he observed with a microscope, that, on the application of various irritants to these parts, the motion of the globules of the blood was invariably retarded, and in some points appeared altogether suspended.

More accurate experiments on this subject have since been undertaken by Hastings, in England, and M. Gendrin in France, the results of which may be summed up as follows:

1. Immediately after the application of various irritating substances, chemical or mechanical, to the membrane of a frog's foot, the circulation becomes more rapid in the neighbourhood of the irritated point, and at the same time the calibre of the vessels is considerably diminished, but still no change is perceptible in the globular appearance of the blood.

2. At the end of a certain time, when the application of the irritating substances is continued, or when their action has been so violent that the hyperæmia continues after their re-

moval, other phenomena are observed; the capillaries became gradually dilated, the circulation, which was at first accelerated, becomes manifestly retarded, the blood assumes a deeper colour, and the globules become less distinct, and seem evidently disposed to coalesce.

3. At a still later period of the experiment, the circulation ceases altogether, and the blood forms a homogeneous mass, without any determinate form, or appearance of globules; its colour is changed to a brownish yellow, which gradually assumes a darker hue.

4. If the congestion continue, the vessels become still more dilated, and the blood, now perfectly stagnant, assumes a dark brown or even a black colour; but if the congestion be diminished, the blood gradually recovers its mobility, the globules become distinct, the dilated vessels by degrees recover their natural calibre, and the circulation resumes its wonted activity.

5. The application of a second stimulus in some cases serves to dissipate the congestion produced by the action of the former stimulus.

The membrane of a frog's foot was moistened with a solution of muriate of soda; in ten minutes after, there was a remarkable dilatation of the vessels, the circulation was retarded, the blood, deprived of its globular appearance, seemed disposed to coagulate, and its colour

was changed to a dark red. Some alcohol was then poured on the part; in five minutes after its application, the venous trunks were contracted, the blood circulated more rapidly, and resumed its globular appearance and natural colour. When five minutes more had elapsed, the same changes were observed in the smaller vessels; some of them however continued dilated, their blood retained its deep red colour, presented no traces of its globular composition, and circulated much more slowly than in the veins. The blood which passed from these dilated capillaries into the venous trunks, was remarkably different in appearance from that which was poured into them from the sound capillary vessels. It was deeply coloured, and seemed to contain several small irregular flocculi, not unlike the torn fragments of a coagulum of blood: these flocculi disappeared after having circulated for some time in the larger veins.

6. So long as the blood circulates with increased rapidity, no other change is observed in the part irritated than this increased velocity of its motion; it coincides with the contraction of the vessels, and is in fact a necessary consequence of it. But when, at a later period of the experiment, the circulation becomes retarded, a new series of phenomena is presented; serous or purulent fluids make their appearance in the

part congested, and at the same time, the tissues are softened. At a later period still, when the circulation is completely suspended, and the blood assumes a deep brown tinge, all the parts in which these phenomena occur, become more and more soft and flaccid, are transformed into a gangrenous mass, and finally separate in the form of an eschar, from the adjoining sound parts.

It follows from these experiments that we must admit the existence of several degrees of hyperæmia, both as regards the state of the blood itself, and of the capillary vessels of the part affected. The first degree of hyperæmia is that in which the vessels are contracted, and the circulation consequently accelerated, both because the vessels then act more energetically on their contents, and because of the fulfilment of an established principle in hydraulics; namely, that a fluid passing in full stream from larger into smaller tubes is thereby accelerated in its motion.

The second degree of hyperæmia succeeds to the first: the vessels dilate, the blood circulates more slowly, its particles tend to coalesce, and the whole mass seems disposed to coagulate. From the condensation and unusual accumulation of the blood, the part affected assumes a deep red colour, which subsequently changes to

a brown shade, as the circulation of the part becomes more completely suspended.

In the third and last degree of hyperæmia, the blood becomes perfectly stagnant, and the seat of the hyperæmia assumes a yet deeper shade of brown, and finally becomes quite black.

These successive alterations in the colour of the blood, arising from its retarded motion, and subsequent stagnation, were long since ascertained by the experiments of Hunter, who likewise observed that whenever arterial blood is stopped or even retarded in its course, it assumes the dark colour of venous blood. The following experiment is illustrative of this fact. If a portion of artery be intercepted between two ligatures, and if, after some time, an incision be made into the intercepted part, the blood which issues will be found black and perfectly similar to venous blood. The blood which flows from a wounded artery and is effused into the surrounding cellular tissue, becomes in like manner almost completely black on coagulation. This dark colour of the blood is also observed in such cerebral apoplexies as are not immediately fatal ; in pulmonary apoplexy, and likewise in those cases where the colouring matter of the blood being deposited in the tissues, gradually acquires from its prolonged stagnation in the part, that uniform black colour which has received the name of melanosis.

If, then, it be established, that the blood cir-
culates more slowly, or even ceases altogether
to circulate, in parts affected with hyperæmia in
the second or third degree ; and that the blood
uniformly assumes a darker shade whenever its
motion is retarded or suspended ; we are, I con-
ceive, warranted in attributing to these causes,
the slate-coloured, brown, or black colour which
parts affected with hyperæmia not unfrequently
present.   If we consider attentively the circum-
stances in which such appearances are usually
observed, we shall find them referable to one of
two classes : 1st, where a violent congestion is
rapidly formed ; as when the mucous membrane
of the stomach is exposed to the action of a
corrosive poison, or the cutaneous tissue to an
extreme elevation or depression of tempera-
ture ; 2d, where a hyperæmia is formed slowly,
and gradually, and exists for a considerable time
in a chronic form.   Now it is precisely in these
cases, that, according to the experiments above
cited, the circulation is retarded, or suspended.
In the first case, when a violent hyperæmia has
been suddenly developed, the circulation must
be retarded, and if the hyperæmia be sufficiently
violent, it will be suspended altogether ; if this
suspension of the circulation be prolonged, and
the stagnation complete, the consequence is, that
the part being gorged with blood, which is no

longer renewed, and which soon becomes un-fitted to maintain nutrition and life, must ne-cessarily die, and present the phenomena of gangrene, just as in the experiments of Hastings above recorded ; so that in these cases the black colour of the part announces the stagnation of the blood, and its stagnation, if prolonged, neces-sarily produces the death of the part. Such, in my opinion, is the mode of production of that species of gangrene, which is generally attributed to excess of inflammation.

In the second case, when a chronic hyper-æmia is slowly formed, the circulation is not completely suspended ; it is only retarded in proportion to the dilatation of the capillaries, and accordingly, in the chronic hyperæmia, we do not observe the same deep black colour, but a slate-coloured, grey, or brown shade, similar to that which, in several of the experiments already cited, was observed to depend on the retarded motion of the capillary circulation.

We occasionally observe, that parts which had at some former period suffered an attack of hyperæmia, although they may have been sub-sequently exempt from any recurrence of the affection, still continue to present an unnatural colour, either violet, yellow, grey, slate-coloured, brown, or even black. These different shades of colour are often met with, on the sites of

old herpetic eruptions, and of ulcers long since
healed.   The continuance of these different
colours after the tissue affected has in all other
respects recovered its natural appearance, seems
to depend on the dilatation of the vessels continu-
ing after the complete removal of the irritation,
which necessarily produces a retardation in the
motion of the blood contained in the capillaries,
and consequently an alteration in its colour.

Let us now endeavour to investigate the
nature of those forces under the influence of
which the capillary vessels, that were at first
contracted, become subsequently dilated. Does
the force by which the blood is impelled from
all parts towards the seat of irritation, contrary
to its natural course and the laws of gravity,
reside in the blood itself?   Is the dilatation of the
vessels a passive result of the mechanical disten-
tion which they undergo from the unusual
afflux and accumulation of blood? or does it
rather proceed from the diminished elasticity of
their parietes, resulting from some alteration in
their texture? or, lastly, does it arise from an
expansive force residing in the coats of the ves-
sels; a force analogous to that which appears to
exist in the parietes of the heart (whose dilata-
tion is decidedly not a passive phenomenon) and
in the erectile tissues?

The analogy is perhaps stronger than might

at first be expected, between the phenomena which occur in an organ affected with active hyperæmia, and those which take place in a tissue in a state of erection. One material difference may however be noticed, namely, that in the erectile tissue the parts are naturally so constructed, and disposed, as to admit of a sudden accumulation of blood under the influence of certain physiological conditions ; whereas the natural texture of an organ not erectile must first undergo some modification, before it is capable of receiving and retaining more blood than it is ordinarily supplied with ; hence arise various derangements of function in the organ congested, and alterations in its nutrition, secretion, and sympathetic relations with other organs.

As these considerations are not so much matters of fact as of speculation, I shall not urge them further at present, and shall conclude this part of my subject with the observation, that even if all hyperæmias are identical at their commencement, if they all uniformly consist in an unusual afflux of blood towards some point, accompanied by contraction of the vessels, and increased rapidity in the local circulation ; if, I say, in this first stage of their existence, they are simply the phenomena of the healthy condition of the part in a state of exaggeration, a second

period sooner or later succeeds, in which the phenomena can no longer be considered as such; at this period commences the development of the different alterations of texture, and of the various morbid secretions, which we cannot at all conceive to be produced by the simple augmentation of organic action.

The hyperæmia, instead of being confined to a simple organ, may exist at the same time in every organ of the body; the general capillary system is then overloaded with blood, and the whole system is said to be in a state of *plethora* or *polyæmia*. I shall not enter into a detail of the symptoms which characterize this state, the essential character of which seems to consist in the formation of a greater quantity of blood than is necessary for the purposes of nutrition and secretion. There are some individuals who, according to a common observation, naturally make a greater quantity of blood than others; in general those persons who live high and make but little exertion either mental or corporeal, are most liable to this affection. It has been said, but without the slightest proof being adduced in support of the assertion, that an appearance of plethora has been produced in some individuals by an inordinate expansibility of the blood.

When the blood-vessels contain a greater proportion of the nutritive fluid than is neces-

sary to supply the demands of the different organs, the superabundant quantity becomes a permanent source of excitation to the solids, and at the same time the blood has a remarkable tendency to accumulate in different organs, so that in such cases, the whole system is in a general state of excitation, and some of the organs may become the seats of local congestions of various degrees of duration and intensity; indeed the phenomena which result from the plethoric diathesis cannot properly be termed morbid, unless when some such local congestion is formed. Sometimes the brain is the seat of this congestion, and then follow the various symptoms of cerebral disease, giddiness, headach, drowsiness, alteration of the sensorial and intellectual faculties, &c., which may be so violent as to produce death, and yet leave no trace of disease, except a little more blood than usual in the cerebral vessels. Sometimes the congestion more particularly affects the pulmonary organs; the dyspnœa which accompanies this form of the disease arises from an unusual quantity of blood being transmitted through the lungs, which necessarily requires a corresponding quantity of air to fit it for the purposes of the general circulation; it is this want of proportion, between the blood which requires to be aerated, and the quantity of air inspired for that

purpose, which produces the dyspnœa. In other cases, the complication of palpitations with various degrees of dyspnœa, prove that the heart has become the seat of congestion.

In some instances the different mucous membranes are the parts which are more especially affected ; the habitual injection of the cutaneous surface so constantly observed in plethoric individuals, would lead us to infer the probable existence of a similar state of the internal tegumentary membranes, of the gastro-intestinal membrane for instance, thus producing all the phenomena of impaired digestion, in the same manner as the functions of the brain become deranged from the accumulation of blood in the cerebral capillaries. The mucous membrane when thus congested, not unfrequently suffers repeated attacks of sanguineous exhalations more or less abundant ; and it is by no means uncommon to see different portions of this membrane successively affected, and giving rise accordingly to alternate attacks of epistaxis, hæmoptysis, hæmaturia, menorrhagia, hæmorrhoidal flux, &c.

Under the influence of this state of general hyperæmia, serous effusions unattended with pain or other symptoms of inflammation, take place into the cellular tissue and into the different cavities lined with serous membranes, especially

the abdomen. It appears to me highly probable that these dropsical effusions which are general-ly denominated *active*, are simply the mecha-nical result of the over-distention of the vessels, which allow the serous portion of the fluid by which they are over-distended, to transude through the parietes of their capillary ramifica-tions. In confirmation of this view of the sub-ject, I may cite the observation, that if a large quantity of water be injected into the veins of an animal, without having first withdrawn blood from his system, serous effusions are quickly formed; whereas, if the mass of blood be dimi-nished by venesection before the water be in-jected, that fluid is gradually and almost imper-ceptibly eliminated. Besides we know from actual experience, that those dropsies usually termed active, which are combined with a state of general hyperæmia of the system, are con-stantly relieved, and not unfrequently altogether removed, by the use of the lancet.

When, in consequence of an universal hyper-æmia, each solid particle of the system becomes over-excited by its excessive supply of blood, and when this state of general excitation is carried to a considerable extent, the sympathies which associate the different organs, are rendered more active, and an inordinate reaction ensues; in consequence of which the functions of the ner-

vous system become disordered, the temperature of the surface elevated, the different secretions variously modified, the pulse augmented in strength and frequency, and in short all the phenomena of fever are fully developed. This fever once formed may be ephemeral, or may continue for several days. Sometimes it presents no dangerous symptom during its entire course, thus constituting the *simple continued fever* of authors. In other circumstances the intensity of the reaction of the different organs gives rise to more alarming symptoms, and various nervous phenomena make their appearance, attended with sudden prostration of strength, and false adynamia. Lastly, it not unfrequently happens that some one organ becomes more especially affected, and so the disease, which, in the commencement, was universal, is subsequently converted into a local affection.

The morbid state which I have now described, and to which may be referred some of the species of continued fever described by the older nosologists, may terminate in recovery or death. When the termination is favourable, the symptoms gradually improve, as the superabundant quantity of blood, the original source of all the accidents, is diminished by abstinence and blood-letting. When death ensues, the *post*

mortem examination generally exhibits traces of a well marked inflammation of one or more organs ; this inflammation seems to have taken place subsequently to the commencement of the febrile paroxysm, at least the symptoms would lead us to this conclusion. But on other occasions no trace of inflammation can be discovered, and the only morbid appearance consists in a simple accumulation of blood in the capillaries of different organs, their texture remaining perfectly unaltered. These slight congestions, affecting simultaneously several organs, may, by the various morbid sympathies which they excite, produce as violent and formidable symptoms as the most serious organic lesion of any individual organ. In such cases where are we to assign the origin of the disease ? Wherever the blood is distributed, there derangement of function is found. In the blood, then, indisputably resides the first cause of the disease ; the lesion of the solids is only a secondary affection, but may notwithstanding become, during the progress of the disease, the predominant affection, and give rise to many and formidable accidents.

E.

ARTICLE II.

Asthenic Hyperæmia.

A VIOLET colour may frequently be observed on the anterior surface of the legs and feet of persons advanced in life, without any assignable cause but the diminished energy of the capillary circulation. It appears that in these cases the blood having arrived at the termination of the arterial branches, where its circulation is maintained by the united influence of the heart's action and the tonic force of the capillary vessels, has a tendency to stagnate whenever these forces are diminished. This diminution of the circulating forces is principally felt in those arterial ramifications farthest removed from the heart, and where the blood in its passage from the capillaries into the larger veins has to overcome the force of gravitation. The influence of this cause is clearly proved by the fact, that simply placing the limb in the horizontal position is in most cases sufficient to remove the appearance of congestion.

In some of these cases, the blood which passes from the arteries into the capillaries of the feet, returns but in small quantities by the veins, and gradually accumulates to such an extent, as to oppose an effectual obstacle to the arrival of a

fresh supply of arterial blood from the heart. The blood thus accumulated in the capillaries, being arrested in its course, coagulates, and obliterates the cavities of the vessels, so that their calibre is filled with coagulated blood, which is often found advancing towards organization. The same series of phenomena must then ensue, as when the blood was accumulated in the capillary vessels under the influence of an acute hyperæmia, (see the preceding article ;) namely, the blood becomes black, is no longer adapted to maintain the life of the part, and gangrene supervenes.

Such is the true pathology of the disease termed *gangrena senilis.* There is at first, in the most dependent portion of the limb, passive stagnation of blood in the capillaries, and, in consequence of the mechanical obstacle to the circulation thus formed, coagulation of the blood which arrives by the arteries, and, as a necessary consequence of these two phenomena, gangrene of the feet and legs.*

The existence of a true asthenic hyperæmia appears to me fully established in the case just described, and this may serve to prove how erroneous is the conclusion that, if a part be more

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* M. Cruveilhier succeeded in producing gangrene of a limb, by injecting the minute arterial ramifications of the part with quicksilver.

red than natural, it must necessarily be affected with *active* hyperæmia. It is evident that by covering the livid part with emollient poultices, we should but aggravate the disease, and that the only practice likely to prove beneficial in such cases, consists in applying active stimulants to arouse the languid circulation of the capillaries.

Before proceeding to consider whether the redness observable in the internal organs may not, in like manner, occasionally depend upon passive congestion, it may be worth while to examine whether other instances might not be brought forward to illustrate the existence of asthenic hyperæmia in the surface of the body; especially as some modern pathologists have thought proper to deny its existence altogether.

During the course of certain acute diseases, in which the functions of the nervous system are more or less seriously deranged, the application of the slightest irritation to the cutaneous surface is sufficient to convert the red colour, which the parts previously presented, into a violet, brown, or even black colour; and thus substitute gangrene in the place of a simple sanguineous congestion. No doubt in such cases the gangrene was preceded by active hyperæmia; but does it necessarily follow from thence that the gangrene was produced by excess of irritation? To me

it appears much more probable, that, in consequence of some peculiar modifications of the nervous influence, the blood, after accumulating for some time in a part of the cutaneous surface, at length ceased to move, and became perfectly stagnant, because the capillary vessels being deprived of the nervous influence which should regulate their functions, could no longer expel their contents ; and in this way a passive hyperæmia was formed where an active hyperæmia had previously existed. The frequency of gangrene in these cases is directly proportional to the alteration of the nervous influence. Its occurrence is most common in the various epidemics of the plague and typhus fever, in which its appearance is not necessarily preceded by increased vascular action, or active hyperæmia ; for it constantly happens that several spots in the cutaneous surface turn spontaneously red, then brown, and finally form a gangrenous eschar.

By this method of accounting for the formation of gangrene, the application of therapeutic agents is considerably simplified, and additional confirmation is afforded to the efficacy of the old established practice of covering with powdered cinchona, &c., the red patches, excoriations, and sores, which occur during the progress of severe fevers, whenever their surfaces

present a grey or brownish colour. Thus we see that when a part is threatened with gangrene, the inflammatory action which ushered in the disease should not exclusively engage our attention, as there are various other matters equally important to be taken into consideration, in order that we may form a correct idea of the phenomena of this formidable affection, and adopt the most appropriate method of treating it. We have another example of the asthenic hyperæmia on the surface of those old ulcers and sores which shoot up red, flabby, fungous granulations, composed of loose cellular tissue gorged with blood, which are speedily removed by the application of topical stimulants. These fungous productions occur most frequently in those parts of the cutaneous surface, which have been long exposed to irritation, in debilitated exsangueous individuals, whose circulation is languid, and who have a manifest disposition to scurvy.

Asthenic hyperæmia also occurs in the external mucous membranes, either as a primitive affection, or consecutively to an attack of active hyperæmia. Thus after the mucous membrane of the eye has been for some time affected with an active congestion of greater or less intensity, three cases may present themselves : 1. The redness of the conjunctiva may disappear alto-

gether. 2. It may continue indefinitely, though in a less violent degree; but the ill effects which are constantly produced by the application of stimulants, prove that the congestion is still kept up, under the influenceof some irritation. 3. There are other cases in which the capillaries of the conjunctiva continue minutely injected, and appear dilated and varicose ; but their colour is a deeper shade of brown, is rather increased than diminished by emollient applications, and often disappears altogether under the use of stimulants. How then is the action of these irritating agents to be explained? Simply thus ; they stimulate the relaxed debilitated vessels of the conjunctiva, restore their natural tone and elasticity, enable them to propel the blood as quickly as they receive it, and thus dissipate the appearance of increased vascularity.

In this last case then, the hyperæmia was asthenic, while in the other two, it was sthenic ; thus we see that, when we propose treating a congestion on the stimulant plan, the question to determine is, not whether the hyperæmia is acute or chronic, but whether it is sthenic or asthenic. It matters little whether the blood flows towards the part congested for a single day or for a series of months ; if irritation be the cause, the application of any description of stimulus will be injurious; if, on the con-

trary, the congestion be kept up solely by the passive dilatation of the vessels, stimulants will then act beneficially, by restoring to the over-distended vessels the power of reacting on their contents.

The mucous membrane which lines the mouth presents, in scorbutic individuals, another example of asthenic hyperæmia; for in addition to the alteration which the blood undergoes in such persons, there is likewise a diminution of energy throughout the whole system of the capillary circulation, and hence results the congestion by stagnation, in those parts which are naturally the most abundantly supplied with blood; as the gums, the spleen, and other parenchymatous organs. This mode of explaining these phenomena enables us to understand how the passive congestions which so frequently occur in scorbutic individuals are successfully treated by the local and general employment of tonics.

In the several cases just enumerated, the appearance of the congestion, the circumstances attendant on its formation, but more especially the nature of the therapeutic agents found most efficacious in removing it, lead us to conclude that the hyperæmia was not the result of irritation. We will assume, then, as an established fact, that asthenic hyperæmias may be formed in those parts of the body situated externally; which

constitutes a strong presumption in favour of the possibility of their formation in the organs situated internally. Let us examine how far this supposition is supported by observation.

I shall commence with the lungs, which, as is well known, receive and transmit through their capillaries (for the purpose of aeration) the whole mass of blood which is subsequently distributed to the different parts of the body. Perhaps there is no one organ in the animal œconomy, which is so frequently affected with active hyperæmia in its different forms and degrees ; but this viscus is likewise susceptible of other forms of congestion, the asthenic nature of which appears to me satisfactorily established. In the first place, I presume that few persons will refuse to admit as an instance of asthenic hyperæmia, those sanguineous congestions of the pulmonary parenchyma which so constantly occur during the last moments of existence. It is evident that, in such cases, the blood driven into the ultimate branches of the pulmonary artery, or into the minute ramifications of the pulmonary veins, no longer receives from these vessels the impulse which should propel it onwards to the left side of the heart ; the lungs become in consequence gorged with blood, just as in those animals in which the eighth pair of nerves has been divided, or in persons labouring

under an apoplectic fit. In all these cases the activity of the capillary circulation is diminished, in consequence of the diminished energy of the nervous influence ; and yet the morbid appearances found on dissection are precisely the same as are presented after inflammation ; namely, a great accumulation of blood in the vessels, and in the small bronchial tubes a quantity of serous fluid mechanically filtered from the blood. We should learn from this example not to place too implicit reliance on the anatomical characters of a morbid lesion, as a criterion for deciding the nature of the disease.

But this passive congestion of the lung is not confined to the last moments of the mortal agony. Can we not, for instance, detect its existence in certain cases of convalescence from acute pneumonia, in which a slight degree of dyspnœa remains, and a "*râle crepitant*" continues audible, although the thorax has resumed its natural sound on percussion ? No doubt these symptoms often depend on a trace of the original inflammation still lurking in the part, and not yet subdued ; but I have also seen similar cases, in which the pulmonary congestion continued for a length of time stationary, notwithstanding the employment of antiphlogistics and revulsives, and yet yielded immediately to the use of

tonics, such as the decoction of polygala or cinchona.

Is it not reasonable to conclude that those substances, when absorbed and carried into the circulation, produced the resolution of the pulmonary congestion, either by directly stimulating the coats of the pulmonary vessels in their passage through them, or else by exciting the centres of the nervous system, and restoring their natural influence over the lung and its circulation? If it has been proved that the asthenic may take the place of the sthenic hyperæmia, when affecting the conjunctiva or the skin, why may not the same changes take place in the mucous membrane of the lungs? The success of the tonic treatment in both cases argues strongly in favour of this supposition.

At a certain period of long protracted diseases, when the patients lie constantly on their backs, even though the lungs may have presented no previous symptom of disease, the pulmonary circulation becomes impeded, and the lung itself more or less congested, and after death is found gorged with blood and serum. I do not think that this congestion, which has been aptly termed by M. Lerminier the obstruction from position, (*engouement de position*) can reasonably be attributed to any process of irritation; it is, in fact, an asthenic hyperæmia pre-

cisely similar to that, which, in individuals ex-
hausted by protracted illness, is produced in
any part of the skin that happens to be placed
in a dependent position. If we suppose the
part to be maintained in this position, the
weakened capillaries will no longer act with
sufficient energy to overcome the force of gravity
of the blood, will gradually yield to the dilating
force of their contents, and will ultimately be
converted into mere passive tubes, which will
discharge only that portion of their contents
which they cannot retain.

I am also disposed to think that in some
other conditions of the œconomy, such as severe
scorbutic affections, the lungs may be passively
congested as well as the gums and certain por-
tions of the cutaneous surface. This at least I
am sure of, that in four cases of severe scurvy,
two of whom I attended at the Hopital des
Enfans, a third at La Charité, and the fourth
in private, all of whom were affected with con-
stant dyspnœa unattended with other symptoms
of pulmonary disease, I found, at the *post mor-
tem* examinations, the lungs not altered in tex-
ture, but gorged with an enormous quantity of
blood, remarkable for its extreme tenuity and
bright rose colour, and presenting the appear-
ance of water slightly tinged with red. A fluid
precisely similar in appearance was effused into

the cavities of the different articulations ; the spleen and liver were also filled with it : in two of these cases several ecchymoses were found between the tunics of the alimentary canal, and in all of them several patches of the subcutaneous and intermuscular cellular tissue, as well as of the skin itself, were infiltrated with blood.

Have we not, again, instances of asthenic hyperæmia affecting the mucous membrane of the bronchia, in persons labouring under chronic catarrh, whose symptoms are relieved or altogether removed by the use of tonic medicines? On the contrary, in those individuals labouring under the same disease, whose catarrhal symptoms, however chronic, are uniformly aggravated by the use of stimulants, the sthenic character of the original hyperæmia would seem to be still preserved.

If, then, direct proofs, and powerful analogies, coincide to prove the existence of asthenic hyperæmia in the interior as well as on the surface of the body, whether existing as a primary affection, or as consecutive to sthenic hyperæmia, we cannot reasonably withhold our assent from the proposition, that several of the red patches found after death in the mucous membrane of the stomach and intestines, are simply the result of passive congestions formed during the life of the individual.

Thus we find that in every organ two species of hyperæmia may occur, (we have not yet taken into consideration a third species, namely, the mechanical ;) the one *active* or *sthenic*, produced by the increased afflux and accumulation of blood caused by some irritation ; the other *passive* or *asthenic*, the result of the diminished tone of the capillary vessels, which no longer possess the force requisite for propelling the blood as fast as they receive it. It sometimes happens that the blood remains accumulated in an organ, long after the irritation which first produced its afflux and accumulation, has subsided. This, which is a case of consecutive asthenic hyperæmia, seems to depend principally, if not entirely, on the permanent dilatation of the capillary vessels. The sthenic hyperæmia is one of the degrees of what is generally termed inflammation ; one of the elements of that complex phenomenon. The asthenic hyperæmia is essentially different both in its nature and in the causes which produce it, and comes nearer that state of parts which was long designated by the term *asthenic inflammation*. The origin of this expression may be traced to the fact long since observed, that certain morbid states were most successfully treated by stimulants, whilst others, precisely similar in their anatomical characters, could only be subdued

by the employment of antiphlogistics properly so called. The expression should now no longer be retained, for the words *asthenic inflammation* imply a manifest contradiction of terms.

ARTICLE III.

Mechanical Hyperæmia.

THIS term may be applied to the sanguineous congestion formed during life, wherever an impediment to the free course of the venous circulation presents a mechanical obstacle to the return of the blood from the capillaries towards the heart.

The principal causes which produce mechanical hyperæmia are as follow:

1. Simple gravitation, when exerted in parts which are not naturally subjected to it, and are consequently less prepared to resist its influence. Thus, the face quickly becomes congested when the head is held for some time in the dependent position. This cause produces hyperæmia more promptly, if the circulating forces have been previously debilitated, as has already been explained in the preceding article. In such cases the hyperæmia may continue after the mechanical cause, which first produced it, has ceased to operate.

2. A defect of proportion between the respective capacities of the cavities of the heart, or even a simple alteration in their natural dimensions. In this case the blood, brought by the venæ cavæ or by the pulmonary veins to the central organ of the circulation, encounters an obstacle to its entrance, and consequently tends to stagnate in the large venous trunks which communicate with the heart; next, in the lesser veins which by their union form these trunks; and, lastly, in the different capillary networks. The parts most abundantly supplied with blood-vessels, such as the lungs, liver, digestive canal, and certain portions of the skin, especially of the face, are in such cases most liable to congestion. It is scarcely necessary to remark that this hyperæmia must exist simultaneously in several organs, and that all the capillaries of the body may be more or less over-distended.

3. The compression or obliteration of a venous trunk. This necessarily produces congestion of the capillary vessels which pour their blood into this vessel, whenever this circulation is not carried on by collateral branches. Thus the application of a ligature round the trunk of the vena portæ necessarily produces congestion of the mucous membrane of the intestines.

4. Any obstacle to the passage of the blood through the capillary vessels which are formed

by the subdivision of a trunk carrying venous blood. Such, for instance, are the capillaries in the liver resulting from the subdivision of the vena portæ, and in the lungs from the ramifications of the pulmonary artery. Accordingly, we observe the mechanical congestion of all those parts which return their venous blood by the vena portæ, whenever an obstacle to the circulation exists in the parenchyma of the liver; and hence, in like manner, proceeds the general hyperæmia of the whole body, which follows the sudden interruption of the pulmonary circulation, as is exemplified in all cases of death from asphyxia. In such instances the face is swollen and livid, the eyes as if starting from their orbits, the lips purple, the tongue tumid and projecting from the mouth, and the whole cutaneous system injected with dark venous blood, and presenting a mottled appearance. When the body is examined, the lungs are found gorged with blood, as are also the right auricle and ventricle, as well as the whole venous system; whilst the left side of the heart and the arteries are remarkably empty. When, however, the pulmonary circulation is gradually and slowly obstructed, the sanguineous congestion which results, is by no means so great as when the obstacle is suddenly formed; the cause of which appears to be, that

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in proportion as the lungs gradually admit a less quantity of blood to circulate through them, the absolute quantity of blood in the whole system is also diminished, the sanguification becoming constantly more and more imperfect; this is strikingly illustrated in pulmonary consumption.

Mechanical hyperæmia produces in the parts where it exists, several anatomical alterations, which may be referred to the three following classes : 1, changes of colour; 2, morbid exhalations ; 3, modifications of the size and consistence of the part affected.

The alteration of colour which accompanies every mechanical hyperæmia, results exclusively from the accumulation of blood in the capillary vessels, and may be either bright red, violet, or brown, more or less deep in shade. In the first stage of this affection, the congestion is confined to the veins of considerable calibie; the transparency of the tissues is not affected, nor is their natural whiteness altered, except where those veins apparently varicose are distributed. In a second stage, veins of a less calibre become congested, and if the tissue affected be membranous, several minute vessels are observed ramifying in an arborescent form on its surface ; if the seat of the hyperæmia be a parenchymatous organ, an unusual quantity of blood issues from

the part when pressed, or simply divided. Thus, in such a case, the brain, when sliced, presents numerous red points, which are nothing else than the divided orifices of the congested vessels ; while a section of the liver presents an uniform red appearance, &c. Lastly, in several parts of the cellular tissue, which is interposed between the different organs or parts of the same organ, a number of minute vessels filled with blood are seen ramifying in every direction ; in such cases, the cellular sheath of the arteries is sometimes beautifully injected, and the vasa vasorum admirably displayed. In a third degree, the most minute vessels become injected, and are so distended that they appear literally to touch and crowd each other ; the tissue thus mechanically congested presents an uniform red, brown, or even black colour.

When the mechanical hyperæmia is carried to a certain extent, other phenomena may arise as its consequence. Thus, the serous portion of the blood, or even pure blood, may escape from the over-distended vessels, just as water or any other liquid transudes through the permeable sides of a vessel in which it suffers compression. To this source are to be referred several hæmorrhages and dropsies produced by simple transudation in a tissue mechanically congested ; and although these effusions have really nothing

active in their nature, yet are they considerably
diminished, and sometimes altogether removed,
by blood-letting, which in such cases acts in a
manner purely mechanical, by removing from
the vessels the fluid by which their parietes
were kept in a state of over-distention. These
pathological observations are well exemplified
in the majority of those cases of hæmoptysis,
hæmatemesis, ascites and other effusions, which
are connected with organic disease of the heart.

An increase in the volume of the part af-
fected with mechanical hyperæmia is a necessary
consequence of the great quantity of blood with
which its vessels are distended ; hence the mere
circumstance of a membrane being thicker than
natural is not sufficient to establish the existence
of inflammation. In like manner, a tissue mecha-
nically congested may lose its natural consist-
ence, and become more or less friable ; whence
we are led to conclude that neither the soften-
ing of a tissue, nor its increased thickness, can
be admitted as unequivocal marks of inflamma-
tion. This remark is particularly applicable to
the lungs, which always offer a less degree of re-
sistance to the finger in those points where they
are gorged with blood (generally their posterior
part) than where their texture retains its natu-
ral appearance. The mode in which the lung
when congested becomes more friable, may be

easily explained. When this viscus, as in its natural state, contains much air and little blood, the air, an elastic fluid, being easily compressible, readily escapes from under the finger, and with it, the portion of solid tissue which invests it; but when, in place of an elastic compressible fluid, the pulmonary parenchyma contains only an incompressible liquid, such as the blood, it can no longer glide from under the finger, and being pressed between two forces, it yields, and is broken down.

It now remains to consider whether we can, by any well-defined anatomical characters, distinguish in the dead body the mechanical hyperæmia from the two other species which have been previously considered. From what has been said in the preceding part of this article, it will at once be seen, that such a distinction is oftentimes impossible; the arborescent appearance of the vessels, and the uniform red colour being common to all the species of hyperæmia. On the other hand, the injection of the larger venous trunks belongs more exclusively to mechanical hyperæmia. But in order to distinguish this species from the others, we must in general attend less to the appearance of the part congested, than to other circumstances; such as the kind of death which the individual has died, the nature of the preceding disease, and the

state in which the other organs of the body are found. Thus, it will be advisable to examine whether the large veins which bring back the blood from the part congested are filled with blood or empty ; whether the cellular tissue in different parts of the body, and especially that which invests the arteries is injected ; whether the parenchymatous, as well as membranous tissues which are most disposed to congestion, are gorged with blood ; and lastly, whether the right and left cavities of the heart, and the large blood-vessels which communicate with them are in a state of emptiness or otherwise. By uniting all these methods of investigation, we shall in some cases be enabled to decide with certainty ; in other cases we shall attain only to a greater or less degree of probability ; whilst in others we must be contented to doubt. When treating of each organ in particular, I shall detail more fully the peculiar appearances which may enable us to distinguish between the mechanical, the sthenic, and the asthenic, forms of hyperæmia.

ARTICLE IV.

Hyperæmia formed after Death.

WE have already seen in the preceding article, how different parts of the body may present

a red colour and congested appearance, in consequence of some mechanical obstacle to the venous circulation, occurring during the life of the individual: it now remains for us to see, that after death, the same appearances and the same varieties of colour may be produced, by the influence of those physical and chemical laws, whose action, suspended, or modified by the powers of life, is quickly restored when the counteracting force of vitality ceases to oppose it.

That sanguineous congestions are really formed after death on the surface of the body, may be proved to demonstration; the several steps of their formation may be traced, and the causes which favour their production appreciated. On the bodies of almost all persons dying of acute diseases, and whose vascular system at the time of death was filled with blood, the skin which covers the most dependent parts, especially the back, and the calves of the legs, will be found to present an uniform livid red colour, disposed in stripes or patches. In other bodies is observed another kind of coloration, which is not confined to the dependent parts of the body, but appears on the arms, thighs, thorax, and abdomen, in the form of red streaks which sometimes run parallel, and sometimes intersect each other in different directions. If

portions of skin thus coloured be dissected, the following appearances are presented. 1. In the dependent parts, the dermoid tissue is filled with blood ; its adherent surface is lined with a net-work of veins ; the adipose tissue which fills its areolæ is stained red ; and in the subcutaneous cellular tissue small patches of ecchymosis are observed, and large veins are seen ramifying, distended with a dark brown or black blood : this disposition of the subcutaneous vessels is most remarkable under the occipital portion of the scalp. 2. In those parts of the skin which, though not dependent, present a streaked red appearance, these streaks will be found to follow the course of the veins, and seem produced by a true sanguineous suffusion into the dermoid tissue, a suffusion which appears to result after death from the transudation of the blood through the parietes of its vessels.

But if sanguineous congestions can be thus formed after death in the cutaneous surface, analogy would lead us to suppose, *a fortiori*, that similar congestions may be formed in those tissues which are situated in the interior ; for in the last moments of life the blood flies from the surface, and accumulates in the internal organs. In those organs therefore we should, *a priori*, expect that sanguineous congestions would be formed after death, not only when the mass of

blood is considerable at the moment of dissolu-
tion, but even after protracted chronic affections,
when even the small quantity of blood which
remains in the system, is almost wholly accu-
mulated in the capillaries of the internal organs.
Observation confirms the justice of this reason-
ing ; for if the body of an animal be opened im-
mediately after death, and the state of the organs
as regards their colour and the disposition of
the blood, be at the time carefully noted, and if
those same organs be again examined at succes-
sive intervals, the blood will be found to accu-
mulate gradually in different parts, which imme-
diately after death contained no more than the
rest ; parts naturally white will turn red ; vessels
will become visible where not a trace of vascula-
rity could be previously observed ; there will be
developed a coloration of a uniform red tint,
disposed in isolated spots, long stripes, or broad
patches ; the blood will be seen escaping from
its vessels, and forming more or less extensive
effusions around them, or else soaking through
the neighbouring tissues and imparting its colour
to them ; and, lastly, the colouring matter of the
blood will be seen uniting, in the different serous
cavities, and in several points of the cellular
tissue, with the colourless albuminous fluid
which had been previously effused, or else seen
transuding through the tunics of the vessels

with the serum, if this fluid had not been previously effused separately. At last, when the body, no longer endowed with life, begins to decompose under the influence of those laws which govern all inert matter, various gases are disengaged, which, traversing the coats of the minute vessels, impart an unusual colour to the blood, just as they are found to do in the case of the experiment where they act on this fluid through the coats of the bladder in which it is contained. In this manner are produced the different brown, livid, and greenish hues observable on bodies undergoing putrefaction. The concave surface of the liver is generally the first part to present this appearance, in consequence of its vicinity to the transverse arch of the colon, which usually contains a large quantity of those gases, and also in consequence of the vast proportion of blood contained after death in the capillaries of the liver, which is thus placed in the most favourable circumstances to undergo these chemical alterations : it is not until after the liver and adjacent parts are thus coloured, that the abdominal muscles and subsequently the integuments present the same appearances. Theory might easily have led us to anticipate these results of observation.

In summing up the causes which are capable of producing hyperæmia after death, we are

led to recognise several genera and species, which may be arranged as follows :

First Genus.—Hyperæmia produced at the moment of death.—Cause : the contractility of tissue which resides in the small arteries continuing to act after the heart has ceased to beat.

Second Genus.—Hyperæmia produced at a certain period after death ; this genus comprehends the following species :

First Species.—Hyperæmia by hypostasis, or dependent position.

Second Species.—Hyperæmia by transudation of the blood, or of some of its component parts, through the parietes of its vessels.

Third Species.—Hyperæmia by chemical affinities.

I shall enter into some details respecting each of these genera and species.

First Genus.

Hyperæmia produced at the Moment of Death.

We generally date the moment of death from the time when the respiration and action of the heart cease to be performed. After that period, however, the contractility of the arteries still survives for a certain time, and, by virtue of this contractility, the arteries propel the blood they contain onwards towards the capillary system, in which it must consequently accumulate,

as no force then exists whereby the capillaries may be enabled to propel their contents into the veins. Hence it arises, that the different capillary networks are uniformly found in a state of congestion in the bodies of those persons who die with much blood in their system. These congestions will of course vary considerably according to the quantity of blood, and also according to the manner in which the circulation was finally interrupted; whether in both sides of the heart, in the large venous and arterial trunks, in the capillaries of the lungs, or in those of other parts of the body. There is often a strong analogy between certain asthenic hyperæmias which are formed while the heart still continues to beat, and this cadaveric hyperæmia formed at the moment when the visible phenomena of life cease to exist.

Second Genus.

Hyperæmia produced at a certain Period after Death.

In whatever position the body is placed after death, the blood quickly passes from the more elevated to the most dependent parts of the different organs. By taking advantage of this circumstance, we can at pleasure produce the red congested appearance of the lung in either its posterior, lateral, or anterior surface, by laying the body immediately after death on its

back, side, or face ; we can in like manner give to different coils of the intestines a red vascular appearance, by simply suffering them to hang in a more dependent position than the adjoining parts, and retaining them for some time in this position. The parts which most frequently present this hypostatic congestion are, on the exterior, (as we have already seen,) the skin of the occiput and of the back; and, internally, that part of the membranes of the brain, which corresponds to the occipital region, and its continuation which lines the posterior part of the spinal canal ; the lobes of the cerebellum, and the posterior part of those of the cerebrum ; the portion of the lungs situated posteriorly at each side of the spine in the concave surface of the ribs ; the most dependent portion of the stomach, (supposing the body to be lying on its back,) and those folds of the intestines which are likewise the most dependent, and towards which the blood must consequently gravitate from the neighbouring intestinal folds and from the mesentery. All these parts may present every shade of redness, from the slightest blush produced by the injection of a few minute vessels, to the uniform deep red colour which results from the most intense congestion.

Besides the hyperæmia by hypostasis, there is yet another species formed after death, which results from the transudation of the blood or

some of its constituent parts through the coats of the vessels.

So long as life continues, the fluids contained in the several cavities cannot escape through the membranous parietes of these cavities ; but this impermeability does not depend on their texture or organization, so much as on the vital forces by which they are animated ; for when these forces cease to exist, the membranes become permeable to different substances which they contained during life.   This fact is exemplified by the escape of different gases through the parietes of the colon, which announce their presence in several of the surrounding parts, by the colours which they produce on entering into combination with the blood of those parts. The bile also transudes through the gall bladder, and stains the adjacent tissues. Can the blood in like manner pass through the parietes of the arteries and veins ? The following experiment seems favourable to this supposition. Introduce some prussiate of potash into a vein or artery in a dead body, and on the outside of the vessel deposit some sulphate of iron ; in a short time the external surface of the vessel will present a blue colour, thus proving the transudation of the salt of potash through the coats of the vessel.   Why should not these tunics be equally permeable to the blood ?   Indeed the

recent experiments of M. Dutrochet have established, as a constant fact, the transudation of liquids through their membranous parietes.

The cadaveric transudation of the blood through the coats of the vessels, produces three phenomena: 1. When the blood arrives at the external surface of the vessel, it soaks through the adjacent tissues, and dyes them of its own colour, just as the bile tinges those parts which immediately surround the gall bladder. 2. The blood is effused into the surrounding cellular tissue in the form of red spots of different dimensions: these ecchymosed spots are frequently found on the internal surface of the scalp, and in the great cul-de-sac of the stomach, where they are distributed along the course of the blood vessels. 3. The blood thus transuded may form collections of a red fluid in the different serous membranes: indeed, in almost every body opened at about six-and-thirty hours after death, these reddish effusions are found in the cerebral and spinal arachnoid, as well as in the pleura, pericardium and peritoneum. It does not appear that the blood which thus transudes through the coats of its vessels, necessarily retains all its component parts; for if so, it would coagulate in the cellular tissue, and in the serous cavities into which it is effused: the fact is, that the serum and colouring matter pass

through the vessels, whilst the fibrine remains behind either fluid or coagulated.

Various circumstances influence the transudation of the blood or of its elements, through the parietes of the blood-vessels ; of these some relate to the state of the blood itself, others to the state of the vascular parietes. There are certain diseases in which the blood retains a remarkable fluidity after death, and seems as if its particles no longer possessed their natural force of aggregation : in such cases the blood must necessarily have a greater tendency to escape through the coats of its vessels. On the other hand, great thickness of the coats of the vessels presents an obstacle to the escape of their contents; accordingly we seldom observe traces of transudation in the neighbourhood of the large veins or arteries. This transudation becomes more abundant, as the coats of the vessels are further advanced in the state of putrefactive decomposition. But, as the rapidity of putrefaction is extremely variable, it follows that, in some cases, no trace of transudation from this cause can be observed at the expiration of twenty-four hours, whilst in others it commences much sooner. The rapidity with which this hyperæmia by transudation is formed, will also be found to vary materially, as the body has been kept in a dry or moist place, or at a high

or low temperature. For instance, traces of this transudation are almost uniformly found in the mucous membrane of the intestines and elsewhere, in those bodies which are examined in private houses, where they are generally kept at a much higher temperature than in the theatres attached to hospitals. It is evident that these circumstances can only influence the extent and rapidity of the transudation, by accelerating the putrefactive process, and perhaps also by contributing to maintain the blood in a fluid state.

Lastly, as the time elapsed since death increases, various chemical affinities come into action, and produce certain *appearances* of hyperæmia. Thus, if a portion of lung or intestine be exposed to the atmosphere, although at the time of its exposure it presents little or no appearance of vascularity, a short time will suffice to produce in it a bright scarlet appearance, evidently resulting from the oxygenation of its blood, which, being more highly coloured, appears more abundant. If, instead of atmospheric air, other gases be employed, such for instance as are generated in the body during the process of putrefaction, the parts exposed to their influence soon present another series of colours. Thus, the internal surface of the intestines exhibits a livid or greenish cast which may pervade all the intestinal coats; the lung assumes a

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greenish or black colour, and, on incision, a brownish liquid flows out, which in its sensible qualities resembles putrefied blood; and its tissue becomes at the same time friable and easily broken down. This state of the organ has often been mistaken for gangrenous inflammation, whilst in reality it is simply an effect of incipient putrefaction, which it is by no means rare to observe, during the great heats of summer, even at a short period after death.

I shall merely allude at present (as on a future occasion I shall enter into more minute details on the subject) to the uniform red tinge which the internal coats of arteries often present, and which, in many cases at least, is produced by the combination of the colouring part of the blood with the membrane which it bathes.*

Such are the different forms of hyperæmia formed either during life, or after death, the existence of which appears to me fully established by a strict and impartial observation of facts; and, if it be true, as I have endeavoured to prove, that these several varieties cannot always be distinguished by well defined anatomical characters, it is evident that simple inspection cannot in all cases enable us to decide as to the

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* See on this subject, in the 2nd Vol. the chapter which treats of the diseases of the sanguiferous system.

nature of the cause which may have produced those sanguineous congestions that are found on dissection.

There is one phenomenon which is liable to succeed to all these species of hyperæmia, namely, the escape of the blood from its vessels, and its effusion, either on the free surface of the membranes, into the areolæ of the cellular tissue, or into the parenchymatous texture of the different organs, where it causes by its deposition a certain disorganization. No doubt can now be entertained that hæmorrhage may follow those hyperæmias which are produced by a mechanical cause. Several years have elapsed since Boerhaave saw hæmorrhage from the intestines produced by the application of a ligature round the vena portæ of a living animal; and it is highly probable that certain hæmoptyses which occur in individuals labouring under aneurism of the heart, proceed altogether from the mechanical obstacle which is thus presented to the pulmonary circulation. The blood likewise escapes from its vessels, in those hyperæmias which are formed after death, especially in those varieties which are caused by transudation and by hypostasis. M. M. Rigot and Trousseau have frequently seen the blood exude from the internal surface of a coil of intestine which was suspended in a dependent position. In the article,

which has been dedicated to the description of asthenic hyperæmia, we have seen that hæmorrhage may result from this species also, and that the hæmorrhage in this case, as well as the hyperæmia which produced it, is asthenic or passive. Lastly, hæmorrhage may almost be considered as one of the natural terminations of active hyperæmia, so frequently are they combined. It is difficult to assign a reason, why two sthenic hyperæmias apparently similar in intensity and duration, shall nevertheless present this remarkable difference, that in one the blood shall escape from its vessels, whilst in the other there shall be no appearance of hæmorrhage whatever. All that we know upon the subject may be summed up as follows :—

1. There are some cases in which the ordinary signs of sanguineous congestion no sooner make their appearance, than the blood which flows to the organ affected escapes from its vessels, and hæmorrhage ensues. The signs of congestion cease as the blood flows, and the general health is in no way deranged, provided the hæmorrhage occurs in an organ of minor importance, or that it be the result of a natural process, such as the menstrual discharge. If, however, the organ be one whose functions cannot be deranged with impunity, the general health will suffer a proportionate derangement, as in the

case of apoplexy, or hæmoptysis. In the latter disease, however, the health may be re-established, provided the whole quantity of the blood effused be spit up ; but if the blood be only partially thrown up, or if it all remain effused into the pulmonary parenchyma, the derangement of the general health will be permanent ; as is exemplified in cases of extensive pulmonary apoplexy. When the bodies of persons dying during an attack of hæmorrhage are examined, the organs from which the blood was effused are sometimes found red and congested, whilst in other cases they are remarkably pale, and, with the exception of the blood effused, present no morbid alteration whatever. Such for instance is the appearance often presented in cases of hæmorrhage from the brain, bronchia, stomach and intestines. This pale state of the bleeding tissues cannot be admitted as proof that no congestion had existed either before or during the hæmorrhage ; all that it establishes is the simultaneousness of the afflux of blood to the tissue, and of its escape from its vessels.

2. Blood may for some time continue to accumulate in the vessels of a tissue, without making its escape ; and in consequence of this accumulation, gives rise to various functional and organic derangements ; but the hæmorrhage does not commence until a later period, when

all the symptoms of inflammation have been fully developed. In all such cases the quantity of blood effused is never so great as in the ordinary forms of hæmorrhage, as will readily appear by instituting a comparison between pneumonia and hæmoptysis, dysentery and me-læna, &c.

3. When an organ has been irritated, the blood which flows thither in consequence of that irritation, may at first escape from its ves-sels in large quantities, and subsequently cease to be effused; and it is at this latter period when the hæmorrhage ceases, that the most formida-ble symptoms generally occur. In such cases the hyperæmia has only changed its form, but still persists; sometimes assuming an acute type, and advancing rapidly towards its termination, whether favourable or fatal; sometimes, also, retaining a latent chronic character, and laying the foundation of various alterations of nutrition in the organ where it exists. Thus hæmoptysis is sometimes transformed into pneumonia, hæ-matemesis into gastritis, menorrhagia into me-tritis, &c.; thus also these hæmorrhages, after recurring frequently, and leaving some trace of hyperæmia after them at each visit, lay the foundation for the development of tubercles, in the lungs, and of that degeneration termed can-cer, in the stomach and uterus.

4. We have just seen that hæmorrhage is in some cases the source from which various chronic alterations of nutrition derive their origin ; it is in others evidently the effect of some of these alterations of nutrition ; such for instance as induration, ulceration, accidental productions, &c.; around which, congestions, possessing a peculiar tendency to terminate by hæmorrhage, are frequently formed.

5. There are some active hyperæmias, which, whether existing simply, or combined with other organic derangements, have never been accompanied with the slightest extravasation of blood, either at their commencement, during their progress, or at their final termination.

6. Morbid anatomy does not afford any distinctive characters between the *post mortem* appearances, presented by those cases which were attended with hæmorrhage, and those which were not.

We know not what the peculiar modification is, which the texture of an organ undergoes, so that in one case it allows the blood determined towards it to escape from its vessels; in another forms pus, or exhales only a thin serum ; whilst in a third it becomes indurated, softened, or ulcerated : but there is one common link which unites these different altera-

tions, and hence it is, that under the influence of apparently the same causes, we often see them produced indifferently, and not unfrequently replaced one by the other. Thus an attack of coryza may be ushered in by epistaxis, which may be succeeded, first by a total cessation of secretion from the affected membrane, next by a serous exhalation, and subsequently by a puriform exhalation, which in its turn may be succeeded by a return of the epistaxis, with which the disease first commenced, and by which it terminates. But in all this series of phenomena we can perceive, throughout the whole course of the irritation, one constant lesion, namely, the hyperæmia; and a succession of morbid alterations in the organic action of the tissue affected, producing alternately, hæmorrhage, cessation of all secretion, exhalation of serum, and of pus, and, lastly, a recurrence of the hæmorrhage. I might also adduce here the well known fact, that in many cases of inflammation of serous membranes, which present no perceptible difference either in their nature, duration, or intensity, pure blood is sometimes found effused, sometimes a simple albuminous fluid, and sometimes perhaps false membranes, &c.

Thus from the observation of symptoms, as well as from the inspection of the part from which the blood flows, (which can be made in

cases of cutaneous hæmorrhage) we arrive at this conclusion, that *active* hæmorrhage is uniformly preceded by the sanguineous congestion of the organ or tissue affected. But are we hence authorized to conclude that every species of hæmorrhage depends on increased vascular action? In my opinion, certainly not; for we can easily understand how certain hæmorrhages may depend exclusively on some modification of the organic disposition of the coats of the vessels, in consequence of which they may allow the blood to escape. Such a modification surely may exist without depending more on a sthenic, than an asthenic state of the vessels: indeed this fact appears to me abundantly proved by those cases of hæmorrhage which yield to the application of astringents, after blood-letting and other anti-phlogistic measures have been repeatedly employed in vain.

There are other cases again, in which the hæmorrhage cannot properly be referred to either the sthenic or asthenic hyperæmia, nor yet to any peculiar modification in the texture of the vascular parietes; but is evidently dependant on some peculiar state of the blood itself. To this cause may be attributed the sanguineous effusions which occur in the following cases. 1. After profuse hæmorrhages. I recollect a case, in which, after a violent attack of epistaxis,

small extravasations of blood appeared all over the cutaneous system, and subsequently disappeared as a fresh supply of blood was generated in the system. 2. Towards the termination of chronic diseases which reduce the system to an extreme state of debility, and by which the blood is diminished in quantity, and in its quality altered to a thin serous fluid. 3. In other individuals with whom this general debility and this watery state of blood are constitutional. 4. In scorbutic persons. In all these cases it seems as if the blood, deprived of its natural degree of consistence, could more easily transude through the coats of its vessels. On a future occasion I shall revert to this subject, and shall then enter more minutely into particulars.

CHAPTER II.

Anæmia.

THIS state is precisely the reverse of that which I have described under the name of hyperæmia. An organ affected with anæmia contains a less quantity of blood than should circulate through it in its natural healthy state. The anæmia is *incomplete* if the organ only receives a

less quantity of blood than natural ; it is *complete*
when the organ receives no blood at all : this
latter case is much more rare than the preced-
ing. Anæmia, like hyperæmia, may be either
local or general. We shall first consider the
local affection.

ARTICLE I.

Local Anæmia.

THE circumstances under which anæmia
of an organ is most frequently observed, and
which seem in a greater or less degree to favour
its production, are the following :

1. A diminution in the calibre of the artery
which conveys the blood to the organ affected.
However, in estimating the degree of importance
which should be attached to this cause, we
should recollect that it is by no means established,
that the diminution in the size of the artery in
all cases precedes the anæmia ; on the contrary,
it seems just as reasonable to suppose, that the
capacity of the artery diminishes in conse-
quence of the organ to which it is distributed
having itself a tendency to atrophy, and conse-

quently requiring a less supply of blood for its nutrition.

2. Certain modifications of the nervous influence which so materially affects the greater number of organic phenomena. Thus, under the influence of a strong mental emotion, the blood suddenly flies from the cutaneous capillary vessels of the face, or of the whole surface of the body; and what is well worthy of attention is, that the very same impression which in one individual causes the blood to recede from the surface, will, in another, cause it to rush with impetuosity into the superficial vessels : accordingly we have all observed that a deadly paleness or a crimson flush may indifferently succeed to an access of passion or a strong emotion of terror.

These phenomena, trivial as they may appear, are nevertheless deserving of our attention for the light which they throw on the interpretation of certain phenomena that occur in other and more important organs under the influence of the same causes. Why, for instance, may we not suppose that, under the influence of similar causes, the stomach may blush like the skin, or like it, turn pale ? In these cases the anæmia is only momentary; but if the nervous cause which has once produced it be often repeated, this state of anæmia may become habitual, and

thus produce, for instance, the pale complexions so frequently observed in men whose minds are constantly engaged, who are tormented by violent and agitating passions, or who are of what is generally termed a nervous temperament, even though no organ be deranged in its structure or function.

3. The hyperæmia of one organ sometimes produces the anæmia of another, or others. In a great number of cases, as we have seen in the first chapter, when a hyperæmia has formed in any one point of the system, it has a constant tendency to extend itself to other parts ; there are, however, other cases in which at the same time that the blood flows towards one organ, and accumulates there, it abandons other parts, and leaves them in a condition comparatively exsangueous, which may be either temporary or permanent. A sort of balance of hyperæmia and anæmia (if I may use the expression) is thus established between the the organs. On the surface of the body, the skin furnishes us with frequent examples of this ; and in the interior, dissection shews a similar state of parts : for example, the brain, in one case is congested, and in another remarkably exsangueous, at the same time that some other organ is affected with a greater or less degree of hyperæmia. In many cases of acute perito-

nitis, the mucous membrane of the intestines is remarkably pale.

4. An antecedent state of hyperæmia in the same organ which at present suffers from anæmia.

5. There are some cases, in which none of the circumstances here enumerated, nor indeed any other appreciable cause, can be discovered, and yet the post-mortem examination exhibits such an extraordinary state of anæmia in one or more organs, that not a single drop of blood can be discovered in their minute vessels, or even made to appear by pressure, incision or laceration. However, as the organs, even in this bloodless state, must have necessarily continued to receive some nutritive fluid, it is highly probable that the blood circulated in their capillary vessels, not indeed in its natural condition, but deprived of its colouring matter; thus assimilating these organs (as regards their circulation) to certain tissues which are naturally supplied with colourless blood, just in the same manner, I conceive, as all the organs are nourished in white-blooded animals. In the course of this treatise we shall have frequent occasion to remark, that the diseased state of an organ in the human body, is the physiological and healthy condition of the same organ in other animals. The parts in which I have particularly observed this extreme degree

of anæmia are, the brain, heart, liver, stomach and other portions of the alimentary canal, and certain muscles of animal life.

An organ affected with anæmia may present no other alteration than a change of colour, being pale and perfectly exsangueous; this change may, however, be complicated with other morbid lesions. Thus, its volume may be diminished; indeed it is evident that the activity of its nutrition must decrease when it no longer receives its natural supply of blood. Its consistence may likewise undergo some modification; we learn from observation that the bloodless state of a tissue or organ frequently coincides with its softening. At the same time that certain membranous tissues, such as the serous, mucous, and cutaneous, are in this exsangueous condition, the extraordinary activity of their secretions often presents a striking contrast to the small quantity of blood which they continue to receive. These facts may serve to convince us that all alterations of secretion or nutrition do not necessarily infer the existence of sanguineous congestion in their respective organs.

When the supply of blood to an organ is suddenly interrupted, as occurs when its artery is at once obliterated, (by compression, ligature, or other mechanical means, such as in M. Cruveilhier's experiments of injecting quicksilver,

&c.,) if the circulation be not quickly re-established by some collateral branches, the organ, deprived of the blood which should support it, speedily becomes gangrenous, and dies. Here then we have an example of the same effect, gangrene, produced by three different and apparently opposite causes. 1. By a mechanical obstacle to the arrival of blood, (anæmia from the sudden obliteration of an artery.) 2. By an unusual afflux of blood, (an advanced stage of active hyperæmia.) 3. By the stagnation of blood in the capillary vessels, (various degrees of asthenic hyperæmia.) In all these cases however, though apparently so different, the cause which determines the gangrene is really the same ; namely, the absence of arterial blood, whether its arrival be obstructed by a ligature applied round the trunk of the artery, or by the stagnation of the blood already in the minute capillary vessels.

Of the functional derangements which result from the anæmia of an organ, some are peculiar to this affection, and may consequently enable us to recognise its existence during life ; whilst others, both local and general, are precisely similar to those produced by hyperæmia of the same organ. Thus, convulsions, delirium, and a thousand other nervous symptoms, may be produced indifferently by the brain receiving either a

greater or a less supply of blood than natural ; and thus also the same disorders of digestion may result from hyperæmia of the stomach, or from the diametrically opposite condition of that viscus, anæmia. The obvious conclusion to be drawn from these facts, is, that symptoms may in many cases deceive us as to the true nature of a disease, and that the practitioner, who, in his treatment of this class of affections, trusts exclusively to their guidance, must inevitably run the risk of committing the fatal error of combating anæmia by bloodletting, and of treating sthenic hyperæmia by excitants, and asthenic hyperæmia by antiphlogistics.

ARTICLE II.

General Anæmia.

THIS expression, taken in its rigorous signification, is incorrect ; for the system can never suffer the total and complete absence of blood, without the heart ceasing to act, and the other phenomena of life becoming extinct : the term *hypæmia* would therefore be more correct. The quantity of blood in circulation may, however, be so diminished as no longer to penetrate the minute vessels of the cutaneous surface, in which

its place is supplied by a thin serous fluid; and after death, a deficiency, or even total absence, of blood is observed not only in the large arteries, veins, and right side of the heart, but likewise in the capillary system, which is remarkably pale and colourless. In these cases, the membranous and parenchymatous tissues, such as the brain, lungs, liver, kidneys, alimentary canal, and the parenchyma of the heart and muscles, are also remarkably pale and exsangueous.

This state of general anæmia may supervene without any appreciable cause. I have more than once had occasion to observe it in the bodies of persons who died dropsical, without presenting any alteration of the solids, such, at least, as could be discovered by our mode of investigation. (*Clinique Med.* T. iii. p. 558.) The use of food not sufficiently nutritive; the habitual respiration of an impure, moist atmosphere, from which the sun's rays are excluded, and which is ill adapted to the due performance of the pulmonary and cutaneous functions; any organic lesion which affects directly or indirectly the parts engaged in the process of hæmatosis; are all so many circumstances, which both reason and experience point out as calculated to produce general anæmia to a greater or less extent. Moreover, when an organ labours under any chronic affection, the vital powers

become concentrated in that organ; and although it may not have in any wise contributed to the process of hæmatosis, it nevertheless causes a considerable diminution in the quantity of the blood.

In the same manner as the blood, when *too rich*, or *too abundant*, gives rise to a certain train of morbid phenomena which have been already noticed, so, when *too poor* in quality, or *too scanty* in quantity, it produces various functional disorders, on which sufficient attention has not, in my opinion, been bestowed by modern pathologists.

When the system loses a large quantity of blood in a short space of time, the action of several organs is singularly deranged; the functions of the nervous system are peculiarly affected, producing not only faintings, and the ordinary and natural symptoms of debility, but likewise other phenomena, which are generally supposed to depend on an over-excited state of the nervous system. Thus, in such cases there often supervene, delirium, convulsions, palpitations, and laborious respiration, such as is observed in cases of pulmonary congestion. In this latter case, (pulmonary congestion,) the dyspnœa proceeds from the quantity of blood in the lungs being too great in proportion to the air inspired for its aeration; whereas in these cases of anæ-

mia just alluded to, the dyspnœa proceeds from the reverse cause, namely, from the circumstance of the air inspired bearing an excessive proportion to the blood which it has to aerate; so that in this case of dyspnœa, the individual is placed much in the same circumstances as when an animal is confined under a glass jar filled with pure oxygen. The function of digestion is also impaired; as the due performance of this process requires that the stomach, when it has received the food, should become the seat of a certain degree of sanguineous congestion; which in persons labouring under general anæmia is manifestly impossible. All these morbid phenomena subside as a fresh supply of blood is generated in the system.

We sometimes see the same train of phenomena supervene in other circumstances, where there has not been, as in the preceding cases, a sudden abstraction of a large quantity of blood; but where, under the influence of some of those causes I have enumerated, the mass of blood is considerably, though gradually, diminished, in consequence of its expenditure for the general purposes of the œconomy not being duly compensated by a fresh supply. Thus, for example, we frequently observe the train of symptoms above enumerated, in persons who have been kept during a tedious convalescence on too low

a regimen : in such cases the symptoms are precisely similar to those which are usually attendant on a protracted state of inflammation, but in this instance evidently depend on a very different cause, as they uniformly disappear when the diet is improved, and a fresh supply of blood thus generated. To these facts, I beg leave to add the analogous observation of Dr. Gaspard. This accurate observer relates (*Journal de Physiologie Expérimentale*) that in a country devastated by famine, where grass was for a considerable time the only article of sustenance which the wretched inhabitants had to subsist on, several of them exhibited unequivocal symptoms of general anæmia, and become dropsical.

I have already enumerated in the list of causes of general anæmia, the protracted deprivation of the genial influence of the solar rays, and the constant respiration, in a dark place, of an impure atmosphere, the constituent principles of which are ill adapted to the due aeration of the blood. Now, such precisely were the circumstances under which several persons employed in a coal mine were every one gradually seized with a remarkable state of anæmia. The history of these cases appears to me so interesting, and at the same time so illustrative of the present subject, that I shall transcribe the follow-

ing passage from the " *Dictionnaire de Medicine,* " article " *Anémie.* "

" All the workmen employed in one of the galleries of a coal mine in Auzain were taken ill in the summer of the year 11 ; which was at the time considered the more remarkable, as none of the miners had previously been affected, although this gallery had been constantly worked for several years before. The men who worked in the adjoining galleries were not affected, although the only difference which could be observed, was, that the latter were somewhat shorter, and rather better ventilated than the other. The disease was ushered in by violent colic pains, accompanied with meteorismus, and black and green stools; these symptoms were soon succeeded by dyspnœa, palpitations, and great prostration of strength ; which gradually disappeared at the end of ten or twelve days, when the symptoms of general anæmia began to make their appearance. The countenance lost all colour and complexion, and presented an appearance similar to that of wax which had been tinged yellow by the influence of time ; the blood-vessels were so completely effaced that not a trace of them could be discovered even in those regions where they are generally most apparent ; not a single capillary vessel could be seen on the conjunctiva of the

eye or eyelids, or even in the mucous membrane of the mouth; and the pulsation of the arteries was so feeble, as to be scarcely perceptible. These various symptoms were constantly presented even during the febrile paroxysms which occasionally supervened. The patients all complained of excessive debility, great anxiety, frequent palpitations, and sense of oppression and suffocation on making the least exertion; they had constantly profuse sweats; their countenance was œdematous; their appetite good, but digestion much impaired; and their emaciation advanced with rapid strides.

" This state sometimes lasted for six months or a year, and in some cases terminated in death; which was often preceded by the re-appearance of the original symptoms. The protracted duration of this affection, as well as its refusal to yield to the ordinary modes of treatment, determined the medical gentlemen in attendance to consult the Society of the School of Medicine in Paris, respecting the nature and treatment of the disease. Four of the patients were sent to Paris, and placed under the care of Professor Hallé, in the hospital of the Faculty. The remedies first employed consisted of light, nutritious diet, combined with bitter infusions of hops and gentian; to these were added, anti- scorbutic wine, and mercurial frictions; the last

more as an experiment, than from any particular indication. During this treatment one of the patients died : on dissection all the arteries and veins were found void of blood, and containing only a little serum ; no blood flowed when the muscles were divided, except on the thigh, from the large muscles of which a few drops issued. This almost total absence of blood, which agreed so well with the phenomena observed during life, induced M. Hallé to discontinue the mercurial frictions, and substitute the internal use of iron filings, in the dose of a drachm daily, combined with tonics and opium. In eight or ten days an evident improvement had taken place in the patients thus treated : a few veins began to appear under the skin of the fore-arm ; the digestion was much improved ; and the dyspnœa considerably relieved. Each subsequent day the patients pointed out as a new discovery one or more blood-vessels which had just become visible : all their symptoms continued to improve, and at the time they were sent home their health was perfectly re-established.

" Appearences similar to those above mentioned were observed in the same parts of the bodies of several who died of this affection ; and the same plan of treatment was employed with equal success at Dunkirk, where some of these

patients had been sent, and at Auzain itself.
During convalescence relapses were frequent."*

In this unusual form of disease, the circum-
stances attendant on its development, the symp-
toms which accompanied its progress, the mor-
bid appearances observed on dissection, and finally
the method of treatment found most successful, all
conspired to prove that some defect in the impor-
tant process of hæmatosis was the immediate and
proximate cause of the disorder, and of the whole
train of morbid phenomena which accompanied
it. Another circumstance in this disease which
merits attention is, that its commencement was
ushered in by diarrhœa and other formidable
symptoms, which after a few days disappeared,
and were succeeded by a state of general anæmia,
which every day became more marked. In this,
as in many other cases where the cause of the
disease acts principally on the blood and ner-
vous system, the morbid phenomena which the
different organs present seem evidently con-
nected with the primary and predominant affec-
tion of these two grand vital agents. Again, as,
in the cases at present under consideration, there
were profuse perspirations without inflammation
of the skin, and serous infiltration of the cellular
membrane without inflammation of that tissue ;

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* *Dictionnaire de Medicine,* Tom. ii. art. *Anémie* by Chomel.

so likewise, I conceive, the diarrhœa was produced by an increased exhalation from the mucous membrane of the intestines, independantly of any congestion, or irritation of that membrane. I might if necessary adduce several pathological facts to support this opinion from analogy ; such as the cases of many individuals who, when brought to the verge of the grave by long protracted disease, and reduced to an almost perfect state of anæmia, were seized with profuse serous diarrhœa a few days before death, and on dissection presented no more traces of disease in the mucous membrane of the intestines, than had been observed during life on their skin, which had been constantly bathed in sweat.

In chlorosis, several of the morbid phenomena first recorded are constantly observed ; and if this disease, as is now generally admitted, frequently results from a defective formation of blood, the cause of which may reside exclusively in the nervous system, can we with any show of reason refer either to irritation or sanguineous congestion, the Proteus-like variety of functional derangements which chlorotic patients so constantly present ; such as epileptic paroxysms, convulsions, chorea, dyspnœa, palpitations, vomiting, &c. ? Or shall we not approach nearer the truth in assigning these different morbid phenomena to the same cause which

produces them in persons who are reduced to a state of anæmia by the deprivation of food, light, or wholesome atmosphere? We may appeal to the test of experience, to the lædentia and juvantia, for the further confirmation of this doctrine. Venesections employed in such cases to combat an irritation which in reality does not exist, invariably produce a marked aggravation of all the symptoms; on the contrary, it frequently happens that by stimulating the nervous system of these chlorotic patients by the physical and moral emotions of matrimony, we produce a more natural complexion and colour of the whole cutaneous surface, thus indicating a corresponding improvement in the process of sanguification; and in proportion as the anæmia disappears under the influence of this new modification of the nervous system, the whole train of diseased action, the difficult respiration, constant sensation of uneasiness and listlessness, impaired digestion, gastralgia, vomiting, tympanitis, and limpid urine, together with all the strange nervous symptoms, which seemed dependant on some organic alterations of the solids, gradually subside and eventually vanish, as a fresh supply of blood is generated in the system.

To conclude, when the duration of this state of general anæmia exceeds a certain limit, another series of disorders supervenes. The dif-

ferent organs, in consequence of receiving a less supply of blood than natural, undergo various modifications of nutrition, whence result the atrophy, the diminution of thickness and consistence of several tissues, perhaps also, the total disappearance of some of them, during the course of long protracted chronic diseases. In these cases, the organs fall into decay in consequence of their no longer receiving a due supply of blood; just as in the fœtus, those organs are either altogether deficient, or incompletely developed, if a sufficient quantity of the nutritive fluid be not supplied to them; and as in the adult, these organs may at pleasure be reduced to a state of atrophy, by mechanically diminishing the afflux of the blood to them.

Such are the principal phenomena which may be considered as the primary and immediate effects of the state of general anæmia; but let us now suppose the supervention of an attack of inflammation in an individual thus circumstanced. We have already seen that in such an individual the nutrition and vitality of all the organs are peculiarly modified; that every organ in the body really enjoys a less degree of vitality than natural, inasmuch as it no longer receives a sufficient supply of that fluid, on which its existence depends. It is therefore evident, that such a state of the system cannot fail to influ-

ence materially the character and termination of the inflammation, which, under such circumstances will produce the most alarming symptoms, and frequently too the most fatal consequences, the œconomy being (if I may use the expression) defenceless. The various acts of innervation will be performed with extreme irregularity; there will be a sudden prostration of strength, a constant tendency to hæmorrhage, and a remarkable disposition to mortification wherever congestions are formed; and since the vis vitæ is actually diminished throughout the whole system, the laws which govern all inorganic matter will commence to exert their influence over the body while yet alive, and produce the various symptoms of decomposition and *putrescency*.

As in determining the true nature of this disease, so likewise in our selection of remedies, the local affection must not engross all our attention; for in reality these symptoms do not depend on the intensity of this affection, so much as on the peculiar conditions of the œconomy, both as regards its innervation and nutrition. The local inflammation is the occasional cause of these symptoms, but their real source is seated in the peculiar conditions of the œconomy which preceded its appearance.

SECTION II.

LESIONS OF NUTRITION.

THE function of Nutrition is liable to various modifications : 1, in the arrangement and distribution of the elementary molecules of which the several tissues are composed ; 2, in the number of these molecules ; 3, in their consistence ; and, 4, in their nature and properties.

Deviations from the natural arrangement and distribution of the elementary particles of the tissues, produce the various species of congenital malformation usually called *Monstrosities*.

Alterations in their number give rise to hypertrophy or atrophy, both which states may in turn become the causes of several malformations.

Alterations in their consistence produce induration or softening of their respective tissues.

From a diminution in their number or consistence result various lesions, such as ulceration, perforation, &c.

Lastly, alterations in the nature and proper-

ties of these molecules produce in the part affected, the transformation of one tissue into another.

CHAPTER I.

Lesions of Nutrition depending on the irregular Arrangement and Distribution of the anatomical Elements of which the Solids of the Body are in their natural State composed.

To this class are to be referred the various congenital aberrations of nutrition, which produce a conformation of one or more organs different from that which naturally belongs to the species or sex of the individual. The term *monstrosity*, which is now generally used to express these malformations, was for a long time employed to represent such anomalies of nutrition only, as were sufficiently great to produce extraordinary or hideous deformities in the external conformation of the body; but in the classification formed on these principles, several malformations were omitted which differed only in situation or degree; no attempt was made to investigate their causes, or ascertain their conformity to any principle deduced from the laws of organization; and, in consequence, the

history of monstrous formations was almost wholly composed of an incoherent assemblage of marvellous tales, inaccurate descriptions, superstitious ideas, and absurd prejudices. Even physicians themselves long viewed malformations in the same light. Accordingly we find that amongst the numerous accounts of monsters, published even as late as the commencement of the eighteenth century, there are few, if any, which are calculated to assist the investigations of the scientific inquirer of the present day. It is not without surprise that, even after that period, we find in the memoirs of the *Académie des Sciences,* a description, with plates, of those imaginary beings, mermen, like the tritons of ancient fable. Shortly after the period alluded to, however, a new era commenced; and according as the spirit of experimental philosophy was introduced into the cultivation of the sciences, was felt the necessity of giving a new direction to inquiries of this nature, in order to render them really useful. Morgagni corrected several erroneous opinions respecting the nature and causes of monstrous formations. Haller collected all the facts relating to this subject which were recorded by his contemporaries and predecessors, submitted them to a judicious analysis, and deduced from them several conclusions eminently calculated to promote the

advancement of the science. But it is to the indefatigable researches of modern anatomists that we are indebted for the greatest advances which have been made in this department of medical science : an idea fraught with the most important results, and which was originally conceived by Littre in the year 1700, has been recently revived, developed, and extended by M. M. Geoffroy St. Hilaire, Serres, Béclard, Breschet, Chaussier and Adelon, Jourdan, and others, in France ; and by Soemmering, Frederick Meckel, and Tiedemann, in Germany. This idea consists in regarding a certain number of monstrosities as the result of an arrest, or suspension of the progress of the development of the organs of the fœtus : and in those cases where no evidence exists of any such suspension of development having taken place, but where, notwithstanding, nature seems to have departed from her established rules, these aberrations have been reduced to certain determinate laws, by an acquaintance with which, all the different varieties of monstrous formations may be determined, foreseen, and, I might almost say, calculated.

The principle of the unity of organic composition, so ably advocated by M. Geoffroy St. Hilaire, is not, according to this illustrious naturalist, in the least violated by these monstrous productions ; but, on the contrary, derives addi-

tional support from them. In the course of this chapter we shall have occasion to cite the facts he has adduced in support of his opinions, which, whether they be applicable only to some particular instances, or capable of comprehending all, are worthy of attention. As Cuvier says, even though the supporters of this doctrine may not have succeeded in establishing it, still the vast number of facts and ideas they have collected are not the less valuable on that account.

It would be quite inconsistent with the plan and object of this Treatise to give a detailed description of each monstrosity that occurs. I shall therefore content myself with endeavouring to lay down the general principles, and point out the laws, which may serve to guide the scientific inquirer in the study of monstrous productions, and help him to recognize, classify, and denominate such malformations as may be submitted to his investigation.

If we take a general view of the different aberrations from the natural state to which organized bodies are liable, we shall find that they are all referable to two classes; viz. vicious conformations, and alterations of structure. The latter class seldom make their appearance until after birth; whereas the former generally occur in the mother's womb, before the individual is perfectly formed. When malformations

occur at a later period, they are almost invariably produced by some alteration of structure of the part; as, for instance, scales on the skin, horny excrescences, &c., which are denominated monstrosities by the vulgar, but which in scientific language must be carefully distinguished from them, as the term monstrosity should be exclusively restricted to those transformations which are congenital. Even at this early stage of our investigations, some analogy may be traced between the human fœtus and those animals which occupy a much lower rank in the scale of organization; for, in the lower classes of animals, such as zoophytes, the conformation of their organs is not so absolutely determined by fixed laws, but that it may be modified and changed under the influence of certain causes which influence their nutrition. But, in those animals, this condition obtains at all periods of their existence, whereas in man, it is almost exclusively confined to the period of his fœtal life.

We are not, however, to conclude that, because monstrous formations are observed at the period of birth, these malformations must have been original; or in other words, that because an infant is deformed at its birth, it may not at some antecedent period of its fœtal state, have enjoyed a natural conformation. We can in fact easily conceive how the process of conformation may

have proceeded regularly during the earlier periods of the evolution of the fœtus, and have been subsequently modified by some derangement or defect in its development.

The development of the fœtus may be modified in various ways : sometimes the formative process, or nisus formativus, as it has been termed, possesses less energy than natural, and the development of the organs is in consequence suspended ; in which case they are found either imperfectly formed, or altogether deficient : sometimes, on the other hand, this force seems to acquire an excess of energy, and then, there is a corresponding excess of development, and the organs exceed their natural limits, either in size, or number. In other cases again, the development cannot be properly said to be either excessive or defective ; but the formative process appears to have been simply perverted, thus producing various modifications in the direction, and situation of the organs. We have examples of this in the general transposition of the viscera, and in certain varieties in the origin of the principal arteries.

These facts are important in a pathological point of view ; for, if many malformations which cannot be accounted for by the simple excess or deficiency of the formative powers, can only be explained by admitting a derangement or perversion of those powers, we are, I conceive, autho-

rized by analogy to admit in explanation of vari-
ous alterations of texture, not only an excess or
deficiency in the act of nutrition, but likewise a
simple perversion of that act.

To the three classes already enumerated,
every species of monstrous formation may, I con-
ceive, be referred. Meckel supposes, that these
species form series rising by regular gradations
from the natural form to the most unnatural
deformity ; and that the intermediate gradations
are not constituted by single or individual cases,
but that every variety of monstrous formation is
accurately repeated in other individuals ; so that,
in fact, a separate and independant kingdom of
monsters might be established. It must, how-
ever, be admitted, that the individuals of this or-
ganic kingdom are not subject to such immu-
table laws of development, but that they may
occasionally differ in some points from those
monsters which come nearest to them in ap-
pearance : I must add, too, that M. St. Hilaire is
rather disposed to consider each individual mon-
ster as constituting in itself a distinct species.

Whatever be the nature and number of these
malformations, the implicit obedience to certain
laws which nature constantly observes in the
midst of these apparent anomalies, is very re-
markable. Thus, the situation of the organs
has never been so perverted, that the lungs were

placed in the skull, or the brain in the pelvis ;
nor have the organs been observed so confounded
together, as that the alimentary canal, for in-
stance, made a continuous tube with the aorta,
&c.; all which would no doubt occur, if certain
laws did not still preside over this state of appa-
rent disorder and confusion. Another illustra-
tion of the existence of these laws is, that
man and the higher orders of animals may
present such an arrest in their development,
that several of their organs shall represent
exactly the natural state of these parts in the
inferior animals; whereas the latter can never
attain such a degree of development, as that
their organs shall resemble the corresponding
parts of the higher orders. Thus, for example,
the human brain, arrested in its evolution,
may present an appearance more or less exactly
analogous to the brain of fishes, or reptiles ; but
the simple brain of these animals can never at-
tain the degree of complicated structure which
the human brain presents. Several malforma-
tions may exist together in the same individual ;
indeed such is perhaps the most frequent case,
whenever the deformity is at all considerable.
Sometimes these various malformations are all
of the same class ; or in other words, are all pro-
duced by the same cause, for instance, by an ex-
cess or a deficiency of development. Such
vices of conformation constitute the *compound*

monstrosities of Meckel ; while his class of *com-plex monstrosities* comprehends all those which result from the existence in the same individual of malformations belonging to different classes.

The complex monsters, in Meckel's accepta-tion of the term, are the most common. Seve-ral of them result from the law so ingeniously conceived by M. St. Hilaire, which establishes that the exuberance of nutrition in one organ involves to a greater or less extent the total or partial atrophy of some other organ ; and *vice versa*. Innumerable applications may be be made of this law of compensation, as it is termed, to the study of monstrosities. Thus, in several individuals who have on one hand, or foot, supernumerary fingers or toes, the hand or foot of the opposite side has fewer than ordi-nary.

In a fœtus with umbilical hernia, the left foot had only one toe, but the right foot had eight, and the eighth was divided. (Neumann.) In another fœtus which had but one foot, the left hand had two thumbs. (Sue). M. Ségalas pre-sented to the Academy of Medicine a fœtus which had no thumb on the left hand, but had two on the right ; this same fœtus had likewise only eleven ribs on one side, but had thirteen on the other. Supernumerary fingers are often found in those cases where parts of greater or less im-

portance are incompletely formed, or altogether deficient. In the case of Cyclopia, for instance, Meckel states that the number of fingers is very frequently augmented: a similar augmentation of these parts has likewise been observed to accompany hare lip, spina bifida, imperforate anus, absence of the genital organs, &c. In a case cited by Rosenmuller, in which the nasal bones were deficient, the ascending processes of the superior maxillary bones were so largely developed, that they met, and supplied the place of the nasal bones. When several of the bones of the cranium are wanting, or exist only in a rudimentary state, those at the base of the skull sometimes acquire an extraordinary thickness, and a consistence like ivory. Again, when the brain is partially or totally deficient, the face often acquires un unusual development, and by the extension of its bones in length or breadth, assumes a degree of resemblance to the face of certain animals. In those monsters called *sirens,* which have the lower extremities united, or partly deficient, the number of vertebræ and ribs is, according to Meckel, almost always preternaturally great. Elben remarks, in his excellent work on acephalous monsters, that they frequently want the heart and liver, while at the same time their kidneys acquire an extraordinary degree of development. Lastly, the application of this

law of compensation may be observed also in those monsters which have several parts double : thus, monsters with two bodies are often acephalous, while bicephalous monsters have been observed with spina bifida. In these two species of monsters, several organs present a very remarkable arrest of development ; the abdominal parietes are deficient ; the intestinal tube incomplete ; the urethra imperforate ; the rectum and bladder open into a common cloaca. The vascular system, likewise, is excessively developed in some parts, and in others is so deficient as to be quite rudimentary ; the heart especially is in many of these cases very imperfectly developed.

The supernumerary parts which result from an exuberance of nutrition, are likewise subject to this arrest of development either in their entire structure, or in the different anatomical elements which enter into their composition. Thus, supernumerary limbs are in some cases mere shapeless stumps ; in others, though well formed externally, they are found on dissection to be deficient either in their bones, muscles, or tendons, &c.

Another application which Meckel has made of this law of compensation is, that in children born of the same parents, the monstrosity from excessive development in one child, is often

compensated by a corresponding deficiency in another. A young girl mentioned by Morand, had six fingers on each hand, and six toes on each foot, in all four supernumerary fingers and toes; her sister had on each foot the regular number of toes, and on one hand the usual number of fingers, but on the other only the thumb, so that she wanted four fingers, exactly the same number that her sister had in excess.

Monstrous formations proceeding either from excess or deficiency of development do not occur with equal frequency in all organs. It may be laid down as a general principle, that those parts which are situated in the interior very seldom have their number augmented; whereas the external parts are particularly liable to this deviation from the natural state. The accuracy of this remark may be readily ascertained by comparing the extreme rarity of those cases, in which the heart, lungs, alimentary canal, or the genital or urinary organs have been found redundant, with the comparative frequency of supernumerary limbs.

If, however, setting the preceding considerations aside, we compare the different organs with regard to their respective liability to malformations, we shall find, that those which derive their nerves from the cerebro-spinal system, are in general the least subject to faults of conformation ; such, for example, are the muscular

system, the larynx, and the lungs. On the contrary, irregularity of form is much more frequent in those parts which are principally supplied by the great sympathetic nerve ; such as the digestive, urinary, genital, and especially the vascular systems. This law, established by Meckel, is the more remarkable, as the cerebro-spinal system itself much more frequently presents irregularities of conformation, than do the ganglions of the great sympathetic.

There are certain unnatural formations which occur indifferently at either side of the body ; as for instance, a deficiency or an excess in the number of fingers. Others again, have a peculiar predilection for the left side : Meckel has remarked, that when the cerebral artery arises immediately from the aorta, it invariably does so at that side. Another remark of Meckel's is, that those monstrosities that result from an exuberance of nutrition, are more common in the superior than in the inferior parts of the body. Thus bicephalous monsters with a single body, are more common than monocephalous monsters with a double body. The fingers too are more frequently augmented in number than the toes ; which, according to Meckel, corresponds with the earlier development of the superior extremities.

Female monsters are more common than

those of the male sex. Out of forty-two monsters with double heads or double bodies, whose histories were collected by Haller, there were thirty females, nine males, two hermaphrodites, and one whose sex could not be determined. In eighty monsters examined by Meckel, there were sixty females, and only twenty males. The excessive proportion of female monsters seems to depend on the circumstance, that during the earlier period of the evolution of the fœtus, as in the lowest classes of the animal kingdom, there is only one sex, namely, the female; so that in fact, when we say that the greater number of monsters are of the female sex, we only state in other terms, that in the greater proportion of monstrous formations, be their seat and nature what they may, the genital organs are arrested at an early period of their development.

The hereditary nature of certain malformations seems established by some very curious facts. We have the histories of whole families, every individual of whom had six fingers on each hand. Meckel records a remarkable instance of a man who had six fingers on each hand, and as many toes on each foot; his eldest son alone presented a similar malformation, and of four children belonging to the latter, only three presented the same anomaly as their father. Morand speaks of a woman who had

twelve fingers and as many toes. She had a daughter whose toes only were above the natural number ; this daughter had eight children, four of whom had six toes on each foot. Osiander relates the case of a woman, who was delivered of a monster with a double body, exactly similar to one to which her grandmother had given birth. Would not these facts almost justify us in supposing, that some of those strange and apparently useless conformations which certain animals present, may have originally been monstrous formations, which were subsequently transmitted hereditarily, and are now so far from being considered unnatural, that they serve to characterise certain species, or varieties.

Parents have been known to produce several children, every one of whom presented the same kind of malformation. Others again, after having had several weakly children, have produced others in whom there was an arrest in the development of one or more organs. There are also cases on record, of the birth of twins having been followed by the birth of monsters with two heads, or two bodies.

Having premised these general observations, I shall next endeavour to establish those laws which are more especially applicable to each of the three grand classes of monsters already

mentioned; and shall commence with that class which seems to proceed principally, if not solely, from an imperfection of development.

This kind of monstrous formation does not occur with equal frequency in all the different organs. It may be laid down as a general law, that those organs are most subject to imperfect development, which are the latest in attaining their complete evolution ; and that every imperfection of development an organ presents, corresponds exactly with the state of that organ in some of the stages of its development. I shall adduce some cases to illustrate this proposition.

The intestinal canal is one of the first organs of which any trace is perceptible : at first it is only a continuation of the vesicula umbilicalis; which gradually elongates itself into two tubes ; one inferior, constituting the large intestine ; the other superior, forming the small intestine and stomach. Now in all the monsters hitherto examined, this primitive portion of the intestinal tube has been found perfect; while on the other hand, those parts which are subsequently developed, have repeatedly been found deficient. Thus, in some cases, the prolongation of the vesicula umbilicalis does not extend downwards, whence results the complete absence of the large intestine : or it may so happen that after its development in this direction has commenced,

its progress is arrested before its evolution is completed, in which case, a part only of the large intestine will be found, such as a small portion of the colon, or if the colon is perfect, the rectum may be imperfect or altogether wanting. Sometimes it is the superior portion of the tube which is imperfectly or not at all developed, in which case, the small intestine may consist only of a short tube, terminating not far from its origin, in a cul-de-sac; or if its development be less incomplete, the intestinal portion may be perfect, but the stomach either totally deficient, or else so imperfectly evolved as to resemble the small intestine, of which it seems only a simple continuation. It is not as yet precisely ascertained how that portion of the alimentary canal above the diaphragm is formed. Some authors are of opinion that it is evolved independently of the lower portion. There is a species of malformation which seems to favour this opinion, where the mouth and pharynx are well formed, but this latter organ terminates in a cul-de-sac, the œsophagus is altogether wanting, and the stomach has no cardiac orifice. In these cases, it appears that the formation of that portion of the alimentary canal which is above the diaphragm, proceeds from the mouth towards the stomach.

Whether we consider the bladder as a con-

tinuation of the allantoid membrane or not, certain it is, that this viscus is always found at a very early period in the embryo, as also are the kidneys. Hence we may conclude, *a priori*, in conformity with the law we have laid down, that the urinary apparatus may occasionally present different imperfections of development, but can rarely if ever be completely deficient. The accuracy of this conclusion is confirmed by observation ; for some traces at least of this apparatus have been found even in those cases, when almost every other organ was either badly formed, or absent altogether. One case however is recorded by Fleishman, in which no trace of the urinary apparatus was discovered, although the intestinal tube and the liver were in their natural condition. These exceptions should not be lost sight of, especially in such a subject as the present, where some of the laws have been founded on the observation of only a few facts, and are consequently far from being certain.

The nervous and vascular systems are likewise very early developed, their first lineaments being already perceptible in the midst of the homogeneous mass of which the embryo is composed at the earliest period of its existence. Notwithstanding, these systems present unnatural formations not less remarkable for their number, than for their variety. This exception

to the general law is, however, more apparent, than real ; for although the rudiments of the vascular and nervous systems make their appearance at an early period of the evolution of the fœtus, it is only at a very late period indeed, that their development is complete ; if it can properly be considered as complete even at the full period of gestation. Hence, the frequent occurrence of malformations in these two systems, so far from invalidating the law, serves, in fact, to confirm it. Each of these systems may in reality be considered as formed by the successive combination of several secondary systems, which have each an independent development : now, if we examine the development of these secondary systems, we shall find, that such of them as are the earliest formed, are likewise those which are the least liable to irregularities of conformation. If we take the nervous system, for example, we shall find that the nerves, which, instead of growing from the brain or spinal cord, (as was for a long time erroneously supposed,) are developed before those parts, are likewise less frequently irregular in their conformation than they are. The spinal marrow too is formed before the brain, and, accordingly, is less liable to malformations ; and lastly, of the numerous parts which compose the brain itself, such as are the latest found, are

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also those which most frequently present irre-
gularities in their development.' The term
anencephalia, which is commonly used as a gé-
neric term, to signify the different imperfections
of development of the brain, is most frequently
incorrect; for it very rarely happens, that the
brain is (as this term would imply) altogether
deficient; the expression *ateloencephalia* might
therefore, perhaps, be substituted for it with ad-
vantage, as the term *atelomyelia* has already been
employed by Béclard to designate the various im-
perfections of development in the spinal marrow.

The remarks which have been made respect-
ing the nervous system are equally applicable to
the vascular. The heart is not the part of this
system which is first developed, as was long
imagined; for, certain vessels exist before any
trace of the heart is perceptible. Its structure
too, during the earlier periods of its evolution,
is very different from the appearance it presents
when fully developed : it is originally a simple ca-
nal, which gradually dilates, and consists at first
only of a single cavity, which is subsequently sub-
divided, according to certain laws which it would
be foreign to my present purpose to enumerate.
Now, we observe, that certain parts of the heart
are more subject to irregular conformation than
others, and that such are uniformly the latest
in attaining their complete development. For

example, immediately before birth the *foramen ovale* is still open, and, accordingly, an open foramen ovale is of all malformations of the heart the most common. At a still earlier period of fœtal life, the septum of the ventricles does not exist, and we find that the absence or imperfection of this septum after birth is of much less frequent occurrence, than a pervious foramen ovale. If we advance still nearer towards the period of conception, we find a period at which there is no line of demarcation between the auricles and ventricles ; a similar conformation has been found in the full grown fœtus, but not so frequently as either of the malformations already mentioned. More rarely still has a simple vessel been found in the place of the heart ; and it will be recollected that this is the form which the heart presents at the earliest period of its development. Lastly, even this vessel has not been observed in certain acephalous monsters, which, with respect to the development of their vascular system, remained stationary at that period when the whole circulatory apparatus of the embryo consisted in a single vessel proceeding from the amnion.

The osseous system is one of the latest in attaining its complete evolution, inasmuch as it is not perfectly formed for a considerable time after birth ; it is likewise one of those which

most frequently present defects of conformation. Of the different parts of this system, those which are the earliest developed are least subject to these defects ; amongst these is the clavicle ; on the contrary, those parts which are the latest developed are most subject to them, as for instance the bones of the skull. In the course of this chapter I shall have occasion to recur to their malformations.

In like manner, if we direct our attention to the external surface of the body, and the principal regions of which it is composed, we shall find that those parts which are most frequently absent or imperfect, are precisely the same as are latest in attaining their natural development. For example, at the first period of its formation, the fœtus may almost be said to consist entirely of an abdomen ; accordingly, this part, more or less completely formed, has never been altogether deficient in any monster : on the contrary, there are several cases on record, in which no trace could be discovered of either head, neck, thorax, or extremities ; so that in fact nothing was to be seen but an abdomen, just as at the commencement of embryotic life. The external parts of generation do not appear until very late; and it is by no means uncommon, in the fœtus, arrived at its full term, to find these parts altogether deficient, or presenting some imperfection which

constitutes their natural condition at an early pe-
riod of their formation. The monstrous forma-
tions of the organs of sense are likewise subject
to the same law. The eye, which makes its ap-
pearance in the form of a black point, before
any vestige of the external ear is perceptible, is
not so often deficient as the ear. The eyelids,
likewise, which are not developed until long after
the ball of the eye, are more frequently absent or
imperfect than the eye itself.

Some authors have advanced an opinion that
an organ cannot be imperfectly developed, or
entirely deficient, unless when those organs
which are formed before it in the natural order
of development, have likewise suffered an ar-
rest in their evolution. This principle is cer-
tainly exemplified in some cases ; thus, an abdo-
men may exist without either head or thorax,
whereas no monster has ever been seen consist-
ing only of a head and neck. It has likewise
been proved by observation that, whenever the
heart is deficient, the liver, which in its develop-
ment is later than the heart, is also deficient.
But in other cases this principle of the depend-
ance of the development of one organ on
that of another, is not borne out ; the osseous
system, for instance, frequently presents various
anomalies, at the same time that the organs
whose development is earliest, are perfectly
well formed.

The progress which has recently been made in the cultivation of embryology and comparative anatomy, has taught us, that the greater number of the organs are much more independent of each other in their respective formation, than was for a long time supposed ; and that, consequently, any arrest in the development of one organ, but seldom necessarily produces a similar arrest in the development of others. For instance, we now know that the nerves may be perfectly developed, independently of the existence of the brain or spinal cord ; as has been abundantly proved in several cases of anencephalia and amyelia.   It appears that the nerves are primarily formed in those organs, which it is their office to connect with the centres of the nervous system ; and that they do not unite with those centres for a considerable time after their first rudiments are perceptible. Where these organs are deficient, the nerves are likewise deficient ; so that the existence of the nerves depends much more on the development of the organ which they are destined to supply, than on that of the nervous centres.   M. Serres has recorded a remarkable illustration of this fact, in the case of a monster with two brains, and a single body, in which there were only two pneumogastric nerves found, arising one from the external side of each brain.   In this case

there were only two pneumogastric nerves, because there was only a single pulmonary and digestive apparatus for them to supply. In other cases, on the contrary, which M. Serres has cited, where these organs were double, and the brain single, there were two sets of nerves destined for the two sets of organs.

These facts go a great way towards proving, that, not only the nerves, but likewise all the different organs, may attain their development notwithstanding the deficiency of the nervous centres ; but, on the other hand, there are also facts which would lead us to infer, that, under certain circumstances, there is at least an intimate relation between the perfect development of some organs and the complete evolution of the nervous centres : thus, when the cervical enlargement of the spinal cord does not exist, the upper extremities are (according to Serres) constantly deficient ; if it be the lumbar enlargement which is absent, the same author states that the lower extremities are as invariably wanting. In cases of congenital atrophy of the limbs, several authors, especially M. Rostan, have seen the hemisphere of the brain at the side opposite to the deformity, converted into a serous sac, as if it had been early arrested in its development, or, having been originally well formed, was at a later period attacked with dropsy. Be that as it may, these

facts seem to announce a decided influence ex-
ercised by the nervous centres over the develop-
ment and nutrition of certain organs.

There is another system, the absence or
imperfect development of which has been re-
garded as the most powerful cause of all those
unnatural formations proceeding from deficient
development; I allude to the arterial system.
According to M. Serres, the absence or incom-
plete evolution of any part of the body depends
on the defective development of the artery which
should supply the part with the materials for its
nutrition and growth.

This skilful anatomist is of opinion, that the
evolution of each part of the nervous system is
entirely regulated by the development of its ar-
teries, and that those parts of the brain, of which
the arteries are earliest formed, are the first to
attain their natural development. Thus, we ob-
serve in the embryo, that the arteries which are
distributed to the tubercula quadrigemina, are
largely developed at a period when the arteries
of the brain and cerebellum are scarcely per-
ceptible; and for this reason, says M. Serres,
the tubercula are formed before the hemispheres
of the cerebrum or cerebellum. At a later pe-
riod, the thalamus opticus, corpus striatum, for-
nix, and corpus callosum, gradually attain their
natural form and dimensions, as their respective

arteries increase in size. The same remark is applicable to the cerebellum ; as the early development of its middle lobe corresponds with the equally early development of its anterior artery, whilst its lateral lobes continue in a rudimentary state until the period arrives for the development of its posterior artery. In like manner, the development of the caudal extremity is, in animals, proportional to the size of the middle sacral artery, and in man is altogether deficient, as only a rudiment of this artery exists. The volume of the different organs is directly proportional to the volume of their arteries ; the great development of the human skull in proportion to the face is thus accounted for : but when it so happens that the internal carotid artery is but imperfectly developed, at the same time that the external carotid attains an unusual volume, the skull continues very small, and the face acquires an extraordinary size. Finally, the direction in which the evolution of certain parts proceeds, is likewise connected with the mode of development of their arteries ; thus the hemispheres of the brain are formed from before backwards, like the carotid artery which supplies them ; on the contrary, the cerebellum is developed from behind forwards, as is also the vertebral artery by which it is supplied.

These facts being established, M. Serres at

once deduces from them the explanation of all
the unnatural formations which proceed from
defective development ; thus, he supposes that
in acephalous monsters the absence of the head
depends on the absence of the ascending aorta, &c.

This opinion, in which M. Geoffroy St. Hi-
laire also concurs (and which he has so ingeni-
ously advocated in his description of a monster
termed by him *podencephalus,*) has not been
generally adopted by anatomists. It is admitted
on all hands, that the volume of the different or-
gans and of the respective arteries are directly
proportional one to the other ; that, when an or-
gan is accidentally increased in volume, its ar-
teries experience a corresponding increase ; and
that, if from any accident it falls into a state of
atrophy, the vessels which supply it with blood
undergo a similar alteration. But, as was well
remarked by Béclard, (in his lectures on mon-
sters, delivered in 1822) it is extremely difficult to
decide, in this connexion of phenomena, which
is the cause, and which the effect ; for there is no
proof whatever in support of the opinion, that
the development of the organs depends on the
development of the arteries, which is not equally
applicable to the supposion, that the size of the
arteries depends on the volume of the organs ;
and that when the arteries are wanting altoge-
ther, it is because the organs which they should

supply, are not evolved. Indeed this latter sup-
position derives considerable support from the
fact, that in several cases the vessels are formed
in the midst of their respective organs, where
they first appear as isolated red points, which
subsequently elongate themselves into canals,
and then, and not before, communicate with the
general vascular system. This mode of forma-
tion is particularly evident in those false mem-
branes which are undergoing the process of or-
ganization, and which eventually become as per-
fect in their structure, properties, and functions,
as the natural serous or mucous membranes
themselves. Now in this case it is evident, that
the artery could not have presided over the de-
velopment of the accidental tissue, but must have
been produced in it, in the same manner as the
other anatomical elements of which its texture
was composed. Why should not the same phe-
nomena take place in the formation of the differ-
ent parts of the embryo, the primary develop-
ment of which has been with so much ingenuity
and justice compared to the organization of
false membranes ? In further confirmation
of this doctrine, we may remark, that some cases
are authentically recorded, in which the brain
was deficient, although the internal carotid gave
off the regular cerebral branches, which were
merely smaller than usual, and were distributed

on the meninges. A very interesting case of this description, in which there existed no trace of brain except a portion of the crura, has been recently communicated to the academy by M. Baron. It appears from the arguments which have been adduced on both sides of this question, that although a manifest connexion subsists between the development of the arteries and that of the parts to which they are respectively distributed, the first of these phenomena cannot in strict reasoning be admitted as the cause of the second, either in the regular or irregular formation.

Another case in which an arrest of the development of one part has been regarded as producing, more or less necessarily, a similar arrest in other parts, is when the parietes of certain cavities are imperfectly formed. It has been stated that, in such malformations, the organs contained in these cavities are likewise imperfectly developed. This rule holds good in many cases, but not in all. Fleishman, for example, has cited a case in which the pelvis contained no other organ than the rectum, and was reduced to much less than its natural dimensions; but cases are likewise recorded, in which the genital and urinary organs were both deficient, and the pelvis was, notwithstanding, found of the natural size and form. In those cases where the diaphragm is wanting, and some of

the abdominal viscera are contained in the tho-
rax, the lungs are constantly found in a rudi-
mentary state, their further evolution being im-
peded by the pressure exerted on them by the
intruding viscera.

M. Geoffroy St. Hilaire has most inge-
niously availed himself of this observation, to
prove the existence of a pulmonary apparatus
in the crustacea, which he argues exists only in
a rudimentary state in this family, on account
of the peculiar form and dimensions of the
cavity in which it is contained ; in one genus
of the crustacea, however, the lungs become
more apparent, in consequence of a partition
which exists between the thorax and abdomen,
and prevents the viscera of the latter cavity from
protruding into the former, thus allowing a
greater facility for the evolution of the pulmonic
viscera.

But of all the regions, the skull and spine
are those in which a direct connexion can most
constantly be established between the develop-
ment of the parietes and of their contents ; even
in these, however, there are some exceptions to
be pointed out. Thus M. Olivier has very justly
remarked, that the imperfections of development
of the vertebræ do not necessarily depend on
those of the medulla spinalis, and *vice versa*.
Cases of very extensive spina bifida have been

observed, in which the spinal cord was perfectly
well formed, and, again, the spinal cord has
frequently been found imperfectly developed,
while the parietes of the vertebral canal were
exempt from any irregularity. In the same man-
ner, the skull may be naturally formed, although
its contents exist only in their rudimentary con-
dition, as is exemplified in certain cases of con-
genital hydrocephalus. M. St. Hilaire adduces
a case of a pig that presented that peculiar mon-
strosity termed *cyclopia,* (both eyes united into
one,) in which the brain did not fill above one
third of the cavity of the cranium. He adds,
that this is the only instance he is acquainted
with, of a well formed cranium not being ex-
actly moulded on the brain. Notwithstanding
these exceptions, we should consider the follow-
ing principle, established by M. St. Hilaire,
as the general expression of a great number of
particular facts : " The bones which enve-
lope the brain, undergo in their development
various alterations which correspond exactly
with those which the brain itself has under-
gone ; the greater the deficiency of the cerebral
mass, the greater also will be the deficiency of
the bones of the cranium, but still their rudi-
ments are in general perceptible." This natu-
ralist has established several species of anence-
phalous and acephalous monsters, according to

the different arrangement and disposition of these rudiments.

In three of these species the brain is altogether wanting. They have been named as follow : 1. The *coccycephalus*, (head having the form of the os coccygis :) in this species, the bones of the skull and neck are reduced to a state of extreme smallness, and surmount the vertebral column so as to resemble a sort of beak or os coccygis. Béclard has seen a case of this species, which he has described and figured in his memoir on acephalous monsters. 2. The *cryptocephalus*, (head invisible exteriorly :) in this species, the head is, to use the expression of M. St. Hilaire, reduced to a parcel of osseous masses, supported by a straight cervical column ; it is excessively small, and does not appear externally, (Béclard, op. cit. plate 4.) 3. The *anencephalus* (head without brains :) in this species, the skull is more apparent than in either of the preceding, but is nevertheless singularly deformed : it is open down the median line, and each of the lateral parietes is reflected outwards, *en ailes de pigeon*.

In two other species, likewise established by M. St. Hilaire, the brain exists in a state of imperfect development, and the evolution of the bones of the skull is much less imperfect. These species are : 1. The *cystencephalus* (head with a

vesicular brain :) the skull is open as in the an-
encephalous species, but the lateral parietes are
more approximated, and not everted.   2. The
derencephalus (head with the brain in the neck :)
the skull is open posteriorly, as are likewise the
cervical vertebræ ; and the brain, which is very
small, rests on the occipital bones and on the
vertebræ.

With these species, in which there is at the
same time imperfect development of the brain and
of its osseous case, M. St. Hilaire groups others,
which differ from them materially in this respect,
that the brain is well formed and of its natural
dimensions, but presents remarkable anomalies
of situation in consequence of the malformation
of its parietes.   These cases in which the brain
undergoes no modification except in its situation,
furnish us with abundant evidence that an ar-
rest of development in the bones of the cranium,
such as exists in these cases, does not necessa-
rily produce a proportional arrest of develop-
ment in the brain; so that even amongst the
examples adduced by M. St. Hilaire himself, we
find exceptions to the law which he has laid
down.

There are several malformations, differing
widely from each other, and apparently pre-
senting the greatest discrepancies in their speci-
fic characters, which may nevertheless be traced

to one common source, imperfect development. Amongst these malformations may be enumerated the different accidental openings and separations of parts which, in the natural state, are united and closed. These solutions of continuity are all situated in the median line, and proceed from an arrest of development. There is, in fact, a period in the evolution of the fœtus, when almost every organ is composed of two parts, separated by an interval which subsequently diminishes and fills up, as the fœtus approaches the full term of gestation. This gradual obliteration of the intervening space, proceeds from the fulfilment of a law demonstrated by M. Serres; namely, that all the parts of the body are formed from the circumference towards the centre, and not, as was erroneously supposed, from the centre towards the circumference. Hence it follows, that if the evolution of an organ be arrested at any time near the period of its first formation, the organ so arrested will in general be found composed of two parts, separated from each other by a certain interval. To this cause must be referred those cases which present a greater or less extent of deficiency in the parietes of the cranium, the spinal canal, the thorax, or the abdomen. The parietes of the cranium are most commonly deficient at the sutures; those of the spinal canal present various degrees of separation, from the

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simple division of a spinous process, to a perfect
cleft in the very body of the vertebræ.   The
opening in the thoracic parietes consists some-
times of a simple cleft in the middle of the ster-
num ; in other cases this bone is altogether want-
ing, and in others, again, the ribs themselves
exist only as rudiments, and appear like small ap-
pendices attached to the vertebræ. As to the ab-
dominal parietes, their deficiency may consist in
the absence of the linea alba ; or else the abdo-
minal muscles themselves may be totally want-
ing, in which case the abdomen presents a large
opening in front. There are some cases in
which the abdominal parietes are deficient only
in a small space above the pubis ; in these the
anterior portion of the bladder is frequently de-
ficient at the same time, and a moist reddish
surface, from which a fluid oozes by a double
orifice, is exposed to view between the umbilicus
and pubis ; this surface is the mucous coat of
the posterior portion of the bladder.

The bones of the pubis may, in like manner,
continue in the same state of separation, as they
naturally present at a certain period of fœtal life ;
or may even be absent altogether : along with this,
there may be observed posteriorly a complete or
incomplete division of the sacrum and os coccy-
gis. In all these unnatural formations, the
same laws are observed as preside over the natu-

ral development of the bones. Thus, in conformity with the law of the formation of the organs from the periphery towards the centre, the ilium appears before the ischium, and the ischium before the pubis ; now, as the pubis is the last formed of these bones, so it also is the one which is most frequently wanting ; nor does its absence infer that of either of the other bones, whereas if the ischium be deficient, it is necessarily so likewise.

The double or single division of the upper lip, and the fissure of the roof and velum of the palate, producing the various degrees of harelip, represent the natural state of those parts at the commencement of fœtal life, and are therefore evidently caused by an arrest of development. The lips, when first formed, are seemingly composed of as many distinct portions, as there are bones in the corresponding parts of the osseous parietes of the mouth ; and each of the intervals which separate these portions corresponds with the space interposed between the several bones, or, at least, between the several points of ossification. The lower lip must, consequently, never be composed of more than two pieces, whereas the upper lip must at first be composed of four ; namely, two small portions in the middle, corresponding to the two ossa incisiva, and two lateral portions of longer size, which correspond each to a maxillary bone.

It appears, that the two middle portions are very early united, as are also the ossa incisiva ; and hence arises the extreme rareness of a harelip situated on the median line, although the possibility of such a deformity, may, from what has been just stated, be easily conceived. On the contrary, the two lateral portions of the lip do not unite with the middle portion until a much later period : as this union does not take place at one, or at both sides, the malformation termed harelip will be either single, or double. The extreme rareness of the congenital division of the lower lip is satisfactorily accounted for, by the earliness of the period at which the two portions that originally compose it are united.

Not only may the lips be arrested in the progress of their development, and remain divided, as in the different varieties of harelip, but their evolution may even be suppressed altogether ; in which case the whole interior of the cavity of the mouth is exposed to view.

Congenital hypospadias is also evidently an arrest in the development of the male organs of generation, which are divided down the median line at a certain period of their formation. Traces of this original division may remain in the form of a channel or groove, running along the inferior surface of the penis ; the greater or

less extent of this division constitutes the differ-
ent degrees of hypospadias. In the first degree,
a simple opening is observed underneath the
glans; in the second, this opening is continued
along under the penis; and in the third degree,
the scrotum is itself divided, and the division of
the urethra extends nearly to the bladder. These
different degrees of hypospadias, especially the
last, often co-exist with other malformations of
the genital organs; which may give rise to an
appearance of hermaphrodism. For instance, at
the same time that the urethra is open inferior-
ly, the penis, being small and imperforate, may
easily be mistaken for a clitoris; the division of
the urethra may resemble the aperture of the
vulva, especially when the scrotum is divided;
while each division of the scrotum, whether it
contains a testicle or not, represents with tolera-
ble accuracy an external labium; and in some
cases, the division of the penis forms two folds,
which descend to the perineum, and may be
mistaken for the nymphæ. In all these cases,
the resemblance to the female organs is much
more striking when the testicles remain in the
abdomen. It is a very remarkable circumstance,
that in a great proportion of those cases in which
the original division of the male organs of gene-
ration continues to a greater or less extent, we
likewise find other characteristics of the female

sex, in these organs, as well as in the constitution and temperament of the individual. So constantly, indeed, is this the case, that it may be set down as a law, that, whenever the distinctive character of either sex is modified, the effect of that modification is to produce a marked tendency to the character of the other sex. Thus, in extreme cases of hypospadias, not only is the penis (as I have already remarked) diminutive and imperforate, but the testicles likewise are small, and instead of descending into the scrotum, remain in the abdomen, at no great distance from the situation which, in the female, is occupied by the ovaries. The individual is feeble, and of the lymphatic temperament; the voice is feminine, the beard scanty, and the breasts are sometimes remarkably developed. In like manner, in the female, when the clitoris attains an unusual size, the general appearance is masculine, and the chin is covered with hairs, &c.

If we next turn our attention to the accidental apertures and communications, which many of the internal organs occasionally present, we shall find that they also are referable to an arrest in the development of these organs. I have already alluded to the successive formation of the cavities of the heart, and may now remark, that all the unnatural communications between these cavities, which have been observed after

birth, are the natural state of the parts at certain periods of the evolution of the fœtus. In the female, the genital, urinary, and digestive organs, have often been found communicating, and uniting into a sort of common reservoir previously to their opening externally; and if we follow these organs through the different stages of their development, we shall arrive at a period when this triple communication was the natural conformation of the parts. To the same class of malformations, should likewise be referred those cases in which certain vessels and ducts continue pervious after birth, which, in the natural state, should have had their cavities obliterated at that period; such as the ductus arteriosus, the umbilical vein, and the urachus.

A great number of congenital misplacements depend on the imperfect union of the parietes of the different cavities. In this way may be explained those cases, in which all the organs usually contained within the thorax and abdomen, are found on the outside of these cavities. To this cause, is also to be attributed the unnatural situation of the brain, termed encephalocele; in which, however, while the skull continues open posteriorly, the several bones which compose its sides and base, sometimes change their natural situation; and, according to the position which they assume, the brain is protruded more or less completely out of the cavity

which was destined to contain it : hence arise
several forms of encephalocele, which have been
particularly noticed by M. St. Hilaire.   In one
of these forms, the brain, thrust almost entirely
out of the skull, is pushed downwards and back-
wards, and rests on the back, with no other
covering than the common integuments.   He
has given to this species, on account of its situ-
ation, the name of *notencephalus*, (head with the
brain on the back.)   In other cases, it happens,
that in consequence of the extraordinary eleva-
tion of the sphenoid bone, and the consequent
alteration in the situation of the other bones,
the brain is placed outside the skull, and seems
supported on a pedicle which traverses the
summit of the cranium.   In these cases, the
brain is imperfect, many of its parts being de-
ficient, (as the commissures,) or imperfectly
formed, (as the tubercula quadrigemina, and the
cerebral lobes ;) whence arises its unusual form.
They constitute the *podencephalus* (head with
the brain on a peduncle) of M. St. Hilaire. This
form is nearly allied to another species of ence-
phalocele, described by this illustrious naturalist,
from whose works we have quoted so largely,
under the name of *hyperencephalus*, (brain situ-
ated on the skull.)

Other misplacements are likewise evidently
the result of an arrest of development : thus,

the presence of the testicles in the abdomen, the situation of the kidneys in front of the vertebræ, the distance of the fundus of the gall bladder from the anterior margin of the liver, the immediate attachment of the hands to the scapulæ, or of the feet to the ossa coxarum, are, in the adult, so many misplacements, but were the natural situation of these parts at a certain period of fœtal life. We must not, however, suppose that all congenital misplacements may be thus accounted for. I once, for instance, found one of the kidneys in the pelvis; and, as it received its artery from the hypogastric, its situation must have been congenital; but I do not believe that such is the natural position of the kidney at any period of fœtal life.

As there are some malformations which consist of unnatural apertures and communications, so likewise there are others which result from the obliteration, or (more correctly speaking) the absence, of the natural openings and cavities. This species of monstrous formation, which has received the generic appellation of *atresia*, should, in like manner, be attributed to an arrest of development. To this class belong imperforate anus, imperforate urethra, the termination of different portions of the intestines in a cul-de-sac, the non-obliteration of the membrana pupillaris, the absence of the frontal

and maxillary sinuses, &c. When the testicles remain in the abdomen, the inguinal canal is often obliterated; but, in this instance, the atresia is adventitious, not original. The hemispheres of the brain have, in some monsters, been found without any lateral ventricles : this deficiency is evidently the result of an arrest of development in the hemispheres ; for, it is an established law, both in comparative anatomy, and in embryology, that cavities do not exist in any part of the brain, until that part has attained its maximum of development. As the cerebral hemispheres are in man at their maximum of development, so, according to the law just laid down, they should contain cavities in their interior ; but, if we trace the evolution of the fœtus to its commencement, we shall find, that the hemispheres are, at a very early period, much less developed than other parts, than the tubercula quadrigemina for instance. Accordingly, the tubercula contain a much larger cavity, at that period, than the hemispheres do ; at a later period this proportion is reversed. If, however, we suppose a stop put to the development of the brain, the parts will remain in their primitive state ; the hemispheres will be found without ventricles, and a cavity will be observed in the tubercula quadrigemina. Such was the state of these parts observed in the monster described

by M. St. Hilaire, under the name of *podence-phalus*, to which I have already alluded.

After *atresia*, follows, naturally enough, the class of malformations termed by M. Breschet, *symphysia*, which consists in the unnatural union of parts that are usually divided ; whether by simple approximation, or by double organs running into one. This class comprises several malformations of peculiar interest, which may, like the preceding, be satisfactorily accounted for by an arrest of development. The species of symphysia that has longest attracted attention, is that which consists in the union, or more or less perfect incorporation, of the eyes, which thus become situated in the median line : it has been described under the different names of *cyclopia, monopsia,* and *rhinencephalia.*

Cyclopia, which is a defect more common in certain animals than in man, constantly co-exists with the absence or imperfect development of the olfactory bulbs and nerves, and of the ethmoid bone ; so that, in this case, it is evidently the absence of one organ of sense, which produces the displacement of the other. Indeed, we might expect *a priori,* that the absence of the osseous parts usually interposed between the orbits, would be followed by the mutual approximation and confusion of the latter ; but, in this confusion of the orbits, and, consequently, of the organs which they contain, there exist

several degrees, which I shall now proceed to describe.

We may consider as the first degree, that in which both orbits communicate, in consequence of the imperfect development of their internal walls; but the eye in each still continues separate and distinct. In the second degree of this malformation, there is only a single orbital cavity, containing the two eyes, which are in contact, but are not confounded together. In the third, both eyes are united, and run into one; while the compound eye thus formed, still contains all the parts belonging to each; the humours and membranes being all double, as is also, in general, the optic nerve. In some cases, however, there is only one optic nerve, although there are two crystallines. In several of these monstrous formations, a superficial observer would suppose there was only one eye; but, on examining its structure, all the constituent parts of the two eyes will most commonly be found, enclosed in one sclerotic as a common envelope. Sometimes, however, the eye is really single; in which case it is always remarkable for its extraordinary size.—(Haller.) Lastly, Tenon, and before him, Bartholin, have recorded cases in which there was a total deficiency both of eye and orbit: this constitutes the *anopsia* of authors. In some cases of cyclopia mentioned

by Haller, it is stated that a single eye was fur-
nished with two lachrymal glands and four eye-
lids.

In cyclopia, the nasal bones abandon their na-
tural situation, and are placed in the middle of
the forehead, where they form a considerable
prominence, from which the soft parts descend
like a proboscis, or snout ; hence, the denomina-
tion rhinencephalus, which M. St. Hilaire has
given to this species of monster. In several of
these cases we likewise find a singular conforma-
tion of brain, namely, a single lobe, ill developed,
and situated in the median line ; to which cir-
cumstance, perhaps, as much as to the absence
of the olfactory apparatus, is the cyclopic malfor-
mation to be attributed.

We have just seen that the junction of both
eyes co-exists with the absence of the organ of
smell ; and if, in addition to this deficiency, the
different parts of the buccal cavity are also want-
ing, (astomia,) other sensorial organs will like-
wise evince a disposition to meet, and unite in
the median line. In this manner is produced
another species of symphysia, which consists in
the approximation and sometimes the union of
both ears. In a case of this kind, described by
M. St. Hilaire under the name of *triencephalus,*
from the simultaneous absence of the organs of
taste, sight, and smell, the ears were united in-

feriorly, and at the central point of their junction was situated a single external aperture leading to a single tympanum; while there was a prolongation of skin, somewhat similar in form to the external ear, situated at each side. In other cases, more or less analogous to the preceeding, both the tympana are firmly united in the median line. M. St. Hilaire states that this disposition may present a striking resemblance to the lower jaw, which in these cases often exists only in a rudimentary state.

There are certain organs which, in consequence of imperfect development, have their dimensions increased considerably beyond the natural standard: of this class are, the liver, thymus gland, supra-renal capsules, and clitoris. The spinal marrow, also, is occasionally found longer than natural; apparently because the vertebral canal is not sufficiently developed. There is a certain period in the evolution of the embryo, when the os coccygis is much longer than it is afterwards, and constitutes a sort of tail. Now, if this bone does not diminish in proportion as the lower extremities increase in size, as, according to the natural order of formation, it should do; the consequence will be, that the fœtus is born with a caudal prolongation, which, in reality, depends on an imperfection of development.

It seems equally paradoxical to assert, that

an augmentation in the number of certain parts is the result of an arrest of development in these parts; yet such is the fact with respect to the osseous system. Sometimes this numerical augmentation is real; as when the ossa wormiana fill up the spaces left between the bones of the cranium in consequence of their imperfect development. The most remarkable of these ossa triquetra, or wormiana, as they are indifferently called, is that which has been named epactal (*os intercalatum:*) it is formed after birth, and is situated between the occipital and parietal bones, when they have ceased growing before the interval which exists between them during the period of fœtal life has been obliterated. Most commonly, however, this appearance of supernumerary bones in the full grown fœtus is more apparent than real; and depends on the circumstance of the different pieces of which each bone was originally composed, continuing distinct, as they naturally exist at different periods of the evolution of the embryo, as well as in certain animals. Thus, for example, all anatomists agree in describing the os frontis as originally composed of two distinct pieces, which subsequently become united along the median line; but no anatomist, as far as I am acquainted, has noticed the fact, that each of these lateral pieces was itself, in the em-

bryo, composed of two other subdivisions, the one appertaining to the cranium, the other to the orbit. I have, however, satisfactorily ascertained the separate existence of these two portions, in certain fœtuses, whose development was arrested in its progress. In one of these, which was an anencephalous monster, the orbital portion alone existed; its termination was marked by a sharp edge in the situation where the superciliary ridge is usually found. In another fœtus affected with hare lip, and in which the central portions of the parietes of the cranium, thorax, and abdomen, were deficient, I found the cranial and orbital portions of each lateral division of the os frontis perfectly distinct and separate from each other; so that each side of the frontal bone was actually composed of two portions separated from each other by an oblique line extending from below upwards, and from within outwards, and reaching from the internal angle of the orbit, to the outer margin of the os frontis. This retardation of the union of the osseous portions has become, in the hands of several modern anatomists, a powerful argument in favour of the theory of the unity of organic composition.

There are, however, also certain cases in which the bones, especially those of the skull, instead of appearing larger or more numerous

than natural, seem, on the contrary, almost totally deficient. Now, as I have just endeavoured to establish that the augmentation in the number of these bones is in general only apparent, so also, M. St. Hilaire has attempted to prove, that, in the majority of cases, their absence is in like manner more apparent than real. According to this anatomist, the skulls of anencephalous monsters present all the individual bones appertaining to these parts in their natural state, subject, it is true, to infinite varieties in their form and size, but uniformly consisting of the same materials, and presenting the same connexions. When the brain is altogether wanting, the bones which in the natural state serve to envelope and protect the cerebral mass, and are consequently in their size proportionate to its extent, do not entirely disappear, but diminish considerably in size, and present the same appearance as in those animals whose brains are naturally little developed. The parietal bone, for example, in a case of anencephalia described by M. Lallemand, consisted only of a narrow band some few lines in breadth. I have myself seen a similar case. According to M. St. Hilaire's idea, this bone should be considered, not as a fragment, but as retaining its rudimentary form in consequence of having no office to fulfil in the œconomy : it had, besides, its usual connexions.

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In this same anencephalous monster, the occipital bone was strangely deformed, but M. St. Hilaire proves, by an ingenious analysis, that it contained the same number of pieces, which it naturally is composed of at an early period of its evolution, and that, in the case under consideration, they only underwent a certain modification in their form and size, but in the essential points of number and connexions remained unchanged.

Meckel is of opinion that the finger-shaped prolongation known by the name of diverticulum, which is sometimes found attached to the ilium, should be ranked amongst the supernumerary parts resulting from imperfect development. He considers this diverticulum as the vestige of the canal which, during the formation of the embryo, served to establish a communication between the vesicula umbilicalis and the intestine, or rather constituted in itself the intestine. A circumstance which lends considerable weight to this opinion, is, that this part frequently contains the remains of the omphalomesenteric vessels. On the other hand, this diverticulum, when existing in the adult, must be considered as a simple accidental formation, by those anatomists who agree with Oken, St. Hilaire, and others, in assigning a different situation (the cœcum for instance) to the origin of

the intestinal canal, and its separation from the vesicula umbilicalis. Further observations must be made, and additional facts collected, before this question can be decided.

During the first months of fœtal life, several organs which subsequently incline to the right or left side, occupy a perpendicular position in the median line. Thus, the heart, instead of the oblique direction which it afterwards assumes, is parallel to the axis of the body : so likewise is the stomach, and indeed the whole intestinal tube, which, at first, consists of a simple canal, extending in a straight line from the stomach to the anus. These peculiarities of structure may continue after birth, and are then evidently the result of imperfect development.

Lastly, to this cause may also be traced even the congenital anomalies of colour, which different individuals present. Thus the black pigment of the choroid does not make its appearance in the fœtus until the fifth month after pregnancy ; and if at that period its formation does not proceed, the choroid will appear red after birth ; as is the case in albinos.

The greater number of malformations of the human subject which result from an arrest of development, are more or less analogous to the natural organization of some of the lower orders of animals. This is a necessary consequence of

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the law, that man, in the several periods of his
fœtal life, passes through the different degrees of
organization which are the permanent condition
of those animals placed beneath him in the scale
of existence.   The facts illustrative of this are
so numerous that the only difficulty is in the se-
lection ; we must here be content with pointing
out some of the most striking.

The human body, arrested in its develop-
ment, may represent the natural structure of
other animals, either in external form, or in the
peculiar conformation of their respective organs.
A very superficial examination is sufficient to
convince us, that many of the alterations in the
external form of the human subject are found
copied exactly in the inferior animals.   For in-
stance, the absence of the extremities, which in
man constitutes a very great deformity, is the
natural conformation of the cetacea and of several
reptiles, and fishes. We have likewise addition-
al instances of this resemblance, in those mon-
sters which have, in the place of regular limbs,
short stumps, without any trace of division at
their termination ; or a less number of fingers
than natural ; or fingers or toes joined together
by a web or membrane ; and, lastly, in the pre-
sence of a caudal extremity, &c.

The resemblance which may be traced be-
tween the irregular conformation of the organs

in man, and their natural formation in other animals, is still more striking. If we take, for instance, the vascular system, we shall find cases of monstrous formations in which no other trace of the circulatory apparatus can be discovered, than a few vessels whose parietes are scarcely distinct ; a conformation which exactly represents the rudimentary state in which the vascular system naturally exists in the zoophytes. The heart drawn out into a vessel, as found in some acephalous monsters, bears a strong analogy to the dorsal vessels of insects ; when consisting of a single cavity with muscular parietes, it represents the simple heart of the crustacea. When composed of two cavities only, it resembles the heart of fishes, and of several of the mollusca. When possessing two auricles and one ventricle, it becomes the heart of the batrachia ; and if we suppose this ventricle subdivided into two by an imperfect septum, it becomes the heart of the chelonea. In certain monsters, the pulmonary artery is only a branch of the aorta, as it is in the batrachia. In others, the aorta communicates with the pulmonary artery by a wide canal, as in the tortoise tribe. In others, again, two aortas arise from the heart, as is the case in birds. The nervous system affords a still greater number of such analogies. For instance, the prolongation of the spinal marrow to

the lower extremity of the vertebral canal, and the existence of a cavity in its interior, constitute the natural condition of these parts in the greater number of the vertebrata.   The different degrees of development at which the brain is arrested in anencephalous monsters, correspond almost invariably with the permanent state of this viscus in the lower animals. In some human monsters the spinal nerves have been found inserted into the membranes which invest the spinal marrow.   According to M. Desmoulins, this disposition exists naturally in certain fishes, which have their nerves constantly inserted into the spinal membranes, without their having any communication whatever with the medulla itself. Lastly, those cases of monstrous formation in which the brain and spinal marrow are totally deficient, the spheno-palatine ganglions united, and the vertebral ganglions and nerves preserved, are, according to M. Serres, perfectly analogous to the natural state of those parts in invertebral animals.

The greater number of the imperfections of development which the alimentary canal presents, are, in like manner, an exact representation of the natural formation of this canal in other organized beings.   Thus, in human monsters, the alimentary canal has often been found with only one orifice, generally the superior :

this will be readily recognised as the regular formation in several zoophytes, in which class of animals the alimentary canal represents a cul-de-sac. In fishes and reptiles, the cavity of the mouth is not separated from the nasal fossæ ; in birds the communication between these cavities is only partial ; and in certain mammalia, especially the rodentia, it is still more confined : the musculo-membranous partition, (septum staphylinum), which forms the posterior continuation of the roof of the palate, presents a division in birds, and many reptiles : lastly, in several of the mammalia, the upper lip is divided. These peculiarities of structure are occasionally found individually, or conjointly, in the human subject ; constituting the different varieties of hare-lip. In certain classes of animals, as well as in several monsters of the human species, the stomach is not distinct from the rest of the alimentary canal, and the latter does not present any curvature, &c. The kidneys, which in the adult human subject have been occasionally found joined together, or else divided into lobes, constantly present these appearances in several fishes and reptiles, and even in some of the mammalia. The cloaca, which I have already alluded to as an unnatural formation in the human adult, though it exists naturally in the foetus a few months before birth, is the regular

conformation in birds and reptiles. The gall bladder is naturally deficient in some mammalia, as the solipeda, and in several birds and fishes. The thymus and supra-renal capsules, which in man disappear, or at least diminish consider- ably, after birth, sometimes retain a considerable development in the human adult : this is the natural disposition in the rodentia, the amphi- bia, and in many of the plantigrada.

The irregularities which the osseous system occasionally presents in man, are also often re- markably analogous to the regular forms of this system in other animals. Thus, several bones retain sometimes in the adult the mucous or car- tilaginous character which they possessed at first in the foetus, and which they constantly present in invertebral animals, and even in some of the vertebral, as in the chondropterygious fishes. The division of the vertebræ, which in man constitutes a malformation, exists as the regular condition of these parts in many fishes. The sternum is naturally deficient in certain species of reptiles and fishes. The bones of the pubis, which are never naturally divided in the mammalia, are constantly so in birds, and in several reptiles. Lastly, different animals pre- sent, as the natural conformation of the cranial bones, a great number of detached pieces, which become united at an early period of human life,

or, if they remain separate, constitute an unnatural formation.

The genital organs of both sexes present few malformations which are not analogous to the natural state of these organs in other beings: such are, several of the varieties of hypospadias already noticed; the uterus being two-lobed; the penis imperforate or altogether deficient; the testicle remaining in the abdomen, &c.

There are other unnatural formations in the human subject, which, like the preceding, seem analogous to the regular formation in certain animals, but do not appear to have been the natural state of these parts at any period of the evolution of the fœtus. Such are, for instance, certain varieties in the origins of arteries, of which I shall have occasion to speak hereafter, when treating expressly of the pathology of the arterial system. Finally, there are some malformations, which, although they are evidently the result of imperfect development, present no resemblance either to the natural state at any period of fœtal life, or to the form of any of the lower animals; such, for example, is that monstrous formation named cyclopia.

Such are the most prominent facts in the history of those monstrosities which result from an imperfect development of the organs. Let us now contrast with them those which depend

on an excess of development, or on an exuber-
ance of nutrition. This may produce an in-
crease either in the number or in the size of the
organs. Increase of size, when affecting the
whole body, produces those monsters called
giants : when confined to some particular organ,
it is as often adventitious as congenital ; in the
latter case we have already seen that it frequently
co-exists with atrophy of some other organ.
The numerical increase of parts may be limited
to a few organs, or may extend to every organ
in the body; the parts affected are in general
only doubled, hence, Meckel proposes to term
this species of malformation, *duplication* of or-
gans. In several cases of this kind, the duplica-
tion is so complete that it is highly probable,
it proceeds from the junction or incorporation
of two fœtuses. This opinion has been ably ad-
vocated in the article on monstrosities by M. M.
Chaussier and Adelon, in the *Dictionaire des
Sciences Médicales.*

We shall at first confine our investigations
to those cases in which some particular organs
are increased in number, without there being a
tendency to the duplication of all. The bones are
the parts which in this point of view are most im-
portant to examine ; because the numerical va-
riations which they present, most commonly su-
perinduce several remarkable modifications in the

number and arrangement of the muscles inserted into them, and of the nerves and blood-vessels situated in their immediate vicinity. According to Meckel, the vertebræ are, in the human subject, the bones most liable to numerical variations. They are likewise the part of the osseous system which in animals naturally presents the greatest variety in this respect. The increase in the number of the vertebræ is said to be *perfect*, when one or more supernumerary vertebræ exist ; *imperfect*, when some portion only of a vertebra is interposed between two perfect ones, or when some supernumerary part is added to a vertebra. The ribs likewise occasionally present an increase of number ; sometimes *imperfect*, as when two ribs are united by an osseous prolongation, or a rib bifurcates, and terminates at the sternum by two distinct appendices ; sometimes *perfect*, in which case they present several varieties, relative, 1. to their connexion with the vertebræ, as the latter may be either increased in number or not ; 2. to their situation, the supernumerary ribs being situated below the twelfth rib, which they resemble in their disposition, or else placed above the first, and inserted into the cervical vertebræ, thus representing the natural conformation in fishes ; 3. to their size ; they seldom reach so far as the sternum, and frequently present the appearance

of small appendices attached to the vertebræ; 4. as regards their number; they very seldom exceed one pair. I have already spoken, at the commencement of this article, of the increase of number in the bones of the extremities. I also stated that the multiplication of the bones of the head was only apparent, and depended constantly on an imperfection in their development, or, in other words, on the circumstance of the component pieces of the same bone not being united into one.

The muscles too may increase in number, either by the production of additional fasciculi of fibres in the regular muscles, or by the formation of new muscles altogether. According to Meckel, almost all these varietes are analogous to the regular forms of the muscular system in different animals.

If we pass on to the consideration of the internal organs, we shall find that in general they are not so frequently increased in number as the external parts: indeed this increase seldom takes place unless when the parts on the exterior of the body are likewise multiplied. This remark is particularly applicable to the organs of circulation and respiration. The digestive organs are more frequently multiplied, without a corresponding increase in other parts of the body. The following cases may be cited as exam-

ples : 1. the existence of two tongues, which are almost invariably placed one over the other; they are seldom of the same size, and are generally united posteriorly in one common base : 2. a double œsophagus : 3. a double duodenum terminating in one pylorus forming a cul-de-sac : the only case of this kind on record has been observed in Edinburgh.

The genital organs are very seldom increased in number. When this malformation does occur, the supernumerary parts either belong to the same sex, or to the opposite sex. In the latter case they give rise to different appearances of hermaphrodism ; whilst in the former, they produce the duplication of certain organs, as the penis and clitoris. This monstrous formation, which has sometimes been observed, represents the natural state of these parts in didelphous animals, and in several of the reptile tribe. The organs are situated one over the other, and spring from a common root. In the male there is a separate passage for the urine in each penis, whilst the semen generally passes through but one. There is no well authenticated case of supernumerary testicles : Weber states that on one occasion he found four vesiculæ seminales. Several authors have described cases of supernumerary mammæ, in which three, four, or even five of these organs

were found, presenting several varieties in their size and situation.

There are other cases in which supernumerary organs belonging to different sexes are found in the same individual. The greater number of the following examples of this species of malformation have been borrowed from a Dissertation on Hermaphrodism, published in Germany by Steglehner.

A. Testicles contained in the pelvis ; vesiculæ seminales, and vasa deferentia, in their natural state, the latter opening into a well formed urethra ; uterus without any orifice, occupying its natural situation.

B. Glans penis imperforate, with hypospadias. In the interior, a testicle and vesicula seminalis at one side, and at the other, an ovary and fallopian tube terminating in a membranous sac, which occupied the place of the uterus. In this case the parts of generation of both sexes were united, but were each in a state of imperfect development.

C. Penis very small, glans imperforate, testicles with the vasa deferentia in the inguinal canal. Scrotum divided down the middle, and forming the orifice of a passage terminating both in a urethra and uterus.

D. Uterus well formed, wanting only the cervix ; and opening into the urethra ; neither ovary

nor fallopian tube to be found. Penis and testicles well formed ; but each vas deferens, after passing through the inguinal canal, plunging into the substance of the parietes of the uterus, and, after forming numerous convolutions there, as if to represent the vesiculæ seminales, opening as usual into the urethra.

E. Male organs of generation, both external and internal, well formed, and presenting no irregularity, except that the testicles were contained in the pelvis. The uterus opening into the urethra, and having attached to it two ligamentous cords, without any cavity in their interior, terminating in the testicles, and thus resembling in their distribution the fallopian tubes, as the testicles resembled the ovaries by their situation in the pelvis.

In the cases just enumerated, the uterus was the organ which was most frequently found supernumerary ; but at the same time the male organs of generation presented some imperfection of development ; so that these cases afford an additional illustration of the law of compensation established by M. St. Hilaire.

The urinary apparatus never presents a real numerical increase of parts, although unnatural openings and septa frequently give it the appearance of such an increase, as we have already observed.

The different organs which we have hitherto examined, may have their number increased without necessarily inferring the duplication of the entire body; there are, however, other parts which very seldom have their number increased unless when the whole system is doubled. Of this class are, 1. the heart; and 2. the extremities. In some rare cases, indeed, the heart presents several additional parts, and even becomes perfectly double, although the rest of the body remains single. Thus, in a heart which was otherwise well-formed, De Haen saw a species of hollow muscular appendix attached to the left auricle. Kerkringius found the right ventricle divided into two cavities, from each of which a pulmonary artery arose, that soon united with its fellow, and formed one common trunk. Winslow relates a case, in which two hearts were contained in a simple thorax; each heart was enclosed in a separate pericardium; the large vessels, both venous and arterial, were double at their origin, but soon coalesced into single trunks. It is remarkable, that in this case several organs had undergone an arrest of development; the œsophagus and trachea being deficient, and cyclopia existing. This double state of the heart, which is exceedingly rare in man and other mammalia, occurs much more frequently in birds. Littre states that he has seen

it in partridges ; Soemmering and Meckel have also observed it in geese. In other cases the heart is well formed, but gives rise to two aortas, which generally unite after running a short distance. In a case related by Malacarne, the aorta was single, but much larger than natural, and furnished with five valves at its origin. The unnatural formations of the heart, aorta, and pulmonary artery, just enumerated, constitute the natural state of these parts in many animals. Thus, in some classes of the mollusca, the aortic heart is found single, with two pulmonic hearts perfectly distinct from each other ; in others, there are two aortic hearts found. In all reptiles there are two aortas, which, in some species, arise by distinct and separate origins from the heart, and in others, result from the bifurcation of a single trunk.

The multiplication of one or more of the extremities constitutes, in reality, the first degree of double monsters. In some cases every limb is doubled, and the individual then has eight extremities : in others there is only one supernumerary extremity ; or the multiplication may even consist in a limb, which at its origin is single, becoming doubled or tripled towards its termination ; as when two or three feet are attached to the same leg. The supernumerary limbs, whatever be their number, present great

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varieties in their form, structure, and point of insertion. Thus, their form is sometimes perfectly similar to that of the other limbs, while, in other cases, they consist only of an appendage, or shapeless stump. Their structure is likewise exceedingly variable; for, they may contain all the parts of which the limbs to which they correspond are composed, or they may be deficient in one or more of these parts. The muscles appear to be the parts most frequently wanting, the bones being often found covered merely by fat and skin. Again, the bones themselves are occasionally found in their rudimentary state, or even altogether deficient. Nothing can be more uncertain than the point of insertion of these supernumerary limbs. They have, in some instances, been found attached to one of the natural extremities, in which case they are very imperfect; in others, to some point of the pelvis, or of the scapula. A moveable articulation is sometimes found at the point of their insertion.

In a great number of these cases, we can observe traces of the duplication of other parts. Thus, fragments of a second pelvis have been found attached to the regular pelvis, and it was to these rudimentary bones, that the additional extremity was found appended. In a case cited by Meckel, a species of sac, containing vestiges

of an intestine with an anal orifice, extended along the thigh from the buttock to the ham ; to its inferior extremity was attached an arm two inches and a half in length, furnished with a humerus, radius, and ulna, but deformed, and altogether devoid of muscles. In another case, also recorded in Meckel's treatise " *De Duplicitate Monstrorum*," an irregular tumour, from which two feet projected, was found attached to the dorsal vertebræ. It contained an intestine one foot in length, without any aperture, and surrounded by fat. This intestine was attached to a bone which bore some remote resemblance to a sacrum ; and in the sac were likewise found two tibias, together with the bones of two feet and one hand.

When there are two well formed supernumerary lower extremities, some of the internal parts are generally found double ; especially the intestinal tube, which divides into two portions, terminating each by a separate anus. The genital and urinary organs are also frequently double in such cases.

Lastly, we come to those cases in which the multiplication of different parts seems to depend on the union of two fœtuses more or less perfectly developed. These cases may be divided into two classes ; the first comprehending those, in which a well formed fœtus has, annexed to it,

either a simple fraction of another fœtus, or else a shapeless mass in which fragments of a fœtus are included ; the second, those cases in which two fœtuses seem to have been incorporated into one, though not so completely but that some of the parts of each continue distinct. I shall quote the following examples of the first of these classes from Meckel's treatise.

On the vertex of the head of an infant in other respects well formed, was placed a second head, united to the first by its vertex, and surmounted by a neck which terminated in a round tumour. The infant having died at a year old, the heads were found to be united by an osseous suture.

There are in the same work descriptions of other fœtuses, to which was attached a tumour resembling an abdomen, containing within it several viscera, especially an intestinal tube, and occasionally presenting the rudiments of a thorax, or of a pelvis, with or without their respective limbs.

In all these cases, the fragments of the supernumerary fœtus are situated externally, being attached to the skin, cellular tissue, or some part of the skeleton ; but, in other cases, the fragments of one fœtus are contained in the interior of another. One of the most remarkable cases of this kind on record, is related by M. Dupuy-

tren, in the first volume of the *Bulletins de la Faculté de Médicine*. A cyst was found in the transverse mesocolon of a boy 13 years of age, containing an organized mass which, in M. Dupuytren's opinion, was decidedly a fœtus. When carefully examined, it presented traces of some of the sensorial organs, together with a brain, spinal marrow, nerves, muscles, and most of the bones; but, no sign could be discovered of the genito-urinary system, or of the organs of diges-tion, respiration, or circulation. It is very re-markable, that in a case where the osseous sys-tem was so well developed, there should have been no trace of an intestinal tube, although the formation of the digestive apparatus is consi-derably prior to that of the skeleton. With the knowledge we now possess of the laws which regulate the evolution of the embryo, the cir-cumstance of one fœtus being contained within another is not more difficult to conceive, than the fact of their being united externally. The reader who wishes for further information on this subject, may consult the Thesis of M. La Chaise, *De la Duplicité Monstrueuse par inclu-sion*, defended before Béclard in 1822; also, an interesting essay on the same subject recently published by M. Olivier.

The second class comprehends the three following divisions: 1st. the body double, the

head being single ; 2d. the head double, the body being single ; 3d. both head and body double.

The first division may be comprised under the generic appellation of monocephalous monsters with two bodies. In some of those cases, the separation of the bodies is only complete inferiorly ; all the double parts from the umbilicus upwards, manifesting a disposition to coalesce : in others, the separation is perfect as high as the neck. The most remarkable circumstance, however, in these cases, is, that the head, although single, almost invariably presents on dissection some supernumerary parts, which seem to indicate a disposition in that organ to become double, as well as the other parts of the body. The natural conclusion from these appearances is, that the two fœtuses continued separate inferiorly, whilst they were confounded together superiorly ; in conformity with which supposition, we find, that, in addition to the regular bones which enter into the composition of a well formed cranium, others are, in these cases, superadded, which serve to constitute the rudiments of a second head, and generally observe the following arrangement : the occipital and temporal bones are those which attain the greatest degree of development, while immediately before them is situated a confused mass of small bones, without any determinate

shape, which appear to be the rudiments of the anterior part of the skull and face; from which arrangement we may reasonably infer that the two heads were placed one before the other, and that the posterior one was arrested in its deve- lopment. Within the skull, we also find traces of a second head; thus, the brain, which at its anterior part is single, presents posteriorly one or more supernumerary parts; the cerebellum, for instance, being not unfrequently found double, thus answering to the existence of a double oc- cipital. The rest of the skeleton, as high as the neck, is to a greater or less degree double in all its parts. Each thorax contains two well formed lungs; there are also two tracheas, and two larynxes, often surmounted by but a single epig- lottis. In general there are likewise two hearts, which are not constantly of the same size; the two ascending aortas unite into one, before giving off the arteries to the head. In some cases, however, there is only one heart, situated in the middle of a double thorax: the vessels rising from it then give off a double set of branches. The arrangement of the alimentary canal varies according to the condition of the superior parts of the body. Thus, we some- times find, 1. a single mouth, and immediately behind it, all the parts double; as, two tongues, two œsophaguses, &c.; 2. the alimentary canal

simple as far as the insertion of the œsophagus into the stomach ; 3. the stomach itself simple, and the rest of the intestinal tube double ; 4. and lastly, the small intestine simple, until we arrive near the point of its insertion into the cæcum. The liver in some cases is single, but remarkably large, and provided with two gall bladders ; in others, there are two livers perfectly distinct from each other. The spleen and pancreas, as also the genital and urinary organs, have been found double in all the cases of this description which have as yet been recorded. The extremities are sometimes all doubled, and naturally formed ; in other cases there are only two perfect upper extremities, whilst a third, either imperfectly developed, or else composed of two incorporated together, is attached to the point of contact of the two bodies : the lower extremities present the same anomalies.

The second division comprises monsters with two heads and a single body, (dicephali). This class likewise presents several varieties. 1. The head may be single posteriorly, and double anteriorly ; in which case there is only one skull, but there are two faces, more or less perfectly formed, placed side by side, and separated by a longitudinal division. The nose is in this case invariably double, and Meckel states that the mouth has never been found single except in one

solitary instance. Each face is provided with a pair of eyes; in one case, however, there were only three eyes altogether, but one of them was placed in the median line, and seemed formed by the union of two, as in the case of cyclopia. The number of ears is variable : in some cases four have been found, with the two intermediate separate or united; in others, three, and in others, only two : in general each face presents some imperfection in the side which corresponds with its neighbour. 2. The two heads may be completely separate throughout their whole extent, and perfect in every point. Sometimes, however, the heads are united at their posterior surface by a delicate membrane ; this may be considered as an intermediate degree between the preceding variety and the present. 3. In the two preceding varieties, the heads alone were double, but in this the neck also presents the same anomaly. 4. The head and neck being double, a supernumerary upper extremity is interposed between them. The structure of this additional limb is exceedingly variable, as it may contain either a double or a single humerus, the latter thicker than usual, a double radius, a hand with two thumbs, or with supernumerary fingers, or else two hands attached to a single forearm, and arm : the limb itself has been found connected with a scapula, which is

also occasionally double. 5. The head being double in one of the preceding degrees, and the upper extremities presenting their natural form and number, there may be three lower extremities. In this case, which is of rare occurrence, the supernumerary limb is sometimes found attached to one of the lateral portions of the pelvis, which at the same time generally presents some tendency to duplication. 6. The upper extremities may be perfectly double ; in which case the heads are not placed side by side, but face to face. Lastly, the lower extremities also may be double. Here the supernumerary limbs are sometimes perfect, but are more frequently imperfectly developed, and may consist, for instance, of simple excrescences of a few inches in length attached to the nates, and terminating in one, or two toes at most.

In all these varieties of double headed monsters, although the body appears single externally, yet, when we examine its internal structure, we find that several organs are double, and that, in proportion to the degree of separation between the two heads and necks, and to the number of supernumerary extremities. Thus, the vertebral column, which in the majority of these cases is double only in the cervical region, may be bifurcated throughout its whole extent, or as far, at least, as the lumbar region. The

several bones which enter into the composition of the pelvis, may likewise have their number doubled. Two hearts have been also found; most commonly they are contained in a single pericardium; the vessels distributed to the upper parts of the body are constantly increased in number. The organs of respiration have, in like manner, been found double. The portion of the alimentary canal situated above the diaphragm, the stomach, and even the intestine, are constantly double; the latter, however, towards its inferior extremity becomes single, and opens externally by a single anal orifice. The liver is invariably simple, but yet larger than usual, and in many cases furnished with a double gall bladder. There are frequently two spleens. The kidneys may either be simple, or may offer some traces of an approach to duplication; as when, in addition to the two kidneys occupying their natural position, two others are found united into one, and situated on the vertebral column. In another case, four kidneys were found, but two of them were exceedingly small, and destitute of ureters. The organs of generation, and the urinary bladder, are most commonly simple and well formed.

Thus, then, it would appear, that, as in those monsters which have two bodies and a single head, the head frequently presents une-

quivocal traces of its being formed by the incor-
poration of two heads, so likewise in the case of
two-headed monsters with single bodies, the
body is in fact but apparently simple, and, when
carefully examined, exhibits several of its organs
in a state of duplication.

The last variety of double monsters which
we shall enumerate, is that in which all the
grand cavities are separate, at least externally ;
where, in short, there are two heads and two
bodies. In this variety, the extremities occasion-
ally present some anomalies ; for instance, one
of the lower extremities has been observed in
merely a rudimentary state, attached as an ap-
pendix to the thigh of its fellow, which was well
formed ; while the leg belonging to this latter
had seven toes on its foot.

The junction of the fœtuses may take place
at any point of the body ; and, accordingly, they
have been seen attached to each other ; 1st, by
the crown of the head, in the same right line ;
2d, by the anterior portion of the thorax ; 3d,
by the anterior portion of the abdomen ; 4th,
by the dorsal spine ; 5th, by the sacrum ; 6th,
by the nates, &c.   The point of junction,
wherever situated, presents two important varie-
ties ; in the one, the attachment is superficial,
being effected only by the skin, and the bones ;
in the other, it is more deeply seated, the

cavities at the point of union, though in appear-
ance distinct, being, in fact, converted into one,
and some of their organs having a tendency to
become incorporated at the same point. If, for
instance, the two fœtuses are joined together by
the anterior portion of the thorax, the sternum
may be altogether deficient; in which case, both
thoracic cavities are thrown into communication,
and the viscera they contain present several ano-
malies in their form and arrangement. Some-
times there are two hearts perfectly distinct, en-
closed each in its own pericardium; sometimes
the hearts, though both well formed, are con-
tained in one common pericardium, in which
they may be either distinct from each other, or
superficially joined together at a single point,
or through their whole extent; the uniting me-
dium being either composed of cellular tissue or
of their muscular substance. In other cases,
though two hearts are still found, yet, neither of
them is perfect in its form, or structure. Lastly,
there may be only one heart, presenting several
varieties of conformation. It has been observed
in one case composed of four distinct ventricles;
in another, it presented the natural number of
cavities, but the left ventricle was much larger
than usual, and divided by a septum into two
compartments. From one of these compart-
ments arose the aorta belonging to the left fœtus,

which gave off the pulmonary artery to the same individual ; from the other compartment, arose a small trunk communicating with the aorta of the right fœtus, which arose from the right ventricle, and likewise gave off the pulmonary artery—(Meckel). In other cases of this description the heart was well formed, but the large vessels were all double, so that two aortas sprung from the left ventricle, &c. Finally, in some monsters of this class, the heart, so far from being double, is reduced to an unnatural degree of simplicity in its structure. In the centre of a double thorax, united so as to form a single cavity, a solitary heart has been found, composed of but one auricle and ventricle ; the pulmonary arteries were given off by the aorta, which did not divide until at a considerable distance from its origin : in another case, which, as well as the preceding, is recorded by Meckel, there were two auricles, and but one ventricle, which was divided by an imperfect septum ; from the principal cavity of the ventricle arose two aortas, and from the lesser compartment, two pulmonary arteries.

When the fœtuses are attached by the abdomen, the intestinal tube is occasionally found single, in some part of its extent : sometimes there is only one liver, in which case it is very

large, and often composed of several lobes, and furnished with two gall bladders.

If the point of junction is situated at the very bottom of the abdomen, the different parts which constitute the parietes of the pelvis, or are contained in its cavity, are more or less confounded together. In such cases there is sometimes only one anus for both bodies, or only one set of genital organs. The varieties which the bones of the pelvis present are not less remarkable, they being sometimes supernumerary, and sometimes, strange as it may appear, altogether deficient. When this occurs, the lower extremities are either wanting, or are only imperfectly developed, and attached to the base of the vertebral column by small osseous fragments.

We have already seen, that, from various causes more or less appreciable, the *nisus formativus* may be either increased or diminished; thus producing the two grand classes of monstrous formations resulting from excessive, or imperfect development, which have hitherto engaged our attetion in this chapter. This force, however, is not only liable to increase or diminution, but is also capable of being perverted, or (if I may use the expression) set astray. From this perversion of the nisus formativus result another class of monstrous formations, which exhibit neither a deficiency nor an excess of development, but

simply an unusual disposition of one or more or-
gans.   One of the most striking examples of this
class is exhibited in the general transposition of
the thoracic and abdominal viscera ; in which
all those parts usually situated at the right side
are found at the left, and *vice versa*.   The heart
affords a remarkable illustration of this transpo-
sition ; its apex, instead of pointing towards the
left, corresponds to the interval between the fifth
and sixth ribs of the right side ; its auricles and
ventricles occupy a position exactly the reverse
of their ordinary situation ; and the aorta de-
scends along the right side of the vertebral co-
lumn.   The left lung is divided into three lobes,
whilst the right has only two.   The pyloric ori-
fice of the stomach is turned towards the left
hypochondrium, which is occupied by the liver,
the spleen being at the right side.   The whole
intestinal tube presents a similar transposition ;
thus, the cæcum rests on the left iliac fossa, &c.

This general transposition can only be ex-
plained by supposing an aberration from the
natural manner of development, in the original
formation of the different organs.   It is import-
ant to remark that, during the earlier periods
of the evolution of the fœtus, several organs
which subsequently incline to the right or left
side, commence by being perpendicular, and
situated in the median line of the body : such

is the original position of the heart and stomach, and even of the liver, which, at the commencement of fœtal life, extends as far to the left as to the right side. The knowledge of this anatomical fact enables us to understand more readily how those organs once situated on the median line, may at a subsequent period incline to one side rather than the other ; although we are as yet unable to ascertain the causes which influence this irregular determination.

To this same class of malformations should likewise be referred the many anomalous varieties observed in the origins of arteries and veins. Of these, we shall only notice the most remarkable, as the minor anatomical varieties scarcely merit the appellation of malformations.

The heart, in other respects well formed, may have two aortas arising from its left ventricle, and the pulmonary artery may be a branch from the aorta. Beclard and J. Cloquet have seen two superior venæ cavæ, perfectly distinct, opening separately into a single right auricle. The arteries which arise from the arch of the aorta present several irregularities in their origin, which have been carefully described by Meckel, and faithfully represented by Tiedemann. These irregularities are chiefly numerical, and, most commonly, the number is increased ; as when the right subclavian arises immediately

from the aorta, or when the aorta gives off branches which do not usually arise from it, such as the vertebral, inferior thyroid, or internal mammary. These arteries may likewise present several varieties in the points at which they arise, the directions which they follow, and the mutual relations they bear to each other. The diminution in the number of trunks furnished by the arch of the aorta results from the union of two arteries which are usually separate ; as when the left carotid is given off by the inno-minata, or arises from the aorta by a common trunk with the left subclavian ; or when one common trunk furnishes the two carotids, and another, the two subclavians ; or, lastly, when the right subclavian arises singly at its usual place, and another trunk gives off the left sub-clavian, and the two carotid arteries. In other cases, the number of trunks arising from the arch of the aorta is neither increased nor dimi-nished, but their origin is modified and altered ; as when there is no arteria innominata, and each subclavian arises separately from the aorta, but there is a common trunk for the two caro-tids ; or when the carotid and subclavian arteries arise separately at the right, and the innominata is at the left ; or when the innominata, situated at its usual side, gives off the left carotid ; in this case the number of arteries springing from

the arch of the aorta is still the same, for the place of the carotid is occupied by one of the vertebral arteries, which arises directly from the aorta.

The last anomaly which we shall notice is an alteration, to a greater or less extent, in the relative position of the three vessels which naturally arise from the aortic arch ; as, when they are at a greater distance from each other than natural, or, on the contrary, are more closely approximated : in this latter variety they sometimes show a disposition to coalesce, thus forming an intermediate step towards the anomalous formation in which two or more trunks, usually distinct, become conjoined. It is a remarkable fact, that several of those anomalous varieties in the origin of arteries, which we have just enumerated, constitute the natural and regular condition of these vessels in certain animals : thus, in birds, the left carotid generally arises by a common trunk with the left subclavian, &c. Since we have learned how little the qualities of the blood depend on the situation of the origins of the arteries, these varieties have lost much of their importance in a physiological point of view ; as the only influence which they produce on the circulation is limited to some modification of its velocity. It may be received as a general law that all arteries are detached

from their trunks, at the nearest possible point to their respective organs, so that if the congenital position of any organ be altered, its artery likewise undergoes a corresponding alteration in the place of its origin, which, as I before remarked, is invariably at some point near the organ to which it is distributed. For instance, in an individual in whom I found the right kidney lodged in the pelvis, the renal artery of the right side was given off by the hypogastric.

If the interpretation which we have given to the facts adduced in this chapter be correct, we must adopt the general conclusion, that the greater number of monstrous formations may be referred to vices of development, and, consequently, do not require for their explanation any hypothesis of previous disease having affected the fœtus. In the first place, this cause, which several authors would have us consider as almost the exclusive agent concerned in the production of monsters, is altogether inadmissible in those malformations which proceed from an excess in the number, or size of the parts: neither can it afford us any clue to those congenital transpositions of different organs, which we have already alluded to. As to those monstrosities which depend on a deficiency of parts, it would be absurd to deny that they ever can proceed from the accidental destruction or alteration of the

parts by some disease affecting the fœtus. No doubt, certain cases of anencephalia, hydrocephalus, encephalocele and atelomyelia, are to be referred to a morbid accumulation of serum in the interior of the skull, or spine; indeed this fact has been clearly and satisfactorily established by the recent researches of Professor Dugès. M. Velpeau states that he has had opportunities of examining fœtuses born before their full time, in which different parts of the body, such as legs or arms, and parts of the face, were in a manner decomposed, and partially detached from the trunk, as if they had been seized with gangrene. It is highly probable, that, ere long, the separation would have been complete, and that the fœtus would thus have come into the world, wanting certain parts, which were at first naturally formed, but subsequently became diseased, and, by the ordinary process of gangrene and separation, were ultimately detached from the body. In the majority of cases, however, this explanation is inadmissible, and the different malformations above enumerated can only be accounted for, by supposing an arrest in the progress of their development. This subject has been already so fully discussed in this chapter, that I shall not at present enter into any additional details; but refer the reader who may wish for further information on the

subject, to the excellent article on anencephalia, by M. Breschet, in the *Dictionaire de Médicine.*

M. St. Hilaire, who has so ably advocated the doctrine that monstrous formations proceed from faults of development, or, in other words, from a derangement of the *nisus formativus*, admits the influence of mechanical causes, in certain cases. He is of opinion, that unnatural adhesions, formed between the fœtus and its investing membranes, at a period when the organs are as yet in their rudimentary condition, may have the effect of altering their natural situation and direction ; and, likewise, by turning towards the placenta a portion of the blood destined for the fœtal organs, may thereby produce an arrest in their development. If to this doctrine, it be objected, that the malformations are not confined to the surface of the body, but are likewise found in its interior, M. St. Hilaire replies, that there has been a period in the evolution of the fœtus, when these organs were exterior, and consequently susceptible of contracting adhesions with the placenta : that, if these adhesions continue, the organs remain superficial, and the parietes of their respective cavities, which are generally subsequent in their formation to the organs they enclose, are in such cases not formed at all ; but that, if from the increased weight of the fœtus, or any other accidental cir-

cumstance, these adhesions be ruptured, the organs whose development they had impeded are no longer found protruding from their cavities, but still remain in a state of imperfect development, because the natural period of their evolution had gone by.

The number of observations and facts by which this theory is, as yet, supported, is too inconsiderable to warrant its general application : at present it can only be admitted as applicable to some particular cases of monstrous formation.

If monstrosities be the result of a fault of development produced by external mechanical causes, it is evident, that we must possess the power of preventing the regular development of the fœtal organs, and of producing at pleasure certain malformations, by artificially modifying the condition of the embryo at different periods of its existence. This experiment has been tried by M. St. Hilaire. He caused several eggs to to be hatched, some of which had been previously varnished in different parts, and others, enveloped wholly, or partially, in gold beaters' leaf, while others, again, had had their shells perforated by various means. At the expiration of the usual period of incubation, it was found, that in some the chicken was not all developed ; in others, it had not attained its natu-

ral size ; whilst in some instances its growth was quite preternatural.

In another series of experiments, he endeavoured to modify the organization of the chick, by perforating, striking, or shaking the eggs, at different periods of their incubation. We have not, as yet, been made acquainted with the results of these experiments.

It is highly probable, that the development of many of the organs of the fœtus is considerably influenced by the quantity and quality of the nutriment which it receives. This conjecture derives considerable support from the very interesting experiments made on bees by M. Hubert of Geneva, in which he succeeded in producing at pleasure males, females, or neuters, by placing the young insect in a cell containing a greater or less supply of honey.

Several authors have enumerated, amongst the causes of monstrous formations, various degrees of pressure made on the fœtus, by tumours attached to the parietes of the uterus, by a second fœtus, or by a mass of hydatids, &c. Others, again, have attributed these malformations to certain varieties in the form and distribution of the umbilical cord. But, in the present state of our knowledge, though we cannot altogether reject the influence of any of these causes, we must consider them as playing a very secondary

part indeed, in the production of the various monstrosities. It appears to me quite unnecessary to enter into a formal refutation of the antiquated superstition of the vast influence which the imagination of the mother exerts over the development of the fœtus ; an opinion founded only on rude resemblances sometimes existing between certain malformations, and frightful objects which may have disturbed the mind of the mother during pregnancy. I am not, however, prepared to deny that a strong moral emotion felt by a pregnant woman, may exert some influence on the nutrition of the fœtus in her womb, and to a certain extent arrest or pervert its development. The influence of such causes is, however, much weaker than might, *a priori*, be supposed ; for, we have examples occurring every day, of women suffering under the most violent moral emotions, and yet producing well formed children ; and, on the other hand, of women bringing monsters into the world, without having experienced a single moment's uneasiness during the whole period of pregnancy.

CHAPTER II.

Lesions of Nutrition with respect to the Number of the Molecules composing the different Solids.

THE number of the constituent molecules of any solid, may be either increased or diminished. An increase of their number seems to indicate an exuberance of the nutritive powers of the part, as is expressed by the term *hypertrophy*, used to signify this particular alteration. On the other hand, the diminution in the number of these molecules appears to proceed from a deficiency of the nutritive powers; hence the term *atrophy* has been adopted to express the condition of a solid, which receives less nourishment than natural, or which, when its nutrition is totally suspended, becomes at last completely obliterated.

ARTICLE I.

Hypertrophy.

THIS term, which has been not many years adopted into medical language, was at first restricted in its application, to the preternatural

increase of nutrition of the thyroid gland, the heart, and the muscles of animal life ; its signification has of latter years been considerably extended, as the investigations of modern pathologists have clearly ascertained, that there is not a single tissue or organ in the body, which is not liable to this affection ; so that hypertrophy may now be justly considered one of the most frequent alterations of nutrition, as well as one of those which occasion the greatest variety of functional derangements. It is not, however, simply by its presence in some part of the body (as is the case with various morbid secretions) that hypertrophy produces an injurious effect on the system ; for its influence is only felt when it disturbs any of those functions which cannot be deranged with impunity. Thus, hypertrophy cannot be considered as a disease, when seated in a muscle of animal life ; but, when affecting the heart and deranging its functions, it constitutes one of the most formidable diseases.

The term hypertrophy should be applied exclusively to those cases in which the tissue whose volume is increased retains its natural structure and organization ; and not to those lesions in which the increase of volume is owing to other causes than the mere increase of number of the molecules of the tissue.

This affection may be studied, 1. in the se-

veral elementary tissues : 2. in the organs which
are formed by the combination of these tissues.
Under the influence of certain causes which I
shall endeavour to appreciate at the conclusion
of this chapter, we frequently observe various
portions of the cellular tissue interposed between
the different organs, become affected with hy-
pertrophy ; in which case it undergoes a variety
of alterations in its sensible qualities. Thus, in
those parts where it naturally possesses but little
consistence, and resembles a sort of organized mu-
cus, it acquires when hypertrophied a greater de-
gree of firmness and density ; and, in the parts
where its density is naturally considerable, its
laminæ and filaments acquire an unusual thick-
ness, become blended together, assume a dull
white colour, or a peculiar grey semi-transparent
appearance, and offer considerable resistance to
the scalpel. When the hypertrophy has arrived
thus far, we observe between the organs, or the
different parts of the same organ (according to
the seat of the disease) a whitish substance in the
form of laminæ, or of irregular masses, inter-
sected by numerous lines and striæ ; and, if we
examine the structure of these masses, and trace
their formation, we find that they are evidently
composed of portions of cellular tissue, which be-
come progressively more and more condensed,
and finally present the appearance of a homoge-

neous mass, which, according to its colour and degree of condensation, resembles either the interior of a turnip, with its dull white striæ in a greyish parenchyma ; the fat of bacon ; or imperfect cartilage, such as is found in the fœtus.

These different varieties of hypertrophy of the cellular texture have hitherto been erroneously, as I conceive, attributed to the development of an accidental production, a new tissue to which there is nothing analogous in the healthy state ; whereas they will in general be found to depend on a preternatural increase of the nutrition of the cellular tissue, the original and common basis of all organized matter. It is to this hypertrophied cellular tissue, disposed in striæ, laminæ, or rounded masses, the term *scirrhus* is applied, when it is grey and semi-transparent ; and *encephaloid*, when its colour is of a dull white ; in consequence of a rude resemblance supposed to exist between the advanced stages of this tissue (the encephaloid) and the substance of the brain. For my own part, I confess that I have never been able to establish any real or definite distinction between those two accidental tissues, nor do I think that others have been more successful. In the dead body we constantly see them united and confounded together, as indeed might *a priori* be expected, inasmuch as they are both simple

varieties of the same morbid alteration, namely, hypertrophy of the cellular tissue; in some cases, simple and uncombined, in others, conjoined with some product of a morbid secretion into the areolæ of the cellular texture.

That peculiar variety of cellular texture which, when drawn out into the form of a membrane, constitutes serous tissue, has not as yet been found in a state of hypertrophy; but an exuberance of nutrition has frequently been observed in the cellular texture which lines the delicate pellicle, or sort of inorganic epidermis, termed *serous membrane.*

The tegumentary tissues, both mucous and cutaneous, are often affected with hypertrophy: in some cases the whole tissue is hypertrophied; in others, some only of its anatomical elements experience this alteration. Thus, in the nervous membranes, we occasionally observe the hypertrophy confined, 1. to the substance of the mucous tissue; 2. to its villosities; 3. to its papillæ; 4. to its crypts or follicles. Thus, in like manner, in the skin, the hypertrophy may affect exclusively the cutis vera or dermoid tissue properly so called, the follicles which it contains, the papillæ which arise from its surface, or the different layers which, taken together, constitute the corpus mucosum of Malpighi. There are certain morbid conditions, which, by producing

the hypertrophy of some one of these constituent portions of the cutaneous tissue, serve admirably to demonstrate its existence, and to throw more light on it ; such is the following case :

A woman, seventy-four years of age, died of phthisis, in the hospital of La Charité, with several tuberculous cavities in her lungs. She had formerly had an ulcer on her right leg, but for the last thirteen years the sore had been cicatrized, while the limb had gradually acquired an extraordinary development. It was swollen and hard, and the skin was rough, and mostly of a yellowish brown colour, not unlike the shade observed on the cubital margin of the hands of negroes ; in some points its colour was considerably darker, approaching to black. After death I proceeded to examine the limb. Neither the arteries nor veins presented any appreciable trace of disease, in the texture of their parietes, or in the sensible qualities of the blood which they contained. The subcutaneous and intermuscular cellular tissue was remarkably developed, and even indurated. I was struck with the perfect resemblance it presented to the submucous cellular tissue of the stomach, when, being indurated and infiltrated with concreted albumen, it has undergone that peculiar degeneration termed scirrhus. It still however contained, in certain parts, a considerable number of fatty lumps. The density

of the tissue increased considerably as it approached the corium or cutis vera, which was likewise much thicker than natural, and in several points it was utterly impossible to establish a precise line of demarcation between the thickened corium, the aponeurotic filaments which terminated in it, and the indurated cellular tissue, which was applied to its internal surface ; indeed all these parts seemed to be merely different degrees of one and the same organization. The colour of the corium was not at all altered, not were its capillary vessels injected.

Above the cutis vera, I observed, 1. the papillæ remarkably developed in several points, and quite separate and distinct from the subjacent cutis ; 2. immediately over the papillæ three layers, more or less distinct according to the points where the examination was made ; 3. the epidermis.

The papillary tissue (*bourgeons sanguins* of M. Gautier) presented in some points its usual appearance and dimensions ; but in others, the little cellulo-vascular bodies of which it is composed were so elongated, that they might readily be mistaken for those whitish appendices which are attached to the mucous membrane of the tongue and mouth in several species of birds. These papillæ were united into groups, between

which was interposed a denser and whiter tissue, which, on one side, was continuous with the corium, and, on the other, terminated in a whitish layer, to be presently described, forming a line of separation between the papillary tissue and those parts of the cutaneous tissue more superficially seated, (the rete mucosum of Malpighi and the Epidermis.) In some other points, these elongated papillæ could not be detected; but in their place I observed a wrinkled layer which seemed formed by this same papillary tissue, with this difference, that the papillæ were so swollen and crowded together, that they had quite lost their characteristic appearance. It was easily separated from the corium, which beneath it presented a remarkably smooth, polished appearance.

From these observations it follows, that the cutis is essentially composed of two parts, the corium and the corpus papillare, which, though confounded together, may nevertheless be perfectly isolated and separated one from the other, in certain morbid conditions. The mucous membrane which lines the intestines presents the same appearance; for the innumerable villosities with which its internal surface is studded form a distinct layer, which in certain diseases may readily be detached from the subjacent mu-

cous membrane without producing any solution of its continuity.

Over the papillary surface, and interposed between it and the epidermis, we found three layers perfectly distinct from each other; but there was a considerable difference in the degree of their development at different points. The first layer which presented itself, proceeding from within outwards, appeared like a delicate white line, which, as it dipped in between the papillæ, assumed an undulating appearance; we could not trace any vessel ramifying on it, and it seemed altogether composed of a cellulo-fibrous tissue. It was not equally distinct all through. This layer appears to me evidently analogous to that described by M. Gautier, in the skin of the heel of the negrò, under the name of *the deep seated white layer*, and by M. Dutrochet as *the epidermic layer of the papillæ*.

Immediately over the undulating line just described, or, in those points where this line was not distinctly visible, (of which there were several,) immediately over the papillary surface, appeared another layer, differing from the preceding in its colour, which was of a greyish brown, or black, according to its situation. When cut vertically, there was nothing to be seen but an apparently homogeneous stratum presenting different shades of colour; but when sliced ob-

liquely with a razor, it presented quite a diffe-
rent appearance, and seemed composed of a
network, formed by exceedingly delicate blackish
filaments, crossing each other in every direction,
and leaving between them several transparent
intervals through which the white parts under-
neath were visible. This reticular layer was
evidently analogous to the coloured layer in ne-
groes. I think it necessary, however, to state,
that, notwithstanding the most minute examina-
tion, I could not succeed in observing it com-
posed (as described by M. Gautier) of a series of
small bodies, of the form of segments of a sphere,
lying closely together, which he has called *gem-
mules*. On the contrary, I could distinguish no-
thing in this layer, though very distinct, except
a delicate network, such as is presented by cer-
tain leaves when dried and deprived of their
parenchyma : neither was this the first opportu-
nity I had of remarking this network charged
with colouring matter ; for I had previously ob-
served it most distinctly after the application of
a blister to the thorax of a negro. It is an inte-
resting calculation, whether those filaments,
which by their interlacement constitute this net-
work, should be considered as vessels which
exist naturally in the white as well as the black
man, but in the former are never charged, unless
accidentally, with colouring matter ; and whe-

ther they are the vessels which in jaundice are fil-
led with the yellow colouring matter? An impor-
tant fact, which in such speculations as the pre-
sent should not be forgotten, is, that the secretion
of the black colouring matter is not so entirely
dependant on any special arrangement of organ-
ization, as to be found exclusively in that layer
of the cutaneous tissue where it exists naturally
in the black, and where, in the white, it is occa-
sionally produced by disease. In confirmation
of this observation I may remark, that, in a few
days after examining the skin which forms the
subject of this paragraph, I had occasion to exa-
mine a portion of the skin of another individual,
the surface of which was studded over with a
number of small black spots, that on examination
were found to depend on a black colouring mat-
ter interposed between the corium and epidermis,
and evidently unconnected with either the one
or the other. Similar spots produced by the
same cause were also found scattered up and
down in the substance of the corium, and in the
subcutaneous cellular tissue ; hence it would ap-
pear as if the simple fact of a healthy secretion
having become a morbid one, were sufficient to
release that secretion from the necessity of ap-
pearing exclusively in its natural situation. Ac-
cordingly, similar depositions of colouring mat-
ter have occasionally been found in every tissue

in the body. Be that as it may, the preceding description proves the accidental development of a coloured layer in the white subject, precisely in the same situation where it is said to exist naturally in the negro ; and little doubt can, I think, be entertained, that it was the colouring matter contained in this layer, which produced the partial coloration of the skin of the limb affected with elephantiasis.

As we prosecuted the dissection, the epidermis appeared at several points in immediate contact with the layer last described, from which it could be separated by putrefaction without receiving the least stain from it; but, at other points, another layer appeared interposed between the epidermis and the coloured layer, presenting different aspects in different situations. In some it was a delicate white layer, analogous to the epidermic layer of the papillæ ; in others, its thickness was much more considerable, and at the same time it acquired a greyish colour, a considerable degree of hardness, and a true horny consistence, and in some places was composed of a series of scales placed one above the other, in an imbricated manner. Where this latter disposition existed, the innermost scale was generally sustained by a cluster of papillæ preternaturally developed. From these details, no doubt can be entertained that this third layer,

situated immediately under the epidermis, was analogous to that described by M. Gautier, as existing in the negro, and which he named *the superficial white layer*. This layer exists only as a rudiment in man, but in animals is more perfectly developed, for the production of the various species of shell and horn ; it has in consequence received from M. Dutrochet the more scientific appellation of *the horny layer*.

Thus then, we have demonstrated by morbid anatomy the complex structure of that portion of the cutaneous tissue which is interposed between the corium and epidermis, to which Malpighi first called our attention, under the appellation of the *corpus mucosum vel reticulare ;* he likewise observed in the coloured layer, that appearance of network, which arrested my attention both on the blistered surface of the chest of the negro, and in the skin of the individual affected with elephantiasis, as I have just mentioned.

From the time of Malpighi to the present day, our knowledge of the anatomy of the cutaneous tissue cannot be said to have made any very important advances. The ingenious treatise recently published by M. Gautier has added some new facts to those with which the Italian anatomist was acquainted ; and the pathological observation which I have just recorded, appears to me to establish the accuracy of the results

which he has announced. Accordingly, I think we may now consider it beyond all doubt, that the skin of the white man, as well as of the negro, and of all animals in general, is composed of several parts or layers, which in different species either attain their maximum of development, or exist in such a rudimentary form, that it is only under the influence of some pathological circumstances they acquire such a degree of development as to become discernible.

Different portions of the fibrous tissue, are likewise not unfrequently found in a state of hypertrophy, which sometimes manifests itself by a simple increase of the natural volume of this tissue, and sometimes by its unusual development in points where it generally exists as a rudiment, and can only be detected by a minute and careful dissection, or even where its existence is only inferred from inductions derived from comparative anatomy.

Of hypertrophy of the cartilaginous tissue we know but little; that of the osseous system is exceedingly common, and presents a great number of varieties, of which I shall defer the description, until I come to treat of the diseases of the organs of locomotion.

To the second volume, I shall also postpone all observation respecting hypertrophy of the nervous tissue; only remarking here, that its

existence has been most clearly established in the nervous centres (both the brain and the spinal marrow).

Hypertrophy of the mucous tissue should be considered as existing, 1. in the muscles of animal life; 2. in the fleshy substance of the heart; 3. in the contractile layers which envelop the mucous membranes of the alimentary canal and bladder; 4. and lastly, in several other parts, where, under the influence of disease, a muscular structure becomes perceptible, which, in the healthy condition of the part, is either totally imperceptible, or presents only a rudimentary appearance; as in the trachea, bronchial tubes and gall bladder. Here again I must remark, that some of these pathological conditions of the muscular tissue in the human subject, are analogous to the natural condition of the same part in other animals.

It occasionally happens, that the minute vessels which convey the blood through the substance of the various tissues, acquire an unusual development, and present an appearance as it were of vegetation : in this state, when clustered together, they form tumours of various shapes and dimensions, which are sometimes prominent, and sometimes lie concealed in the parenchyma of the tissue or organ where they are formed. These vessels may compose the tumour almost exclusively, being supported only

by cellular tissue ; or they may exist merely as accessories in tumours composed of other anatomical elements, such as excrescences of the mucous membrane. I recollect having once found in the intestine, a soft reddish tumour of the size of a walnut, attached to the mucous surface by a broad pedicle. This tumour was composed, 1. of the mucous membrane scarcely altered from its natural state ; 2. of the submucous cellular tissue, which was remarkably thickened and indurated, and constituted the principal part of the bulk of the tumour ; 3. of numerous veins clustered together in purple festoons on the free surface of the tumour, so as to resemble small hæmorrhoidal tumours distended with blood. In this production, which may be ranked among the vegetations, or polypi, as they have been termed, I could distinguish no other morbid alteration than a hypertrophy of some of the natural tissues of the intestine.

When these vessels are thus increased in size, and therefore apparently in number, they sometimes undergo a peculiar modification in their texture, which gives rise to the formation of a tissue, for which I cannot find a better standard of comparison, than the structure of the spleen. In fact, we observe, just as in the spleen, numerous areolæ filled with blood, communicating freely with each other, and with large veins, the

parietes of which, perforated in all directions,
are divided at their termination, or rather ori-
gin, into simple filaments, losing themselves in
the areolar tissue. In these veins and areolæ,
the blood either circulates or stagnates, and in
this way its quantity is exceedingly variable, and
thus produces rapid changes in the consistence,
form, and size of the tumour. In such cases,
the blood not unfrequently escapes, and thus
gives rise to copious hæmorrhages.

The blood which is found in the areolæ pre-
sents the same varieties in its appearance, con-
sistence and colour, as the blood effused into the
cells of the spleen ; thus, in different tumours, or
parts of the same tumour, it appears colourless,
pale-red, greyish, like the lees of wine, or as
black as the pigment of the choroid ; it is per-
fectly fluid, of the consistence of currant jelly,
or hard as a piece of muscle ; sometimes it is im-
possible to separate it from the solids which in-
vest it, sometimes it is easily removed by wash-
ing and pressure, the parenchyma in which it
was contained then presenting exactly the ap-
pearance of a spongy texture : in all these respects
it perfectly resembles the appearance and struc-
ture of the splenic parenchyma.

Such is the morbid alteration which has been
described under the various appellations of
fungus hæmatodes, sanguineous tumour, and
more recently, *accidental erectile tissue.* In the

midst of this vascular development, other lesions of nutrition or secretion may likewise occur; hence it is, that in several tumours of fungus hæmatodes, there have been found, in addition to the peculiar anastomosis of vessels constituting its basis, different morbid productions, such as fibrous or scirrhous masses, pus, melanosis, &c. Similar tumours are, not uncommonly, formed in the cutaneous tissue, and more frequently still in the subcutaneous and intermuscular cellular tissue. They are also found in the mucous membranes and their subjacent tissues. Of all the parenchymatous organs, the testicle appears most liable to this disease, which constitutes in it one of the varieties of sarcocele. I recollect having seen, in the hospital La Charité, a number of erectile tumours developed in the lungs of an individual, who had had one of his testicles removed several months before, in consequence of its being the seat of a tumour that was likewise of an erectile nature. The tumours in the lungs, five or six in number, were each about the size of a walnut: they were embedded in the substance of the lung, which was perfectly healthy all around them; and in the points they occupied, it looked exactly as if the parenchyma of the spleen had taken the place of the pulmonary structure. In another case, for the particulars of which I am indebted to Professor Marjolin, a tumour, perfectly resembling a portion

of the spleen, was found in the brain of an individual, who, like the patient at La Charité, had also had one of his testicles removed for the same affection, as was ascertained on examining it after the operation.

Hypertrophy, when considered as affecting the different organs, should be distinguished into two species; according as it affects the entire mass of an organ, or, as it affects only some of the anatomical elements which enter into its composition. For instance, the cellular tissue of any organ may become so hypertrophied as to form the predominating ingredient in the composition of that particular organ, while at the same time, by virtue of a species of balance or compensation in the nutritive powers of the part, the other tissues undergo a corresponding diminution of volume, and are reduced to a state of partial or even perfect atrophy. Sometimes also it happens, that when an organ is composed of several tissues peculiar to itself, one of them acquires a preternatural development, whilst the others retain their ordinary dimensions, or else suffer a diminution of volume. In general, whenever an organ is in a state of hypertrophy, its vessels acquire an unusual development: the same remark has not as yet been verified with respect to its nerves.

The organs which are in a state of hypertrophy may undergo various modifications in their

size, their form, and in their apparent structure. Their size may either be increased, unaltered, or diminished. Of these three cases, the first is decidedly the most common; the others may, however, occur, when, at the same time that one of the tissues of the organ is in a state of hypertrophy, the others are reduced to a state of atrophy; or when the hypertrophied organ is hollow, and the deposition of the additional molecules is confined to its internal surface, in which case, its cavity is either diminished or altogether obliterated. Sometimes, on the contrary, the hypertrophy of an hollow organ co-exists with a remarkable increase of its cavity; whilst, in other cases, it is neither increased nor diminished.

When only some of the compound tissues of an organ are affected with hypertrophy, the appearance of the part is in some cases so completely altered, as to render it almost impossible to recognize it. It may then easily be mistaken for an accidental production, or may give rise to the supposition, that the original tissue was replaced by a newly-formed tissue, when, in reality, the only alteration in its texture or composition consisted of an unusual increase of nutrition in one or more of its anatomical elements.

Hypertrophy may exist simple and uncombined, or may co-exist with other alterations of the tissue or organ affected. Thus it may be

combined with hyperæmia, or, on the contrary, with anæmia. In the latter case, the part hypertrophied, receiving less blood than natural, becomes pale and exsangueous; in this state we frequently find portions of cellular tissue when affected with hypertrophy. It is true that in such cases the hypertrophy may have been proceeded by hyperæmia; but, during the progress of the affection, the hyperæmia disappeared, and was succeeded by anæmia. Thus it is that we sometimes find the parts affected of their natural colour, sometimes presenting different shades of red or brown, and sometimes also, colourless and exsangueous. In like manner, their consistence is, in some cases, unaltered; in others, (and they are the most numerous) increased; and in others, again, diminished, the tissue hypertrophied being at the same time in a state of softening.

From the observation of the phenomena of hypertrophy, let us now proceed to investigate its causes. The production of this morbid alteration has been by many Pathologists attributed to an increased afflux of blood towards the organ affected. This increased local determination of the nutritive fluid may readily be conceived to perform a very important part in the production of hypertrophy; but, in my opinion, it cannot be considered as its sole, or even as its essential

cause. I do not consider it as the sole cause, be-
cause the increased determination of blood to an
organ can, of itself, only produce the congestion
of that organ, but can never cause its hypertrophy,
unless when aided by a corresponding increase
in the assimilating powers of the part. Now, if
these powers be supposed increased, the other
condition become unnecessary; for, the in-
creased powers of assimilation, by their more ac-
tive appropriation of the nutritive particles con-
tained in the ordinary supply of blood, are
sufficient to produce the preternatural growth or
hypertrophy of the part, independently of any in-
crease in the quantity of the nutritive fluid.

But, though I admit in some cases of hyper-
trophy an increased energy of the assimilating
powers, I am far from considering its existence
as necessary for the production of every species
of this affection. Why may not cases occur in
which, whilst the powers of assimilation remain
in their natural condition, there is a decrease in
the powers of disassimilation, or, in other words,
of that force by virtue of which the molecules of
the various solids are constantly detached, and
absorbed into the circulating medium from
which they were originally derived? Is it in
such cases, that hypertrophies that had been
combated in vain by bloodletting and emol-
lients, have yielded to the use of stimulants,

such as iodine, mercury, &c. ? Let us turn from these speculations, to the consideration of facts ; from which we may derive the following conclusions.

1. Several hypertrophies are produced simply by an increased exercise of the functions of the affected organs.

2. Other hypertrophies have been known to proceed to an acute, but more frequently to a chronic, attack of hyperæmia. In such cases, the hypertrophy is sometimes confined to the tissue which was previously in a state of irritation and hyperæmia ; while sometimes, after the tissue originally affected has returned to its natural healthy condition, the adjacent tissues retain a chronic form of disease, and fall into a state of hypertrophy. Such is frequently the termination of inflammation of the skin and mucous membranes.

3. Lastly, there are certain cases of hypertrophy, in which the existence of a healthy or morbid stimulus in the organ affected, can be inferred only from analogy with the preceding cases. To attribute such changes of tissue to *nutritive irritation* of the part, appears to me wholly gratuitous ; why not as well attribute them to a diminution of its powers of decomposition ? Each opinion seems to me equally hypothetical. I would therefore recommend, that the treatment

of this affection should be founded on neither of these theories exclusively, but that the existence of hypertrophy being once ascertained, we should endeavour to discover *experimentally* what are the most efficient means of combating and subduing it. By adopting this method of proceeding, iodine has been discovered to possess the power of dissipating the hypertrophy of the thyroid; and mercury has been proved a no less powerful agent, in destroying certain forms of exostosis, truly resulting from hypertrophy of the osseous tissue.

Those hypertrophies, the cause of which cannot be traced to any previous or present irritation of the affected organ, may be divided into two classes. In one, they consist of a purely local affection; in the other, they appear intimately connected with the condition of the whole system, and may be considered as local indications of the thorough alterations which the function of nutrition has undergone in every part of that system.

In this class are to be ranked persons affected with scrofula, in whom not the least remarkable of the various groups of morbid phenomena which they present, is the simultaneous hypertrophy of the brain, the thyroid gland, several parts of the osseous system, the liver, the tongue, and the upper lip. I should have but a very

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poor opinion of the physiological knowledge of any one who should consider each of these modifications of nutrition as merely a local affection, and, as such, should direct his attention to it only, neglecting the really important indication of attending to the general state of the constitution.

ARTICLE II.

Atrophy.

THERE are several organs in man and other animals, which only retain their perfect development until a certain definite period, after which their vital activity diminishes, and they are gradually absorbed. In some organs the period of atrophy commences at an early stage of fœtal life; thus, the vesicula umbilicalis speedily disappears, when its functions cease to be requisite for the further development of the embryo. In others, the period of decay commences at the termination of intra-uterine existence ; at that time, the thymus gland, supra-renal capsules, and certain blood-vessels, begin to disappear, and the left lobe of the liver diminishes in size ; and as the individual advances in life, each subsequent period of his existence is marked by the atrophy of

one or more organs. Thus, in old age, the lymphatic ganglions are no longer visible ; the ovaries are reduced to their fibrous envelope, and can, in some cases, with difficulty be detected amidst the peritoneal folds which contain them ; the parenchyma of the lungs is likewise rarified to an extraordinary degree : this increased capacity of the air cells so constantly observed in old age, is evidently produced by the atrophy of the bronchial tissue, and, according to its various degrees of development, presents a striking analogy to the pulmonary apparatus in the natural families of the chelonea and batrachia. These phenomena of atrophy are still more remarkable in certain animals, which in the course of their existence undergo various metamorphoses. Thus, in the tadpole, when about to change into a frog, the tail gradually disappears, and the gills are obliterated, and their place supplied by lungs, which lay in a rudimentary state, as long as the animal retained the form of a tadpole, and respired only in water.

Atrophy, considered in this point of view, may be regarded as a grand physiological phenomenon, which occurs throughout the animal kingdom in every organ whose functions become less exercised, or altogether suspended. In such circumstances, the process of atrophy is subject

to certain determinate laws, which regulate its progress, and under similar circumstances invariably produce similar results. But there are also certain cases, in which atrophy can no longer be viewed as a healthy phenomenon, or as regulated by the laws of physiology ; on the contrary, it proceeds from an infringement of their laws, gives rise to a variety of functional derangements, and constitutes a true pathological condition. The circumstances which in such cases appear principally to favour its development, are the following :

1. A diminution in the usual supply of blood.

2. A diminution of the nervous influence in the part.

3. A diminution in the activity, or a total suspension of the functions of an organ.

4. Imperfect sanguification proceeding from some chronic disease of the lungs, or of other organs subservient to the process. In this case, several organs may be simultaneously reduced to a state of atrophy, in consequence of the bad quality of the blood which they receive.

5. Irritation : this cause in general operates indirectly, and produces the atrophy of one tissue by attacking an adjoining tissue, and increasing the activity of its nutrition ; as the excessive vitality of the one produces a proportionate diminution

in the vital powers of the other, and thus re-
duces it to a state of atrophy.*

Atrophy produces certain general modifica-
tions in the parts where it exists. It diminishes
their volume, producing in the membranes a pre-
ternatural thinness of tissue, and in the parenchy-
matous parts, a diminution of bulk. There are,
however, cases in which the atrophy of an organ
may be very considerable, without producing
any perceptible diminution of its volume; such
cases can only occur, when the organ affected
with atrophy becomes at the same time rarified
in its texture, as is exemplified in the lungs and
bones. The consistence of the atrophied organ
is likewise generally diminished: in some cases,
the alteration amounts only to an unusual flac-
cidity of tissue ; in others it constitutes a more or
less perfect state of softening. The colour of
the part is likewise changed ; most commonly it
becomes paler than natural. Its internal struc-
ture, too, is not less altered than its external as-
pect : the size of its arteries diminishes, and, in
consequence, its supply of blood diminishes also ;
the proper texture of the part becomes every day

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* I have seen suppuration of the gall bladder followed by perfect atrophy
of the part. In a middle aged man an abscess formed in the right hypochon-
drium, and gave exit to several calculi, such as are generally found in the gall
bladder. The abscess healed in a few months, and the man subsequently
died of an organic affection of the liver. On dissection no trace of the gall
bladder could be found ; its place was occupied by cellular tissue.

less apparent, and it frequently presents only a few traces of its original organization, and sometimes, even none at all, the greater proportion, or the whole, of its bulk being reduced to cellular tissue, that general element and first step of all organization, and that to which it tends to return in proportion as it becomes more simple.

At the same time that an organ is reduced to a state of atrophy, it very often has an unusual quantity of fat deposited around it, which is in general proportional to the diminution in the bulk of the organ. The same phenomenon is observed in the animal kingdom : in proportion as an organ decreases in volume, a fatty secretion is deposited around it ; thus, in the spermaceti whale, and many of the fish tribe, an oily substance fills the very considerable space which exists between their diminutive brain and the parietes of the cranium.

The thinning of the membranous tissues which results from their atrophy, and the gradual disappearance of their molecules, whether with or without diminution of their consistence, may proceed so far as to produce a complete solution of continuity in one or more points of those tissues ; so that in this manner we may have both ulcerations and perforations formed, as a simple result of atrophy, and totally unconnected with, and independent of any antecedent inflammation. It is

scarcely necessary to add, that if this doctrine be admitted, the existence of these lesions can no longer be considered as unerring indications of the pre-existence of inflammatory action. Indeed, so far am I from subscribing to the general opinion, that every ulceration and perforation must necessarily be produced by inflammation alone, that I am disposed to think that, in many cases, an attentive and dispassionate consideration of the circumstances which attend the development of these lesions, and of the anatomical condition of the parts adjacent, would justify the conclusion that they result from a diminution of vitality, a deficient supply of the nutritive fluid, in a word, from a true state of atrophy, such as naturally takes place in the membrana pupillaris, and produces the perforation of the iris. Hence it appears, that as the functions of an organ may present the same derangements, whether the part be affected with hyperæmia or anæmia, so likewise, its anatomical structure may present the same alterations as consequences of these two opposite affections.

ARTICLE III.

Ulceration.

ULCERATION is the process by which ulcers are formed on the living body. The term ulcer is

applied to that solution of continuity which is produced in a tissue by the absorption of its molecules. With the mechanism of this process we are altogether unacquainted; all that we can appreciate, are the different morbid lesions which precede its formation : these lesions are as follow.

1. A state of hyperæmia unaccompanied by any alteration of nutrition or secretion. This hyperæmia is most frequently of the sthenic character : sometimes it occupies a considerable extent of surface, in different points of which a number of ulcers appear scattered up and down ; sometimes the hyperæmia is circumscribed, and presents the appearance of a small red patch, which, after remaining stationary for a longer or shorter time, at length presents in its centre a solution of continuity, which extends with greater or less rapidity to its circumference, and in this manner an ulcer is formed in the place previously occupied by the circumscribed redness. The dimensions of the ulcer may either correspond exactly with those of the preceding local hyperæmia, or may continue to spread indefinitely.

But, the formation of an ulcer may also be preceded by a true state of passive hyperæmia, or even by a simple mechanical hyperæmia; indeed, one of the commonest species of ulcers is that which is found on the legs of old men, and of persons of all ages indiscriminately who are employed

in manufactories, where their occupations oblige them constantly to maintain the erect position, at the same time that they are exposed to the influence of several debilitating causes, (a crowded, damp room, ill ventilated, and from which the solar rays are excluded ;) in such cases, the only morbid alteration which constantly precedes the ulcerative process, is a stagnation of the venous blood, or, at least, a considerable retardation of its course, as is evinced by the brown or violet colour of the integuments. I think it highly probable, that the formation of such ulcers is owing to the inordinate accumulation of blood in the capillary vessels, which produces by its presence a local stimulus, such as would result from the presence of a foreign body.

2. Different alterations of nutrition. In fact, there is not one of them, which, after a variable period, may not become the seat of a new morbid action, terminating in the formation of an ulcer. Can we conceive any morbid actions apparently more dissimilar than that which gives rise to the formation of the hypertrophy, the thickening, or the induration of a tissue, and that which produces its ulceration? and yet all these morbid states frequently terminate in ulceration. Several of the affections called *cancerous* are, in fact, nothing more than a succession of these morbid conditions in the same part.

Many of those tumours termed scirrhous, or cancerous, appear to consist altogether of masses of hardened cellular tissue, that are ultimately transformed into ulcers, which, spreading slowly, or rapidly, superficially, or deeply, successively engage all the adjacent tissues. How frequently do we observe a small nodule in the skin, evidently caused by the thickening and induration of the cutaneous tissue,' remain stationary for a number of years, without undergoing the slightest alteration in its size, form, or texture ; but at length, either spontaneously, or in consequence of some slight friction, or other irritation, become the seat of an increased determination of blood, and finally be converted into an ulcer, the vast extent and frightful progress of which bear no proportion whatever to the small size of the primitive nodule, or to the stationary condition which it maintained for so long a period. The greater number of the ulcers which occur in mucous membranes, have their commencement in the follicles, some of which were in a state of congestion and induration for some time previous to their ulceration.

3. Morbid secretions. Whenever any of these secretions is developed in a tissue or organ, there is a constant tendency in the part, towards the accomplishment of a general law of the œconomy, by virtue of which, every foreign body

formed in a part endowed with life, or intro-
duced there from without, must be eliminated
and expelled. In order to accomplish this ob-
ject, at a variable period after the formation of
the morbid secretion, whether pus or tubercle,
&c. the living organized molecules in contact
with this production, undergo a process of irri-
tation, which terminates in the absorption of
these molecules ; in this manner is produced a
solution of continuity, or ulcer, which may either
cicatrize, remain stationary, or extend; after the
removal of the morbid secretion from the system,
either by the natural outlets, as when pulmonary
tubercles are evacuated by the bronchia, or by
exits accidentally formed, such as the different
fistulous passages. If the morbid secretion be
a solid, such as tubercle, the process of ulcera-
tion is preceded by suppuration, the product of
which, combining with the morbid product, gives
it the appearance of undergoing a process of
softening. In all such cases, the whole process
of softening consists in the combination of the
molecules of the newly formed pus with the
molecules of the original product, whatever it
may have been.

4. Gangrene. Certain portions of the skin,
of the mucous membranes, and of the parenchy-
matous parts, especially of the pulmonary paren-
chyma, when affected with gangrene, and de-

tached in eschars, leave after them ulcers, which vary considerably in their disposition to cicatrize. In the lung, this produces a cavity, of which the true origin has for a long time been altogether mistaken, and which shall be particularly described in the second part of this work. Ulcerations of the mucous membranes, arising from the detachment of gangrenous eschars, are of much less frequent occurrence than has been generally supposed ; the error seems to have originated in mistaking for the sloughs of gangrene, detached portions of false membranes of a grey colour and fœtid smell, which frequently come away without producing any solution of continuity in the mucous tunic by which they were exuded ; or else the glands of Pleyer in a state of tumefaction and excoriation, and tinged of a dirty grey by the contact of fæcal matter, or changed to black by certain degrees of irritation.

It is essential to bear in mind, that, whatever be the nature of the morbid lesion which precedes the ulcerative process, the formation of that process, though connected with a degree of irritation, whether acute or chronic, does not depend on it as its sole cause ; for, by irritating a tissue in various degrees, we cannot produce its ulceration *ad libitum :* the fact is, that the

ulcerative process depends on certain special
conditions, which reside neither in the intensity
nor in the duration of the irritation by which
it is constantly either preceded or accompanied.
We often observe an ulcer of frightful dimen-
sions succeed to an irritation of short duration,
and so slight as to be scarcely appreciable; whilst
an irritation of the greatest intensity, such as is
produced in the stomach by the swallowing of
concentrated acids, or of long duration, such as
exists in the intestinal mucous membranes of
persons affected with chronic diarrhœa, shall not
produce a single ulcer. It is also of importance
to remark, that in many cases ulceration must
not be considered as the result of any local
affection ; but rather as an indication of a ge-
neral morbid condition, the existence of which
is revealed by local affections most varied with res-
pect to their seat and apparent nature. Thus, in
scorbutic patients, the blood loses its property
of coagulating, and hæmorrhages take place at
different points, while at the same time numer-
ous ulcers are formed on the cutaneous surface,
and not unfrequently attack the mucous mem-
brane of the mouth also. In like manner, in
persons of the scrofulous diathesis, in whom all
the phenomena of nutrition and secretion are
so remarkably modified, we frequently observe
ulcers formed on the skin, the mucous mem-

branes, and even in the bones. The abuse of mercury is a not unfrequent source of ulcers; whilst its judicious use promotes the healing of another class of these affections.

Some ulcers have an especial disposition to spread superficially, whilst others, without increasing their superficial diameter, burrow deeply into the substance of the part. When ulcers of this character are situated in the interior of a cavity, they successively attack all the tissues which constitute its parietes, so that each tissue in its turn constitutes the bottom of the ulcer; and when, by the progress of the ulceration, the external tissue is at length destroyed, a perforation follows, which may give rise to either of these two cases. 1. The cavity whose parietes are perforated, is, by this perforation, made to communicate with another cavity, either natural or accidental. 2. Before the perforation takes place, adhesions are formed between the ulcerated organ and those organs which are in immediate contact with it; so that when the perforation is accomplished, the parietes of the organs with which the adhesions were contracted, supply the place of the perforated parietes, stop up the bottom of the ulcer, and prevent the escape of the fluids from their natural cavity.

The hyperæmia which in almost every in-

stance precedes the ulcerative process, may either continue after that process is established, and give rise to different shades of colour, or may disappear altogether, leaving not only the parts around the ulcer, but likewise its edges and base, pale and exsangueous. In such cases, the only appreciable alteration which the part presents, is the solution of its continuity. The mucous membranes afford frequent examples of these perfectly white ulcers, which are often found perforating their surface in numerous points.

CHAPTER III.

Lesions of Nutrition which affect the Consistence of the Elementary Particles constituting the different Solids.

THE consistence of the different tissues which enter into the composition of our organs is liable to considerable variations from the effects of age, sex, and temperament; similar variations may likewise be observed in the different species of the animal kingdom. Thus, the cellular tissue of the embryo, which is soft, pulpy, and gelatinous, is remarkably different from the same tissue in the adult, and still more so, from that of the old;

and the dry, firm, brain of the latter presents a striking contrast to the infant's brain, which is almost totally devoid of consistence, and to the perfectly fluid brain which belongs to the embryo, during the earlier period of its evolution. In like manner, if we follow the cartilaginous and ligamentous tissues through the several periods of their development, we shall find that at their first formation they partake more of the nature of fluids than of solids, and subsequently pass through various gradations of consistence, until they finally attain that degree of density and hardness, which is peculiar to those tissues in their perfect state. In the different species of animals, we constantly observe the greatest varieties of consistence presented by the same tissue, according to the species in which it occurs. The same portion of cellular tissue which, in one species of animal, is soft and extensible, in another, acquires a degree of hardness almost equal to that of cartilage. The sclerotica, which in man is purely ligamentous, has a tendency to become cartilaginous, or even osseous, in birds. The epithelium which lines certain portions of the mucous membrane of the alimentary canal, and which in carnivorous animals is so remarkably thin and delicate, acquires a much greater degree of consistence in herbivorous animals, especially in the horse; and in birds furnished with a muscular stomach, it

forms on the internal surface of the gizzard a membrane of considerable strength, rough to the touch, and almost as unyielding as cartilage.

Even in the same animal, the mere change of diet and ordinary habits, may produce various alterations of consistence in several of its tissues ; thus, the soft pale flesh of our domestic animals, bears scarcely any resemblance to the firm dark coloured flesh of the same animals in their wild state. If we examine man in all his varieties of temperament, whether natural or acquired, we shall find, that he presents a still greater variety in the consistence of his skin, and his cellular and adipose tissues, as well as of his muscular system in general. Lastly, there are certain cases in which parts of the living system undergo a temporary softening, in order to aid the accomplishment of some physiological actions ; and resume their former consistence when that end has been attained. Thus, the fibro-cartilage which completes the symphysis pubis, undergoes a softening in the females of certain animals at the period of each parturition.

From these facts we learn, that, in the healthy state, various causes, more or less appreciable, are constantly exerting a powerful influence over the consistence of the different solids ; several of these causes act likewise on the fluids, pro-

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ducing in them, as in the solids, an increase or diminution of cohesion ; so that the blood may present the same variations in its consistence, that we have already seen produced in the muscular fibre. Of these variations of consistence, whether of the fluids, or solids, some are purely physiological, and are consequently compatible with perfect health : others, though not exactly amounting to disease, can scarcely be considered as healthy phenomena ; they are in general connected with some peculiarity of temperament, and certain special conditions of hæmatosis and innervation ; and when an individual of such a temperament is attacked with disease, there is a certain peculiarity in its symptoms, progress, and termination, which might have been anticipated from the degree of consistence of the skin, muscles, and cellular tissue, possessed by the individual. What a difference do we often observe in the character of an inflammatory attack of the gastro-intestinal mucous membrane in two individuals, one of whom has soft flabby flesh, whilst the other is quite of a contrary habit of body.

But it is not only as effects of certain physiological laws, or as connected with those general conditions of the body, usually called constitutions or temperaments, that those variations of consistence, of which I have just given some examples, are observed in the different solids :

they frequently proceed from a true morbid condition of the part, and are attended with more or less derangement in the functions of the organ whose consistence is altered. This alteration may either consist in an increase of consistence, constituting *induration*, or in its diminution, which constitutes *softening (ramollissement.)* If we proceed to investigate the causes of these two opposite conditions, we at once arrive at the disputed question, whether they both proceed from one and the same cause, irritation, or in other words, from an increase in the organic action of the part affected. If I could venture to solve any theorem in Medicine *a priori*, I would unhesitatingly reply to the question in the negative; and in support of my opinion, I would repeat the observations I have offered on the variety of causes, which in the physiological or healthy state are capable of effecting a change in the consistence of the different organs, and I would ask, what there is in common between the greater number of these causes and irritation, and whether several of them do not produce an effect diametrically opposite to that of irritation. Now, if in all these cases in which induration is physiologically produced, we admit the agency of several causes, each capable of producing the same alteration, I should be glad to know why this alteration, when pathological, may not likewise

proceed from more causes than one : this ques-
tion shall be discussed in the two following ar-
ticles.

ARTICLE I.

Induration.

INDURATION consists in an increase of the
natural consistence of the tissues, without any
other alteration of their texture.   In this state
they acquire a greater degree of density than na-
tural, and offer a stronger resistance to pressure,
tearing, or cutting ; when struck they frequently
emit a peculiar sound, and when divided yield a
peculiar grating noise under the scalpel, which
has been erroneously considered characteristic
of scirrhus.

Induration may be divided into two species ;
according as it results from an alteration in the
nutrition of the solid particles which enter into
the composition of the tissues affected, or as it
proceeds from some change in the quantity or
quality of the fluids exhaled into their texture.

The first species may be again subdivided,
as follows :

1. The induration which naturally takes

place in certain tissues from the progress of age :
this species has already been alluded to.

2. The induration which takes place at an
early period of life, whether occurring in those
tissues which have a natural tendency to that
affection at a later period, (such as certain por-
tions of the cellular, muscular, fibrous, carti-
laginous, and osseous tissues,) or in other parts,
which do not usually acquire a greater degree of
density or hardness in old age. Thus, the pa-
rietes of the heart are sometimes found so firm
and unyielding, as not to collapse when pressed,
and its cavities seem distended by some elastic
fluid which resists the falling in of their parietes.
Laennec has remarked that when a heart thus
indurated is struck, it yields a peculiar sound,
similar to that elicited by striking a horny sub-
stance. This induration of the heart's structure
may exist either in combination with, or inde-
pendently of, the hypertrophy of that organ ;
as these two alterations are perfectly distinct,
and should be carefully distinguished from each
other, as well in the heart as in other organs.
The liver, the thyroid gland, the pancreas, the
lymphatic ganglions, and the ovaries, likewise
not unfrequently present a considerable degree
of induration of their texture unconnected with
any other alteration.

In the second species of induration, the

solid portion of the tissue, or organ, retains its
natural appearance; and its increased consistence
depends exclusively on a modification of the
fluids, which may either exist in the blood it-
self, or in the fluids which are separated from
it. In acute pneumonia, for instance, the blood
which accumulates in the parietes of the bron-
chial vesicles, by producing the tumefaction of
these parietes, obliterates the cavity of the air
cells, and thus prevents the ingress of any elastic
fluid : under these circumstances, the consistence
of the pulmonary parenchyma appears singu-
larly increased, but the appearance is altogether
deceptive ; for, although the lung may have lost
its accustomed softness, it has at the same time
acquired an extreme degree of friability, so that
the slightest pressure, or attempt at tearing, is
sufficient to break it up. It is quite otherwise
in those cases, where, in consequence of a pro-
tracted sanguineous congestion, the solid texture
of the lung has itself acquired an increased de-
gree of consistence ; the induration is then real,
and the lung thus indurated is with great diffi-
culty torn or divided. The unusual hardness
which the spleen occasionally presents, is in like
manner caused by the increased density of the
blood which fills its areolæ. There is a disease
peculiar to new-born infants, generally known
by the name of *induration of the cellular tissue,*

(*skin-bound, cirronosis,*) which, as in the case
of induration of the spleen, consists altogether
in an alteration of the qualities of the fluid ex-
haled into the cells of the tissue, which, on dis-
section, are found distended by a concreted albu-
minous matter. The blood of individuals thus
affected, is found to be materially altered in its
sensible qualities, its serum containing, in large
quantities, a matter which coagulates sponta-
neously, and forms a gelatinous mass, perfectly
identical with the matter infiltrated into the
areolæ of the cellular tissue—(Chevreul.)—
Hence we learn, that in these cases, as indeed
in many others, the disease is not confined ex-
clusively to the solids, but exists likewise in the
blood ; and that the morbid secretion which is
generated, or at least contained, in the blood, is
the same which, when effused into the cellular
structure, constitutes the cause of the disease.
Who, I would ask, could have ventured to anti-
cipate such a curious pathological fact some few
years back, when it was the reigning fashion of
the day to attribute all cases of hardening of the
cellular tissue, either to an organic affection of
the lungs or heart, or to an acute or chronic in-
flammation of the alimentary canal ? And who
will now take upon himself to deny, that in cer-
tain tumours called *scirrhous,* composed as they
are of cellular tissue, having its areolæ filled

with concreted albuminous matter, there may not, as in the general induration of the same tissue in new-born infants, be a concomitant alteration of the blood? May not the blood furnish this scirrhous deposit which makes its appearance simultaneously in different and often remote parts of the body ; which has a remarkable tendency to be reproduced in those parts from which it has once been removed ; and which, in many cases, is preceded by no appreciable alteration in the structure of the part affected? No doubt, this supposition is purely hypothetical ; but, if it accounts satisfactorily for several circumstances connected with the production of scirrhous tumours, which are otherwise inexplicable, and if it be (as I consider it) derived from a fair and legitimate analogy, it at least deserves to be ranked among those hypotheses which merit a careful and dispassionate examination.

In some cases, the two species of induration already described occur conjointly, and may be observed passing one into the other. When, for instance, we examine the cellular tissue which surrounds old indolent ulcers, we observe several morbid alterations, which are evidently different degrees of one and the same lesion ; thus, the cellular tissue in the immediate vicinity of the ulcer, is considerably harder than natural, and presents the appearance of a solid homogeneous

mass, of a dead white colour, resembling the fat of bacon ; at a little greater distance, the consistence diminishes, and is no longer uniform ; and the lardaceous appearance exists only in some isolated points, the interval between which is filled by a soft, yellowish, inelastic tissue, which on pressure exudes a semiconcrete gelatinous fluid ; at a still greater distance from the ulcer, the same fluid exists, but gradually diminishes in consistence, until at length it becomes a simple serosity, infiltrating a pale, extensible, cellular tissue, resembling that which is found in a part affected merely with œdema.

Parts in a state of induration present great varieties in their appearance ; the principal of which depend on the colour, size, and form of the part, and likewise on the absence or presence of other species of organic alterations.

The indurated tissue seldom retains its natural colour. Sometimes it is remarkably pale and colourless, either in consequence of actually receiving less blood than usual, or from the presence of the concreted albuminous matter, which is one of the most constant causes of induration of the cellular tissue ; sometimes, this indurated part, instead of being pale, presents an unusual colour ; thus, in some cases it is red, in others greyish, yellow, brown, or even black as ebony. These different colours evidently de-

pend either on the various degrees of stagnation of the blood in the indurated part, or on the exhalation of different colouring matters into it. We frequently find such deposits of colouring matter, in infants affected with the disease already mentioned (cirronosis,) in whom the concreted serosity, which produces the sub-cutaneous induration, is generally tinged by two colouring principles, the one of an orange red, the other of a bluish shade; and (what is extremely remarkable) these colouring principles, as well as the concreted serum, are likewise found in the blood, as has been ascertained by M. Chevreul.

Hence induration may be distinguished, with regard to the different shades of colour it presents, into, 1. induration with evident colourless state of the parts (white induration); and, 2. induration with unusual coloration, (grey, yellow, or black with many intermediate shades.) The white or grey induration constitutes those tumours which authors have denominated scirrhous. The black induration has erroneously been considered as forming a peculiar accidental tissue, designated by the name of *melanosis.* I shall return presently to the consideration of these words, and of the true meaning which ought, in my opinion, to be assigned to them.

The volume of indurated parts is no less

variable than their colour. In some cases, the
size is neither increased nor diminished ; in
others, and they are the most numerous class of
cases, it is increased ; and, lastly, the indurated
organ sometimes undergoes a real diminution
in its size. This latter condition may depend
on various circumstances. 1. In certain paren-
chymatous organs, some of the anatomical ele-
ments of which they are composed may fall into
a state of atrophy, or even disappear altogether,
at the same time that those which remain acquire
a remarkable degree of hardness : such is often
the condition of the liver, one of the tissues of
which increases in size and becomes indurated,
whilst the other shrinks, and has a tendency to
be even totally absorbed. The ovaries, too,
present a similar alteration of structure, for their
fibrous tissue often acquires a remarkable degree
of hardness, at the same time that their paren-
chymatous structure is reduced to a mass of cel-
lular tissue with a few vessels traversing its
substance. 2. When the induration of an organ
depends on the condensation of the fluids which
enter into its composition, the volume of the
part may undergo a remarkable diminution ;
as is exemplified in those cases of indurated
spleens, which are at the same time much smaller
than natural. 3. When the quantity of the fluid
part of an organ diminishes, in proportion as

the solid part acquires a greater degree of consistence. As an instance of the diminution of volume of an indurated organ proceeding from this cause, I shall describe a case which once presented itself to my notice, in which the spleen had undergone a remarkable diminution of size, being scarcely as large as a walnut, and was composed almost exclusively of a fibrous envelope, which was thick and extremely hard. In its interior was found a cavity divided into several compartments by fibrous bands; these compartments contained only a small quantity of reddish serum, altogether different from the usual contents of the splenic cells; the splenic artery was ossified, and its calibre so diminished, that a fine probe could with difficulty be introduced; the vein, immediately after emerging from the spleen, resumed its usual dimensions, and presented nothing remarkable in its structure.

The modifications of form to which a part in the state of induration is liable, are the same as have already been described as occurring in cases of hypertrophy or atrophy; it is therefore unnecessary to repeat them here.

The induration of an organ is invariably a slow process, unless in those cases where it depends on a change in the properties or in the consistence of the fluids of the part; in which

case it may take place in a very short space of time. Thus, in living animals when laid open, and their respiration and circulation consequently greatly disturbed, we often see the spleen suddenly acquire a remarkable degree of firmness, accompanied in some cases with an increase, in others, with a diminution, of its volume.

What are the causes which produce the induration of a tissue or organ? To this question we can only reply by stating the results of observation on the subject.

In many cases the appearance of induration has been for a long time preceded by all the signs of active hyperæmia; this occurs, especially, in portions of the cellular tissue, in the mucous membranes, and in the pulmonary parenchyma. It is, however, of some importance to recollect, that, although a process of irritation may have preceded and produced the indurated state of the part, it by no means follows, that this irritation should persist after the induration is once formed; on the contrary, the vitality of the part, and the quantity of blood which it receives, are in many cases, considerably less than before the consistence of the part was augmented; so much so indeed, that, in an organ partially indurated, the parts whose consistence is increased not

unfrequently resemble inert masses of foreign matter deposited in the substance of the organ.

These facts are important, inasmuch as they explain how it is, that, in a great number of cases, certain tissues in a state of induration, have been restored to their original condition by producing in the man artificial hyperæmia, either by the application of topical irritants, or by introducing into the stomach certain substances capable of restoring the equilibrium of the nervous influence, and of invigorating the capillary circulation.

Are we to conclude, that, because in many cases induration of a tissue is preceded by an increase in its organic action, it necessarily must be so in every case? For the solution of this question also, let us have recourse to observation and facts, and from them we shall learn, that not a few cases have been observed, in which, during life, not a single symptom indicated any determination of blood to the part, either previous to, or during its induration, and in which, after death, no trace could be discovered of any such determination having existed; so that, in all such cases, it is from analogy alone that active hyperæmia can be admitted as the cause of the induration. But I would ask, is the knowledge which we possess of the laws which regulate the nutrition of the several tis-

sues sufficient to justify us in assuming, that no tissue can change its consistence without having first been in a state of irritation, or in other words, unless the laws which preside over its composition and decomposition have taken on them a preternatural activity? In the present state of our knowledge, all that we can positively affirm is, that the induration of a tissue is often preceded or accompanied by an increased action in the part; but we have no authority to lay it down as an established principle, that this increased action, or irritation, is the sole and indispensable cause of every increase of consistence in the organic molecules. If we confine ourselves to the observation of facts, we must be content to say that irritation is one of the most constant elements in the production of induration; but if we assert that it is the most important and indispensable element in its production, we state that which has not as yet been proved, unless by a very questionable analogy. Whatever degree of importance we attach to the agency of irritation, as contributing to produce this alteration of nutrition, it must on all hands be admitted, that, taken singly, it is totally inadequate to explain its phenomena; for, in almost every alteration of structure, we may detect the presence of irritation, and yet, we never can trace the specific differences of these alterations

to any corresponding differences either in the degree or in the duration of the accompanying stimulus. If we attempt to explain it by saying, that there is a difference in the nature or mode of the irritation, we only offer a conjectural explanation of the fact, which may be accounted for just as plausibly by the hypothesis that, in many cases, where a tissue or organ is in a state of induration, there is a diminution in the activity of the absorbents, an unusual stagnation of the fluids in the areolæ of its cellular tissue, and, as a necessary consequence, condensation and increased consistence of its organic molecules ; or, that, in certain cases of induration, the venous circulation of the indurated part is retarded, and that consequently there is a deposit of serum, which accumulates and concretes in the cellular tissue ; doubtless these opinions are purely conjectural, but, like the hypothesis of irritation, they have some analogies in their support, and will be equally acceptable to any unprejudiced mind. In my opinion, we know no more of the essential primary cause which determines the induration of a tissue, than we do of the cause which produces any other alteration of nutrition. All that we know about the matter is, that this cause *frequently* produces its effects in parts which have previously been in a state of irritation ; but there

is no proof whatever that irritation must *inva-riably* precede this alteration of nutrition. Few persons, I presume, will feel inclined to maintain, that a bone which is so overcharged with phosphate of lime as to become dense as ivory, must necessarily have been previously in a state of irritation or inflammation ; and yet, if the intermediate stage of irritation be not essentially necessary in this case, why should it be so in similar alterations of the cellular tissue or mucous membrane ? If the views which I have offered on this subject be correct, they deserve the serious meditation of the practitioner ; for they are by no means indifferent in a practical point of view. In order to restore an indurated part to its natural condition, the practitioner will not rest satisfied with stimulating or soothing the part, but will search empirically in the Materia Medica for such substances as, when absorbed into the general circulation, and brought into contact with the elementary ingredients of the solids and fluids, may modify or destroy the unknown cause, under the influence of which the induration of the part was produced.

To recapitulate, induration, considered with respect to its connexion with irritation, presents the following varieties :

1. Irritation may be the first phenomenon

apparent; evidently preceding the induration, and continuing after its formation.

2. Irritation having, as in the preceding case, existed at the first stage of the affection, may subsequently disappear; so that the indurated tissue may continue in that condition, though unaccompanied by any irritation whatever.

3. In many cases, there is no evidence of the induration of a tissue having been at any period preceded by irritation.

4. Whether irritation has existed or not during the first stage of the affection, a period may arrive, when the quantity of blood sent to the indurated tissue is actually less than before its induration, and when its vitality is also less than in the natural state of the part.

5. In an indurated tissue, two species of irritation may exist, which it is important to distinguish. The one may be called the primary irritation, as it precedes, and occasionally contributes to produce, the induration of the part; the other may be termed secondary, as it comes on at a longer or shorter period after the formation of the induration. This secondary irritation is sometimes the means of restoring the indurated part to its healthy condition; but more frequently it is productive of the most injurious consequences to the indurated organ, which, under its influence, acquires a remark-

able disposition to ulcerate, and become the seat of various morbid secretions, while this alteration in the disposition of the part is generally attended with serious constitutional symptoms. This is what constitutes the transformation of scirrhus into cancer, in the language of the old school of pathologists, or, in the language of Bayle, and his school, the passage of scirrhus from the state of crudity, to the state of softening.

From the preceding parts we may deduce several useful therapeutic indications, both for the prevention and cure of induration. They enable us readily to understand, how opposite modes of treatment may succeed in removing this morbid alteration of nutrition, according to the condition of the part affected, which, as we have already seen, is subject to considerable variety. In some cases, for example, the principal, indeed the only indication, consists in removing the sanguineous congestion, or in preventing its recurrence; and consequently the antiphlogistic treatment is the only one which should then be had recourse to. But if, on the contrary, we have reason to suppose that the indurated organ receives less blood, and enjoys a minor degree of vitality than in its healthy state, a different method of treatment must then be adopted; it is under such circumstances that the

topical application and internal exhibition of stimulants may be rationally employed. This precept is far from being theoretical; it is, in fact, only the rational exposition of a system of treatment which has long since been sanctioned by experience, and which, though liable to be abused, has in many instances been attended with the most decided success. It is scarcely necessary to add, that this practice requires the greatest circumspection on the part of the practitioner, who should always bear in mind, that though he may, by the stimulating plan of treatment, in some cases, restore an indurated tissue to its natural conditions, he may also, by the same method, increase the primary irritation if it subsists, or produce the secondary irritation, the fatal effects of which have been already alluded to. In addition to these two methods of treatment, which, though opposite, are nevertheless equally rational, a third method, altogether empirical, may be conceived as adapted to the treatment of induration; the object of which will be to endeavour, by experiment and observation, to discover whether there exist any substances which, when taken into the circulation, possess the faculty of so modifying the process of nutrition, as to restore to the molecules of the indurated tissues their natural consistence. I will not take upon me positively to affirm, that

such substances do exist ; but the physician who has seen the effects of mercury in dissipating exostosis, and promoting the cicatrization of ulcers, will not treat the suggestion as puerile and absurd.

It is the more important to ascertain precisely what methods are best adapted to the treatment of induration, as, in several cases in which the indurated tissue was situated externally, the parts affected have been seen to reassume their natural consistence. This has particularly been observed in portions of the cellular tissue affected with that species of induration, which has been long known by the appellation of *lardaceous*. They have been observed to lose successively their great consistence, and to present, instead of a homogeneous solid, a dense areolar tissue infiltrated with a white or yellow serum ; subsequently the areolar tissue becomes more delicate and extensible; the serous effusion, too, diminishes in quantity, and, finally, the part reassumes all the qualities of cellular tissue in its healthy state. In some cases, the part undergoes a different process ; the induration having, as in the preceding case, disappeared, the cellular tissue which had been affected falls into a state of atrophy, so that the part which, when indurated, exceeded its natural dimensions, subsequently experiences a considerable dimi-

nution of volume, in consequence of the deficiency of the cellular and adipose tissues. In other cases, lastly, the diminution of volume which succeeds to the state of tumefaction and induration, does not depend so much on the atrophy of the cellular tissue, as on the state of the muscles, which having been compressed and atrophied by the mass of indurated cellular tissue, do not resume their natural condition, when that pressure has been removed by the return of the tissue to its healthy state. If the cellular tissue which surrounds old ulcers situated on the surface of the body, can thus recover from its state of lardaceous induration, and resume its healthy structure, or pass into a state of atrophy, (which may be looked upon as another method of cure,) may not the same sanative process take place in portions of the cellular tissue more internally situated ; for instance, in that portion which lines the mucous membrane of the stomach, the induration of which constitutes the greater number of the so called scirrhous tumours of that organ ? In both cases, there is a perfect analogy of structure and organization, as well as disease ; why then should there not likewise exist an analogy in their sanative processes ?

ARTICLE II.

Softening.

THE softening of the different tissues, or, in other words, the diminution of their cohesion, was only vaguely described by the older anatomists, but has particularly engaged the attention of modern observers; and so successful have been the recent investigations on this subject, that there is scarcely an organ in the body, in which this remarkable alteration of nutrition has not been detected. As I shall have occasion in the second part of this work to describe the softening of each organ individually, I shall at present offer only a few general remarks on the effects of this diminution of cohesion on the different elementary tissues.

The cellular tissue is often affected with softening; in which case the tissues which it serves to unite, lose their natural mutual cohesion, and may be separated from each other with the greatest facility. Thus, it is very easy to separate large portions of mucous or serous membrane from the subjacent parts, when the cellular tissue which connects them to these parts has lost its ordinary consistence. As, in some cases, the cellular tissue of an organ is the only one affected with this lesion, so, in other

cases, it is the only tissue which remains intact, all the others having entirely lost their natural consistence. Hence it is, that in certain cases of softening of the brain and spinal marrow, the cellular tissue alone remains behind, having survived the destruction of the nervous matter which was contained in its areolæ : indeed it is only in such cases that the existence of cellular tissue in the brain is well capable of demonstration.

The serous tissue also frequently loses its natural consistence, and may then be reduced to a soft pulpy mass by the slightest friction. Such a diminution of cohesion often exists in this tissue without any other appreciable alteration, and, consequently, without any evidence of having been preceded in its formation by any increased determination of blood; more frequently, however, it is accompanied by the exhalation of various fluids either on the free surface of the tissue, or on that by which it is attached to the adjacent ones.

The mucous tissue is peculiarly liable to all the varieties of softening ; in some cases presenting only a slight diminution of consistence, in others, being transformed into a soft pulpy substance, or even into a fluid destitute of any trace of organization. Sometimes the affection engages the whole substance of the mucous

membrane; sometimes it is confined to one of its component parts. For example, in those portions of the mucous membrane which are furnished with an epithelium, the softening may be exclusively confined to that delicate layer, which may then be detached in shreds almost totally devoid of consistence, so as to have the appearance of molecules. When the mucous membrane is provided with villi, the affection may be confined to these, without at all engaging the subjacent membranes, in which case the villi are reduced to a mere detritus, or disappear altogether, leaving in the place which they occupied a superficial ulceration or erosion, which does not all affect the continuity of the true mucous membrane.

The cutaneous tissue also frequently undergoes different degrees of softening; and in it, as in the mucous membrane, this affection may attack the component layers individually, or may engage them all at once. For example, certain cutaneous diseases consist of such an alteration in the secretion of the epidermis, as to reduce that layer, which ought to form a solid stratum over the rete mucosum of Malpighi, to the consistence of a liquid which affords little or no protection to the denuded cutis. In many cases it is possible to trace the several stages through which the epidermis passes from

the solid to the fluid state ; or *vice versa,* when it returns to its natural degree of consistence: It may not be unimportant to observe, that this alteration in the nutrition of the epidermis which produces its liquefaction, is very often combined with the so called scrofulous diathesis; so that we have here another example of the connexion which subsists between a local alteration of nutrition, and the general state of the constitution ; and I again repeat, that the only rational mode of combating the local affection, is by attempting to modify that state of the constitution on which it depends. The dermoid tissue, properly so called, may lose its consistence in various ways. 1. When mechanically distended by fluids accumulated in its subjacent cellular tissue, it becomes remarkably soft, and is sometimes reduced to a delicate soft pellicle, which tears with the slightest effort. 2. In certain individuals it gradually loses its fibrous texture, assimilates itself to the cellular tissue with which it is in contact, becomes confounded with it, and eventually acquires its soft friable consistence. 3. This tissue frequently softens down, becomes reduced to a pulpy consistence, and is totally destroyed, by the effects of different degrees of active sanguineous congestion. As the skin, so likewise its different horny productions, in man and other animals, are subject to such

a degree of softening as to reduce their natural firm texture to a soft cheesy consistence. They may even be secreted in the liquid form, and afterwards continue so; and it is remarkable, that in this case, as in the softening of the epidermis, already alluded to, this diminution of consistence, when affecting the nails, in the human subject, frequently co-exists with other alterations of nutrition which characterize the scrofulous diathesis; so that whether our object be to investigate the nature, or to stop the progress of this softening of the nails, or of the other morbid alterations by which it is accompanied, we shall in vain hope for success if we confine our attention solely to the part affected.

The vascular tissue may, like those already enumerated, lose its natural consistence. The softening to which this alteration gives rise, may frequently be observed in the coats of the arteries and veins, and is generally confined to their internal tunic, where it appears occasionally to precede the ulcerative process. In some cases, however, all the coats of these vessels are softened together; and many years have now elapsed since M. Dupuytren announced, that the facility with which a ligature applied to an inflamed artery divided its coats, was owing to the softening of its cellular tissue. The fibrous coat is sometimes transformed by softening, into

a pulpy, inelastic substance, which is easily torn by pressure, or even reduced to a pultaceous mass. Isolated points in this condition have been observed in the coats of the blood-vessels, and to such an origin must be attributed many of the perforations which occur both in the arteries and veins.

The cartilaginous tissue may lose its natural cohesion, so as to present three different appearances. 1. It loses its elasticity, and in some points is reduced to a sort of paste, which yields under the finger, and is easily broken down by the slightest pressure. 2. The dry and elastic cartilaginous tissue of the adult, in some cases reassumes the appearance and qualities which it presented during infancy ; that is to say, the aqueous ingredients preponderate in its composition, and while it loses its elasticity, it acquires some degree of extensibility ; in short, it seems to pass from the state of cartilage, to that of fibro-cartilage. 3. The cartilaginous tissue of the adult may present all the sensible qualities which characterize its appearance during the earlier periods of the evolution of the fœtus ; that is to say, in consequence of the great proportion of water which it contains, it becomes soft, mucous, and transparent as jelly or glue.

The fibrous tissue presents nearly the same

varieties and degrees in its softening as the cartilaginous tissue.

The softening of the osseous system has long attracted the attention of anatomists. We have frequent examples of this affection in the disease called rickets, which consists in such a want of due firmness in the bones, in consequence of a deficiency of the phosphate of lime in their structure, that they may be bent or twisted in any direction by the efforts of their own muscles, or any external force if applied for a sufficient length of time. In some diseases of the bones, they offer no resistance to the knife, and may be cut like lard. In other cases, the compact structure of the bones is so altered, that their interior presents throughout an areolated texture filled with a thin fluid, and limited externally by a delicate pellicle of bone, which is so remarkably brittle that it may be either cut or broken by the slightest effort.

The tissue of the muscles of animal life loses its consistence in the following cases. 1. In the greater number of those cases where the surrounding cellular tissue is infiltrated with pus, as is observed in the vicinity of large abscesses. 2. It also becomes affected, but only so far as to lose its natural firmness, during the course of chronic diseases, or in consequence of having been long unexercised : under these cir-

cumstances the muscles likewise lose their natural colour. De Haen relates a remarkable case of softening of the muscles of an individual who was seized with paralysis of the upper extremities, after an attack of painter's colic: the muscles of the paralyzed extremities, though still retaining a slight degree of contractility, were reduced to the consistence of a soft, pulpy mass; the paralysis subsequently disappeared, and the muscles of the arms at the same time regained their usual consistence and firmness. Barthez has recorded the case of another individual, who, under similar circumstances, was affected with a similar softening of both deltoid muscles: in this case, too, the affection disappeared with the paralysis. It is a remarkable circumstance, that this flaccid state of the muscular system frequently co-exists with a diminution in the natural cohesion of the molecules of the blood. It is an old observation, though I am not prepared to say how far it is true, that, after certain kinds of death, such as those caused by electricity, the poison of the viper, and some narcotic vegetables, the muscles become soft more rapidly and more completely than when death occurs from other causes.

The muscles of organic life have likewise been observed in a state of softening : for example, in almost all the muscular expansions which

surround the mucous membrane, a remarkable diminution of cohesion has been met with. The softening of the heart is sometimes so complete, that the slightest pressure from the finger is sufficient to pierce its parietes through and through, and the least effort, to tear them in any direction.

The softening of the nervous tissue was accurately described many years ago by Morgagni, but has recently been much more fully investigated : indeed it is to the successful investigations of this species of softening, by M. M. Lallemand and Rostan, that we are indebted for the researches which have since been made by various anatomists respecting the same alteration in other tissues.

Lastly, in almost all the parenchymatous organs, as the lungs, liver, spleen, kidneys, uterus, and ovaries, different degrees of diminution of consistence have been observed, which shall be described at length when we come to treat specially of these organs in the second part of this work. The softening of these parenchymatous organs may depend, 1. on the diminution of the consistence of their own proper tissue ; 2. on the diminution of the consistence of the cellular tissue interposed between their proper tissue, and dividing it into lobules, grains, &c. ; 3. on the presence of a certain quantity

of fluid in the areolæ of this tissue, which ne-
cessarily tends to separate and disunite its mo-
lecules; 4. on an unusual fluidity of the blood :
the softening of the spleen often depends on
this cause, and in many cases proceeds so
far, that the spleen resembles in its interior a
sort of reddish pulp, and even conveys a sense
of obscure fluctuation when gently pressed on
its surface, before being opened.　But this soft-
ening does not properly belong to the texture of
the spleen ; it depends altogether on the unusu-
ally fluid state of the blood effused into its cells ;
as may easily be proved by directing a stream
of water on such a spleen, and at the same time
employing gentle pressure, by which process the
blood may be all washed away, and the areolar
tissue of the spleen will remain behind without
any trace of morbid alteration.

Softening, considered generally in the diffe-
rent tissues or organs which are liable to be
affected by it, presents three degrees which it
is important to distinguish.　In the first, the
tissue retains its solid consistence, but may be
ruptured, torn, or perforated, with the greatest
facility.　In the second, the natural texture of
the part is converted into a pulpy mass, which
almost approaches to a state of fluidity ; and,
in the third degree, the pulp itself is partially
removed, and no trace of the original struc-

ture remains except in detritus. This last de-
gree of softening may frequently be observed on
the internal surface of those cavities which are
lined by a mucous membrane, of which the *debris*
alone in many cases remain behind, leaving the
subjacent cellular tissue naked and exposed.
In this manner are formed several of the perfo-
rations of hollow organs, the softening succes-
sively attacking and destroying all the tissues of
their parietes.

Beside these differences of degree which
softening presents, we must also admit several
species of this alteration, depending on the con-
ditions of the tissue or organ affected. These
species are the more important to determine, as
they imply not only a difference of appearance,
but, in many cases, a difference in the nature and
character of this affection. The following spe-
cies of softening may be established with refer-
ence to the different shades of colour which the
softened tissues present.

1. Softening in which the natural colour of
the part is preserved. The mucous and serous
membranes, the tissue *sui generis* of the trans-
parent cornea, the brain, heart, liver, uterus,
&c. present frequent examples of this species.

2. Softening attended with blanching of the
tissues affected. In this case, the part affected
is remarkably pale, exhibits a milky white ap-

pearance, and presents no trace whatever of vascular injection. This species of softening has been observed both in the membranous and parenchymatous organs; the pale appearance by which it is characterized, sometimes arises from a diminution in the quantity of blood circulating in the part; in other cases it depends principally on the preternatural infiltration of serum into the cells of the softened tissue. Some authors have maintained, that in those cases of softening of the brain, in which the softened nervous pulp, so far from being congested, is remarkably pale and exsangueous, this alteration is caused by infiltration of pus into the substance of the brain : this appears to me a mere gratuitous assumption of a fact, for the purpose of accommodating all cases of softening to some favourite theory.

3. Softening accompanied with redness. This species is particularly common ; so much so indeed, that, in by far the greater proportion of cases, the organ affected with diminution of consistence presents on dissection unequivocal marks of a greater or less degree of hyperæmia. In such cases, the blood may either remain in its vessels, or make its escape from them, and thus constitute effusions, more or less extensive, in different parts of the softened tissues. The cause of such hæmorrhages is sometimes

wholly mechanical ; as when they result from
the perforation or destruction of the blood-
vessels, by the constantly increasing softening of
their parietes. Parts affected with softening
may present various shades of colour, from a
bright to a dark red, or to a black, grey, or yel-
low tinge. All these different shades depend
either on the difference of quantity of the blood
circulating in the part ; on the retardation or
stagnation of its course ; or, finally, on the pro-
duction or secretion of some colouring principle.
The redness of the softened tissues may be
either partial or general ; and in either case
may present considerable variety of degree, from
the slight blush produced by a few injected ves-
sels ramifying on a white surface, to the uniform
dark colour observable when the softened tissue
is reduced to a red pultaceous mass.

Parts in a state of softening, when consi-
dered with reference to their bulk, may present
the following varieties. 1. They may retain
their natural dimensions. 2. Their size may
be increased, either by a true hypertrophy of
the part, or, as is more frequently the case, by
the simple congestion of its fluids. 3. They may
present a remarkable diminution of volume, be-
ing in a true state of atrophy. Some facts
would lead us to suppose, that in a softened
part, hyperæmia, attended with increase of bulk

from sanguineous congestion, may precede that quite opposite state in which there is both anæmia and diminution of bulk.

As to the time requisite for the production of the various degrees of softening, no general principle can be established; for there are some cases in which a few days, or even hours, are sufficient for the alteration of a tissue from its natural consistence to that of a soft pulp, or even of a liquid mass, (and this acute form of softening may either co-exist with an increased determination of blood to the part, or may exist without the slightest trace of sanguineous congestion, the part affected retaining its natural colour.) In other cases, again, the formation and progress of this morbid alteration are remarkably slow; so that, in fact, softening is, in some cases, an acute, in others a chronic affection, differing in this respect from induration, which almost invariably exists in the chronic form.

Can a tissue that has once lost its natural consistence, again recover it? We are not as yet in possession of a sufficient number of well authenticated facts to resolve this question.

As to the causes of this affection, we cannot, it is true, discover the proximate cause (which is necessarily uniform) on which it immediately depends; but we can ascertain the phenomena

which usually precede its appearance, and may consequently be supposed to contribute in some degree towards its production. No one of these phenomena can, however, be considered as the only efficient cause ; for, they may exist in every possible variety and degree, without necessarily producing the least change in the consistence of the part. Hence it appears, that softening, like every other alteration of nutrition, is the product of some one peculiar proximate cause, which is in all cases uniform and identical ; and on certain occasional causes, which are not, like the former, constantly and necessarily identical, but are merely the series of phenomena which generally precede or accompany its formation. Of these phenomena, there is one which is so much more constant and striking than the rest, that it has naturally been considered as the cause of most of the forms of the affection ; I mean active hyperæmia. That this phenomenon generally precedes the formation of softening, and not unfrequently accompanies its progress, may easily be established as follows. 1. By examining the morbid alterations of structure which generally accompany softening, and which are universally acknowledged as the effects of active hyperæmia. 2. By investigating the causes which usually determine the softening of a tissue or organ, and which will generally be found of a

peculiarly stimulating nature. 3. By examining the symptoms to which softening gives rise, and which are in most cases similar to those resulting from active hyperæmia. 4. By considering the treatment adapted to this alteration of nutrition, which will be found the same as that employed in cases of hyperæmia.

In many cases, the close connexion which subsists between active hyperæmia as the cause, and softening as its effect, is too palpable to admit of dispute. But there are also cases, and these not a few, in which no such connexion can be discovered; and in which the alterations of structure that accompany this affection, so far from favouring the idea of the existence of inflammation, seem to indicate a diametrically opposite condition of the parts. Of this nature are those cases of softening attended with blanching, or with atrophy, of the affected organ. It also frequently happens, that the production of softening cannot be traced to the action of any appreciable stimulus, but that the state of the general system which preceded its formation is evidently dependant on some important modifications in the function of nutrition all over the body. These modifications may either proceed from external causes, such as a deficiency in the quantity or quality of air, food, &c.; or from internal causes, such as all

derangements affecting the organs concerned in the important process of hæmatosis. The symptoms, too, are often widely different from those which characterize the increased action or irritation of the organ. What resemblance can we trace either in their symptoms or effects between the different degrees of inflammation of the bones, and the softening of the osseous tissue in rachitis? Or where shall we find the symptoms of encephalitis, carditis, hepatitis, nephritis, metritis, &c. in various cases of softening of the brain (especially of its white central portion) and of the heart, liver, kidneys, uterus, &c.; every one of which may pass into such a state of softening, that its tissue may be torn or broken down into a pultaceous mass, without having given rise to a single symptom which could lead to a suspicion of the existence of inflammation.

Organs affected with softening may be divided into two classes, according as their functions are, or are not, deranged by this morbid alteration. When there is no derangement of function, the affection often remains perfectly latent, and neither reveals its existence by any change of sensibility, any disturbance of the circulation, any morbid sympathy, nor, in short, by any of those symptoms which usually accompany every case of irritation, or, in other words, every

exaltation of the organic action of the tissue or organ. It is under such circumstances that softening appears most evidently unconnected with, and independent of, all inflammatory action. When, on the other hand, it produces derangement of the functions of the organ affected, as is generally the case when the brain or stomach is the seat of the disease, a variety of morbid sympathies are called into action, and the symptoms of softening become identical, or nearly so, with those which accompany every acute or chronic irritation of the part. We must not, however, forget, that identically the same functional derangements may result from very different organic affections ; and that, consequently, derangements of function alone cannot serve as an unerring guide to the precise nature of the morbid alteration or condition of the affected organ.

As regards the mode of treatment best adapted to this affection, little satisfactory information can as yet be afforded ; as it is still a desideratum in the science to have a series of well directed experiments, in which shall be fairly compared the different methods by which it has been most successfully treated, according to the seat of the disease, the other morbid alterations with which it was accompanied, and the nature of the symptoms to which it gave rise. Will

any man, in the present state of our knowledge, take upon himself to maintain or deny, that one and the same treatment should be adopted both in the cases where softening is combined with hyperæmia, and in those where no trace of any such combination can be detected, whether from the hyperæmia having never existed, or from its having ceased to exist at an early period of the disease? or will any one assert the propriety of combating, by means of a purely antiphlogistic treatment, the softening of the bones in rachitis, that of the cartilages, nails, and epidermis, in certain scrofulous individuals, and the diminution of consistence which is often so conspicuous in several of the tissues of scorbutic patients?

To sum up the results of this discussion, I conceive that, in the present state of science, we have no grounds for supposing that softening is in every case the necessary result of irritation; but that, on the contrary, the circumstances which frequently attend its formation are utterly incompatible with the existence of any inflammatory action, either antecedently or at the time. Besides, this exaltation in the natural action of the part, is in no case sufficient of itself to explain the production of softening. In fact, all the influence it can possibly have is limited to producing a deviation from the natural

type in the nutritive process of the irritated tis-
sue ; it deranges the nutrition of the part, but it
possesses no control whatever over the mode of
this derangement, and, if possible, still less over
its ulterior results.*   Irritation gives the impulse
to the aberration of nutrition, but does not pro-
duce it ; for the nature of this aberration can
never be calculated from the intensity, nor yet
from the duration of the preceding irritation.
In theory, we have no reason to suppose that
softening is necessarily preceded by an increased
local determination of blood arising from irrita-
tion, any more than induration or any other
alteration of nutrition ; and in point of fact, we
ought not to admit a necessary connexion be-
tween these two orders of phenomena, since in
many cases we find one of them existing singly,
without the slightest proof of having been pre-
ceded or accompanied by the other.   If, how-
ever, I were disposed to offer a theory of my
own, I might suggest, that all the varieties of
softening that occur in sickly, cachectic infants,
whose sum of vitality is actually below the na-
tural standard ; in old decrepid persons ; in
adults affected with scrofula, rachitis, or scurvy ;
and in persons of all ages who are exhausted by
chronic disease, or food not sufficiently nutritive,
as in those animals experimented on by M. Ma-
gendie, in whom softening of the cornea was

seen to follow the protracted abstinence from proper diet ; I say, that all the varieties of softening which occur in these and such like cases, may be considered as merely a more advanced degree of the diminution of consistence, which, in such cases, is observable in the muscular fibre, and even in the blood itself. The integrant particles of the several tissues are brought together and retained in union, by a force of aggregation which is purely and solely vital : if then, (as really happens in an infinity of cases,) the blood and the nerves do not support a sufficient degree of vitality in these tissues, we can readily conceive, that a diminution in the cohesion of their constituent particles may result from such a modification in the influence of these two grand vital agents ; and that thence may arise all the various stages and degrees of softening, from the delicate skin, and flabby flesh, of scrofulous individuals, to that extreme degree in which the solids lose every character of organization, and are reduced to the consistence of a fluid.

The softening of several tissues has been attributed to the action exercised on them during life by their own acid secretions. This supposition is, however, by no means established ; the facts which have been adduced in its support shall be examined when we come to treat of the diseases of the digestive apparatus. It

has likewise been attempted to establish a con-
nexion between certain forms of softening, espe-
cially those of the stomach, and certain injuries
of the cerebral system.   A German physician
states, for instance, that he observed a remark-
able softening of the mucous membrane of the
stomach in all the rabbits he had killed by a
blow on the nape of the neck.   I have repeated
the experiment without obtaining any such re-
sult.

There are certain forms of softening occa-
sionally found in the dead body, which seem to
have been formed after death, and have been at-
tributed to the following causes.

1. The simple diminution of cohesion which
every tissue in the body has a tendency to
undergo, at a longer or shorter period after
death.   This softening is best marked in the
nervous tissue, where it may be easily detected
some time before the decomposition of the rest
of the body commences.   There are other tis-
sues, again, which do not present any traces of
softening until the process of putrefaction is con-
siderably advanced.   Of this number is the mu-
cous tissue, the softening of which seldom com-
mences until a late period, though it is consider-
ably accelerated by exposure to the atmosphere,
and an elevated temperature.

2. The infiltration or soaking of a tissue by

some fluid, which thus subjects it to a species of maceration. The fluid may either be effused into the cavity of an organ, infiltrate the areolæ of its cellular texture, or, lastly, may accumulate to excess in the vessels of the part.

3. The corrosive action exercised on the tissues after death, by the juices of their own secretion. This hypothesis, by which Morgagni long since explained the formation of certain kinds of softening of the brain, has again been revived, in order to explain some similar affections of the stomach ; and I shall revert to it when treating of the morbid anatomy of this organ.

CHAPTER IV.

Lesions of Nutrition, with respect to the Nature of the Molecules composing the different Solids.

WE have seen the different modifications of nutrition, which have occupied our attention in the preceding chapters, producing various alterations in the form, size, consistence, and continuity, of the parts affected ; but we are now about to enter on the consideration of another class, in which the nutrition of a tissue is so

modified as to change its nature, and convert it into a totally new tissue.

The transformation of one tissue into another, is one of the most universal facts which the study of organized beings reveals. It is one of the striking phenomena presented to us in the development of the embryo, inasmuch as several of its tissues do not attain their perfect state, until they have successively passed through the intermediate stages of one or two other tissues. This process of transformation may, in like manner, be observed in the animal series, where, according to the wants of each species, some particular tissue disappears, in order to be replaced by another. Thus, for example, in different animals, the white fibrous tissue, the yellow fibrous tissue, and the muscular tissue, constantly supply the place of each other.* We also find this law of transformation exemplified in the same animal,

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* The longitudinal muscular coat of the large intestine in the human subject is, in the horse, replaced by a fibrous coat. The parietes of the inferior vena cava, which in man are of a simple cellulo-fibrous structure, acquire in several of the larger mammalia a fleshy muscular appearance, especially near the heart. The suspensory ligaments of the horse's sheath are fibrous ; those of the bull are muscular. The middle coat of the arteries is fibrous in man, and likewise in the horse ; but in the elephant is muscular, according to Cuvier. The superficial fascia of the abdomen in man is composed of the white fibrous tissue ; and in the horse, of the yellow ; while in didelphous animals, this expansion changes not only its form and dimensions, but likewise its texture, and is transformed into a muscular envelope, which surrounds the abdominal pouch peculiar to these animals.

especially in man, either as a physiological fact occurring at different periods of his extra-uterine existence, or, as a pathological fact resulting from several of the diseases to which he is subject.

All tissues are not equally liable to transformation, nor does this process take place in the same manner in them all. Their morbid transformations are subject to a certain number of laws, which may be enumerated as follows.

A. All the natural tissues may be produced at the expense of the cellular tissue, which appears to be, by some morbid process, actually transformed into each of them, or at least to resign its place to them ; so that it is in the same cellular texture which constitutes the original framework or matrix in which, during the evolution of the embryo, all the other tissues were originally deposited, that in the adult all these tissues may be again accidentally developed.

B. The nervous tissue cannot be thus formed at the expense of the cellular tissue, unless in those points where it had previously existed naturally. Beclard has seen divided nerves re-connected in this way. All the other tissues may be produced indifferently in any part of the cellular texture.

C. At the same time that the cellular tissue which invests the different organs, or enters into their interior, is thus metamorphosed into some

other tissue, the proper texture of the organ does not itself undergo any transformation, but in some cases it remains perfectly unaltered, and in others is reduced to a state of atrophy.

D. The nature of the transformations which the cellular tissue undergoes, is in certain cases determined by the nature of the functions which it is accidentally called on to fulfil : thus, where it is subjected to an unusual degree of friction, it is converted into a serous membrane ; where there is an accidental necessity for the exertion of elasticity, it is changed into cartilage ; where parts endowed with life require to be protected against the contact of a foreign body, it becomes a tegumentary tissue, more or less perfect ; where the head of a bone is accidentally displaced, it is transformed into a variety of tissues, so arranged, as to constitute an articulating cavity, which, both in its form and structure, bears some analogy to the natural joint, &c.*

E. When a tissue has undergone a solution

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* These alterations of nutrition, determined by changes of function, may likewise be observed in the vegetable kingdom, in which not only a single tissue, but an entire organ, is occasionally metamorphosed ; thus, a branch, when planted in the earth, is transformed into a root, &c. In this kingdom also, another metamorphosis is accomplished by the sole influence of unusually abundant nourishment ; namely, the stamina become converted into petals. In the animal kingdom, the same cause materially influences the production of the different sexes ; for, by varying the proportions of their food, we can create at pleasure young bees of the male, the female, or of the neuter sex.

of continuity, the cellular tissue, by which it is repaired, is sometimes transformed into a tissue precisely analogous to the divided one, and sometimes into another, by which the divided tissue is often replaced in different animals. Thus muscles, when divided, are often reunited by fibrous tissue, which in different animals takes the place of the muscular tissue. In the same way, a cartilaginous substance is sometimes interposed between the fragments of a fractured bone, or an osseous ring maintains in contact the two pieces of a broken cartilage; while in the animal series we constantly see these two tissues replaced one by the other.

F. The only tissues, besides the cellular, which are susceptible of transformation, are such as constantly present similar metamorphoses, during the evolution of the fœtus, or in some parts of the animal series; such are, the muscular, the fibrous, the cartilaginous, the mucous, and the cutaneous tissues.

G. The accidental transformations which these tissues are liable to undergo, are similar to the natural transformations which they exhibit in the human embryo, or during the extra-uterine existence of other animals. Thus, cartilage may be converted into bone, but can never become mucous membrane. The mucous tissue may be transformed into the cutaneous,

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and *vice versa ;* the muscular may be changed into the fibrous tissue, but cannot be transformed into any other. Thus, we see that the meta-morphoses to which these tissues are liable are much more restricted than those of the cellular tissue.

H. Those tissues which do not undergo any transformation in the human embryo, or in the animal series, in no case present any accidental transformation as the effect of disease ; and in those cases where such transformations may be supposed to exist, it will be found, on close in-vestigation, that they have taken place in the surrounding cellular tissue, or that the alteration consists of an unusual development of parts which generally exist in a rudimentary state; as where, in man, the skin is covered with horny excrescences.

I. Every tissue, when reduced to a state of atrophy, has a tendency to undergo a transfor-mation to its original state of cellular tissue ; so that this tissue, which originally preceded in its existence the development of all the other orga-nic elements, is again reduced to its original iso-lated state when these other elements are re-moved. It is curious to observe in the animal kingdom, certain tissues thus resolving them-selves into cellular texture, as they cease to be of use. Thus, the posterior cervical ligament,

which is strongly developed in the horse, and
still more strongly in the ox, becomes less elas-
tic in the sheep, the dog, and the pig; exists
only as a rudiment in the cat; and in man is re-
duced to mere cellular tissue. But even in the
human subject, traces of this ligament have been
observed by anatomists, in the dissection of in-
dividuals who were in the habit of exerting
powerfully the muscles situated on the back of
the neck, or whose heads, from being constantly
weighed downwards and forwards by heavy
loads, required to be supported by a ligament
similar to that which in animals fulfils the same
office.

What is the proximate cause of the transfor-
mation of one tissue into another? Is it in all
cases to be considered as the product of irritation
apparent or latent? It is true that, in many
cases, the first phenomenon which presents it-
self to our notice in the part where the trans-
formation is subsequently to take place, is a de-
gree of excitement attended with more or less
sanguineous congestion; but in other cases,
again, no symptoms of any such antecedent irri-
tation can be observed. Indeed, its existence
cannot always be fairly admitted, either from ana-
logy or induction; and in this particular modifi-
cation of nutrition, still more than in any other,
the preceding irritation and sanguineous conges-

tion can only be regarded as giving rise to some derangement in the process of nutrition, but are altogether inadequate to account for the peculiar character of the alteration which ensues. The more we reflect on the causes which produce the transformation of one tissue into another, the more evident will it appear, that this alteration should be considered as the result of an aberration from the natural nutrition of the part, preceded in many cases by irritation, but neither constantly, nor necessarily so. We are, I conceive, entitled to say, that the peculiar alteration of nutrition on which transformation immediately depends, is neither necessarily nor constantly preceded by irrritation or increased local action, since in a very large proportion of cases, we have no evidence whatever of its existence, either from the symptoms presented during life or the appearances found on dissection ; and since the knowledge which we now possess of the laws of embryogony, as well as of those which regulate the nutrition of different animals, enables us to conceive how every species of transformation of tissue may occur independently of any antecedent irritation. Is it in consequence of this cause that in the fœtus a variety takes place in the origin of an artery ? If then such a change in the situation where the nutritive materials are deposited during the for-

mation of the fœtus, can be conceived to occur without the aid of any preceding irritation, why should the presence of this irritation be considered so indispensably requisite at a subsequent period, for the production of every change which occurs in the selection of these nutritive materials? Is it in consequence of an increased degree of nutritive action in the costal cartilages, that those parts are, in old age, transformed into bone? that the sclerotica of birds is externally osseous, or that, what in one animal is muscle, is in another converted into fibrous tissue, and *vice versa?* Are we to suppose that the process of nutrition is more active in osseous than in cartilaginous fishes, and that the difference of structure which they present, depends solely on this cause? In all these cases, the only fact which we can really appreciate, is, that one series of nutritive particles is deposited in place of another : our knowledge extends no farther. We observe a difference in the mode of nutrition of the parts, but a difference of mode by no means necessarily implies a difference of degree. Let us irritate a tissue or organ as we please, produce a determination of blood towards it, or excite it by every possible variety of stimulus; we shall nevertheless fail of producing any transformation of its tissue, except under circumstances which agree with the laws laid

down, unless by mere accident; and even in
those few cases, in which we do accidentally
succeed, no connexion whatever can be traced
between the effect produced and the intensity,
or duration, of the preceding irritation.

Wherever the transformation of one tissue
into another takes place, the newly formed tis-
sue is in a greater or less degree analogous to
the same tissue as it naturally exists in other
parts of the body. In the following articles I
shall proceed to consider the history of each of
these accidental tissues separately.

ARTICLE I.

Of the Cellular Transformation.

As I have already had occasion to allude to
this species of transformation, I shall at present
offer only a few remarks on it. When treating
of atrophy, I laid it down as a general principle,
that whenever an organ disappeared, a greater
or less quantity of cellular tissue is found in its
place; such cases cannot, however, strictly
speaking, be considered as instances of transfor-
mation; for the cellular tissue had always ex-
isted, and was only rendered more apparent by
the absorption of the proper tissue of the organ.

Whenever the functions of an organ are to-tally suspended, or even rendered less active than usual, it invariably acquires a tendency to lose its natural organization, and return to the state of cellular tissue. Thus we find this tissue, at different periods of life, occupyingthe place of the thymus and mammary glands, of the ovaries, and of the lymphatic ganglions, &c. The extre-mities of an obliterated artery, and of a divided nerve, or tendon, lose their distinguishing ana-tomical characters, and are converted into cellu-lar tissue. In the place of certain muscles which have for a length of time been totally unem-ployed, it is by no means uncommon to find only a few reddish fibres, dispersed through a mass of cellular tissue, from which they can with dif-ficulty be distinguished.

When any part of the body has been affected with active hyperæmia, it is liable to undergo such an alteration in its nutrition, as shall produce a rapid absorption of its nutritive parti-cles, without a corresponding deposition of any new materials ; in consequence of which the part affected may suffer a notable diminution of size, or even disappear altogether, leaving only cellular tissue in its place. I recollect a re-markable instance of transformation of this kind occurring in the gall bladder, as a consequence of inflammation of that viscus, attended with

suppuration. In a middle aged man, an abscess formed under the cartilaginous margin of the ribs at the right side, just over the situation generally occupied by the gall bladder : the abscess burst, several biliary calculi were discharged, and the man subsequently recovered. Several months after, another disease, with which he was attacked, proved fatal. On opening the body, we sought in vain to find any traces of the gall bladder ; in the site which it usually occupies we found only a mass of condensed cellular tissue ; from the ductus choledochus, we traced a duct which, from its situation and direction, must have been the cystic ; but it was impossible to follow it farther than the distance of a few lines, when it terminated in a cul-de-sac, and was lost in the surrounding cellular tissue.

I shall not at present treat of the transformation of various organs into fat, or adipose matter, as admitted and described by several authors; because I do not conceive such cases to arise from the conversion of one tissue into another, but from a preternatural secretion of fat, accompanied with a greater or less degree of atrophy of the proper tissue of the organ. They will therefore come, with more propriety, under consideration in the third section of this work, in which I propose to treat of the different alterations of secretion. In the same place, also, I

shall speak of the genuine accidental cellular
tissue, which, under certain circumstances, is
really and completely formed in the midst of
fluids arising from morbid secretions, and pos-
sessing the property of becoming organized.

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ARTICLE II.

Of the Serous Transformation.

THE serous and cellular tissues present
many points of analogy in their organization,
and functions, as well as in the fluids which they
secrete, and the diseases to which they are lia-
ble. We need not, therefore, feel much sur-
prise at seeing one of these tissues frequently
transformed into the other. In the first place,
it is, as Meckel has remarked, by no means un-
common to find cellular tissue substituted for
certain portions of the serous tissue, even in the
healthy state. Thus, where a synovial bursa is
found in one individual, in another there is only
found cellular tissue, lubricated with a fluid
more abundant and unctuous than the usual se-
cretion of that tissue. The converse of this pro-
position is equally true; for in many points
where, in general, only cellular tissue exists, a
serous cavity more or less perfect is occasionally

found. It is sometimes impossible to assign any satisfactory cause for this conversion of structure ; but, in general, this accidental formation of serous tissue may be referred to one of the laws laid down at the commencement of this chapter, which states, that when the functions of any portion of the cellular tissue are accidentally rendered identical with those of the serous tissue, the structure of the former tissue is likewise identified with the structure of the latter. Thus, when a considerable degree of friction is for a long time exercised between two parts, the cellular tissue which intervenes between them is converted into serous tissue. In several of the bird tribe, for example, no trace of synovial membrane can be discovered, whilst they are still young, between the tarsal bones and the tendons which pass over them, these parts being merely separated by simple cellular tissue ; but, at a subsequent period, as the tendons are more frequently put in motion, a well formed serous tissue is found interposed between them and the subjacent bones. When the skin has been for a long period subjected to an unusual degree of friction, the cellular tissue which separates it from the subjacent parts becomes converted into a synovial bursa of greater or less size. Beclard ascertained the existence of a bursa in some club-feet, at the point where the skin rubs against the prominent

side of the tarsus. When the stump of an amputated limb is examined at a long interval after the operation, a serous sac is not unfrequently found interposed between the skin and the end of the stump. Brodie records an instance of a serous cavity having been formed between the gibbous protuberance of a humpbacked person, and that portion of the skin which constantly glided over it. In some cases of unreduced dislocation, the bones in their new situation are separated from each other by an accidental serous membrane, produced at the expense of the intervening cellular tissue : the same thing is observed to take place between the extremities of fractured bones which do not reunite. I have myself ascertained the existence of a serous sac, filled with an unctuous and apparently gelatinous fluid, interposed between the extremities of one of the cartilages of the ribs, which had been formerly fractured.* In all

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* The formation of serous membranes, in cases of unreduced luxations and non-united fractures, which some authors have thought proper to deny, has been lately placed beyond all doubt by the investigations of M. M. Cruveilhier, Breschet, and Villermé. Eighty-five days after the formation of a false articulation in a boy, whose leg had been fractured, these two latter anatomists found the surface of the false joint lined by a smooth polished membrane, which had all the characters of synovial membrane ; and even so long since as the time of Bichat, that immortal anatomist observed in two men who had false articulations, a genuine cyst, smooth on its internal surface, and lubricated with a serous fluid, *formed at the expense of the cellular*

these cases are we to suppose that the cellular, is converted into serous tissue, solely because it has been subjected to an unusual degree of compression, or friction? Such an explanation is, in my opinion, insufficient to account for many of the facts of this description with which we are acquainted; and I think we should approach nearer the truth in regarding the mechanical cause as only secondary, and in considering such transformations of tissue as the accomplishment of a general law of organization, by virtue of which a modification of structure necessarily follows a modification of function. When foreign bodies are lodged in the cellular tissue which surrounds the different organs, or enters into their structure, it is often possible to follow the different stages through which this tissue passes in its metamorphosis into a serous membrane investing the foreign body, and isolating it from the surrounding parts. A membrane of this description may frequently be detected in the process of formation around effusions of blood. When the clot of blood is thus surrounded by an accidental membrane, it is sometimes gradually absorbed, so that, after a certain time, there is found a limpid fluid contained in

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tissue, and constituting, in the words of this accurate observer, *an accidental synovial membrane.*

a true serous cyst, in the place of a coagulum of blood surrounded by cellular tissue more or less condensed.

When an organ has suffered a loss of substance, which has been but imperfectly repaired, or when a cavity has been formed in its interior, and subsequently evinces a disposition to contract and become obliterated, a serous cavity is established wherever the divided tissue is incapable of being sufficiently approximated to close up the cavity. Examples of serous membranes thus formed may be found in the brains of persons who had at some preceding period manifested all the symptoms of cerebral apoplexy; and in the lungs of individuals who, at some period long prior to their death, had exhibited all the symptoms and stethoscopic signs of a tubercular excavation.

In all these cases, the serous sac is formed in the place of the portion of the organ which had been destroyed; but in other cases, where there has been no destruction of parts, but where these parts have never been developed, a serous cavity is likewise found occupying their place. This etiology of their formation is quite evident in certain serous cysts which are found in the brain; and is also highly probable in many of those cavities with serous parietes which are

occasionally found in the substance of the liver, the kidneys, uterus, &c.

Lastly, serous tissue may be accidentally developed in every portion of the cellular tissue, either where it invests the different organs, or enters into their parenchymatous structure; independently of any of these circumstances which we have enumerated. The parenchymatous organs are sometimes totally transformed into a vast serous sac : in such cases it is (I conceive) difficult, if not impossible, to decide, whether the morbid action which substituted this serous sac for the organ whose place it occupies, be an excess of nutritive action (irritation); a diminution of that action, whether primitive or adventitious ; or, simply, its perversion. All that can be positively affirmed on the subject, is, that in many cases of this description it is impossible to seize on any direct proof of an antecedent irritation.

In whatever part of the body this serous tissue is developed, it invariably assumes the form of a shut sac, and thus constitutes one of those varieties of accidental cavities or sacs which have long been designated by anatomists under the name of *cysts*. This term, as its etymology implies, signifies simply an accidental cavity.

The most remarkable differences may be observed in the structure of the parietes of those

cavities, the nature of the fluids which they con-
tain, and in the origin of their formation. With
reference to their origin, they may be divided
into two classes, according as they proceed from
some modification in the size and structure of a
sac which had always existed (e. g. cysts formed
by excessive development of the cutaneous fol-
licles, the muciparous crypts, or the vesicles of
the ovaria,) or as they are produced by the mor-
bid formation of some accidental tissue. In the
latter case, nothing can be more variable than
their organization; they may be divided into
as many different species as there are tissues
entering into the composition of their parietes.
At present we shall confine our attention to
serous cysts, or, at least, to those in which the
serous tissue is the principal component part of
their parietes. The size of these cysts varies
from that of a grain of millet seed to the
dimensions of an infant's head, or even of that
of an adult. They may either exist singly, or
in groups; their external surface is in immediate
contact with the tissue of the organ in which
they are developed : in some cases it is impossi-
ble to discover any organized connexion between
the cyst and the tissue ; in others, the cyst is
continuous with cellular tissue analogous to that
which lines the pleura or peritoneum. It is
often difficult to ascertain precisely where the

accidental serous membrane commences, and the cellular texture terminates ; for, as the latter becomes gradually more condensed, it passes insensibly into the former. In general no red vessels can be traced in the parietes of cysts ; but in some few cases I have seen several reddish lines traced in an aborescent form on their external surface, just as they are observed in some cases of hyperæmia of the natural serous membranes. The tissues which immediately surround the cyst are by no means uniform in the appearances which they present. 1. They may retain their natural condition ; or, having lost it for a time, may again assume it. This is one of the most common cases. 2. They occasionally suffer a considerable degree of shrinking and condensation, which may materially affect the due performance of their respective functions. In this way, I have found the tissue of a lung in which a serous cyst was developed, entirely deprived of air, although in other respects sound in its texture. 3. They are reduced to a state of atrophy. This occurs more especially in certain parenchymatous organs, such as the brain, liver, kidneys, and lungs, which are sometimes reduced to a thin layer expanded over the surface of a vast serous cyst, which occupies their place. 4. They present a remarkable degree of sanguineous congestion,

without any other apparent alteration. 5. They undergo various alterations of nutrition, especially induration and softening. 6. A morbid secretion is sometimes formed and deposited between the external surface of the cyst and the surrounding tissues with which it is in contact. In this way, I have frequently found serous cysts floating loosely in the midst of large collections of pus, of masses of tubercular matter, or of extensive effusions of blood ; sometimes these cysts were perfect and entire, in other cases they were broken up, and presented only the remains of their original structure. I do not mean to affirm that cysts detached from, and unconnected with, any solid part, may not be formed in the fluid in which they float ; but this case, to which I shall hereafter revert, is essentially different from that which we are at present considering. 7. Lastly, the cellular tissue investing the cyst is liable to different kinds of transformation. It may become fibrous, cartilaginous, osseous, or calcareous. In this way additional layers are formed, which are superimposed on the accidental serous membrane, and thus add materially to the thickness of the parietes of the cyst. In some cases, these layers afford a complete envelope to the cyst ; in others, they exist only in a rudimentary state, as when we observe a few detached fibrous

bands, or patches of bone or cartilage distributed here and there on the external surface of a cyst.

The internal surface of serous cysts is in general as smooth and polished as that of the natural serous membranes. Occasionally, however, it presents other appearances, which are analogous to those presented by the natural membranes as the effects of disease. Thus, their internal surface is sometimes found rugose, uneven, and studded with opaque granular bodies, which appear to me to consist simply of concreted albumen, and to have been erroneously described as one of the characteristics of acephalocysts (hydatids). The interior of these cysts may likewise present the different varieties of false membranes which are found in the natural serous membranes. Although their internal membrane is generally simple, it sometimes acquires a greater degree of complication, and detaches inwardly several processes, which may be compared to the reflections of the folds of the peritoneum. In this way are frequently formed in their interior a variety of septa or partitions, which separate and subdivide its cavity into several compartments, that sometimes communicate with each other, and are sometimes perfectly distinct.

Cysts of this description, in general contain a

limpid colourless fluid, extremely variable in the relative proportions of the water, albumen, and salts which it contains. But there have been also found in them various other substances, which may be enumerated as follows. 1. Pure blood with its fibrinous coagulum and colouring matter. 2. A thin serous fluid, tinged with the colouring matter of blood, but containing no fibrine. 3. Colourless serum with flocculi of fibrine floating in it. 4. A mucous fluid differing from albumen in being almost totally evaporated by heat. 5. A substance having all the physical and chemical properties of fat. 6. Cholesterine, another fatty production, which is found suspended in different fluids in the form of minute brilliant scales. 7. Several species of entozoa. 8. Some crystallized salts. 9. Different productions, solid as well as fluid, which have not as yet been observed except in those cysts ; some resembling caoutchouc, others presenting the characters of melanosis, having the consistence and colour of a thick solution of chocolate, and being probably composed of blood in an altered state. 10. All the different varieties of pus. 11. Tubercular, or strumous matter, similar to that which is so frequently found in the lymphatic ganglions of scrofulous individuals. From this enumeration we may perceive, that there is a much greater variety in the products

secreted by the accidental than by the natural serous membranes.

It is by no means uncommon to find several of these productions existing together in different compartments of the same cyst. Thus, one of them may contain serum, the adjoining one, blood; and another pus, &c. It is in vain to search for any difference in the appearance, or in the anatomical characters of the parietes of the sac itself, or of its septa, to account for this singular difference in their productions : in all cases the same serous membrane will be found to be the source from which all these various productions are derived ; thus clearly establishing the important fact, that modifications of secretion do not always depend exclusively on appreciable modifications of texture. Is it not a curious phenomenon to observe in these multilocular cysts, the delicate membranes which form their partitions exhaling such different fluids from their two surfaces ? How is it that those fluids, produced as they are in almost actual contact, are not mixed together, and why is each of them poured into a distinct and separate cavity ?

It was long a subject of debate, whether serous cysts were formed before or after the fluids they contained : the fact is, that either case may occur. For as no reasonable doubt

can be entertained, that the serous cyst which is found round certain effusions of blood, is subsequent in its formation to the clot which it surrounds ; so likewise, it is evident, that in those cysts with several compartments, in which so many, and so various productions are found, contained each in a separate cell, the formation of the secreted product must have been preceded by the formation of the secreting tissue which produced it. The solution of this question is really so simple, that I conceive it would be a waste of time to dwell on it.

ARTICLE II.

Of the Mucous Transformation.

BAYLE recognized the existence of an accidental mucous membrane, lining the parietes of a fistulous passage, which formed a communication between the interior of the lung, and the sac of the pleura ; and before him, John Hunter in his *Treatise on the Blood,* and M. Dupuytren in his *Lectures on Pathological Anatomy,* had admitted the analogy which exists between the mucous membranes and those which line old fistulous passages. Laennec was also of the same opinion ; and, more recently, Doctor Vil-

lermé has published an excellent description of the lining membranes of fistulæ, in which he has ably developed the great resemblance which subsists between them and mucous membranes. Professor Cruveilhier has also described some cases of this kind, (*Essai sur l'Anatomie Patho-logique*, tom. ii.) M. Chaussier long ago announced the fact of the existence of membranes studded over with villi, and similar to mucous membranes, lining the internal surface of old abscesses which had no communication with the external atmosphere. Lastly, M. Cruveilhier and other anatomists admit the possibility of the reproduction of mucous membranes, after they have suffered a loss of substance. In this latter case, as well as in those preceding, it must necessarily be the cellular tissue which insensibly changes its nature, and is gradually converted into mucous membrane.

We have seen then, in the preceding paragraph, the existence of accidental mucous membranes admitted in three principal cases. 1. In old fistulous passages, or in abscesses communicating externally by such passages. 2. In abscesses which have no external communication. 3. In the place of portions of mucous membrane which had been previously destroyed.

In this latter case, the conversion of cellular tissue into mucous membrane, appears to me

perfectly established. In the first place, we have in favour of the possibility of such a transformation, the analogy of what takes place in the cutaneous surface under similar circumstances ; and, secondly, in proof of its reality, we have the direct observations of M. Cruveilhier, (*Op. Cit.* tom. ii. pag. 170,) and other anatomists. It has been ascertained, that wherever the mucous tissue is destroyed, the adjacent cellular texture becomes, at first, vascular, then presents the appearance of a soft spongy membrane, studded over with minute vascular tufts, and at a still later period the transformation is complete, and no difference whatever can be perceived between the original mucous membrane, and that which is newly formed. I think that I have succeeded in tracing the several gradations in the reproduction of the *internal* mucous membranes, to which my attention has, indeed, been more especially directed. In the first degree, the subjacent cellular tissue which has been exposed, presents a smooth surface and reddish colour ; this constitutes the passage of a cellulo-vascular membrane into the most simple form of mucous membrane. In the second degree, this cellulo-vascular membrane is raised to the same level as the original mucous membrane, but cannot, like it, be detached from the subjacent tissues ; the arrangement of its vessels is

less complicated ; and its surface presents no
appearance of villi.   In the third degree, it be-
comes perfect mucous membrane ; may be de-
tached from the subjacent tissues ;   and, in the
alimentary canal, its surface is studded with
villi.

 If, then, cellular tissue is susceptible of being
converted into mucous membrane, in order to
repair a loss of substance, is it not possible, that
it may undergo a similar transformation, under
other circumstances ; as for instance, when it
has to perform the functions of a mucous mem-
brane, in consequence of being placed in con-
tact with a foreign body ?   In this latter case,
as well as in the former, the conditions of two
of the laws of transformation, laid down at the
commencement of this chapter, are fulfilled.
It may, however, be reasonably questioned, whe-
ther this species of transformation, which has
been admitted by so many authors of the highest
respectability, is in reality perfect and complete ;
or whether the name of *mucous membrane* has
not been too hastily applied to cellular tissue in-
jected and condensed into the form of a mem-
branous layer.   If the reality of this transfor-
mation be admitted, to what degree may it at-
tain ?   Does the accidental mucous membrane
resemble only the very simple mucous tunic
which lines certain excretory ducts ? or is it ca-

pable of attaining the complex structure of the lining membrane of the air-passages, or of the alimentary canal? In order to solve these questions, it is necessary to compare the anatomical characters of those membranes which are found lining certain abscesses, and, more especially, old fistulous passages, with those of the natural mucous membranes.

Mucous membrane may be defined as a spongy layer, supplied with numerous blood-vessels, laid over a dense cellular tissue, from which it may be detached in the form of a membrane; in some parts covered with an epithelium or cuticle, in others with villi; having its surface studded with follicles, and secreting a particular fluid known by the name of mucus. Of these different parts, some are constantly present, others are occasionally absent, and yet the part does not lose its claim to the rank of a mucous membrane. This latter circumstance is important to be borne in mind, when instituting a comparison between these membranes and certain membranous layers which are produced in the morbid state; for it is evident, from what has been just remarked, that these accidental membranes may be regarded as appertaining to the mucous class, although deficient in some of their anatomical characters. Let us now proceed to examine the

composition of these *accidental mucous mem-branes*, as they are called.

I have frequently found on the surface of ca-vities containing large collections of pus, and of old fistulous passages, a soft spongy layer, of a velvety appearance, possessing neither distinct fibres, nor cells, destitute of elasticity, scarcely, if at all, extensible, and in some cases, colourless, in others, liberally supplied with a network of vessels. The membranes on which these vessels were distributed, were sometimes of a pale red, or of a deeper shade of that colour, grey, slate-coloured, brown, or even black. This description is in every respect analogous to that of a mucous membrane, in its healthy state ; or when suffering under an acute or chronic at-tack of sanguineous congestion. The membra-nous layers which I have just described, present the same varieties of thickness as the natural mucous membranes. There are some, for in-stance, which are exceedingly delicate, and scarcely equal in thickness the membrane which lines the frontal sinuses ; others, again, equal, or even exceed in this respect the mu-cous coat of the stomach. They rest on a layer of cellular tissue which is in general remarkably compact, and not unfrequently approaches the density of fibrous tissue, in this respect exhibit-ing an analogy to the cellulo-fibrous layer,

which every where lines the natural mucous membranes. It is in many cases impossible to detach them from this subjacent layer, with which they are in fact incorporated, and seem to constitute its most superficial stratum, only differing from the layers underneath, in exhibiting a greater degree of vascularity ; thus representing the structure of the skin, whose vascular layer cannot be separated from its subjacent tissue unless by the imagination, and of some of the natural mucous membranes, which are so intimately united with the tissues situated underneath, as to render it impossible to separate them, without injuring one or other. There are, however, some cases, in which there is no difficulty whatever in detaching accidental membranes exhibiting all the characters above described, from the parietes of the cavity they line; and there is then found beneath them the cellular layer, which has been already mentioned. Some anatomists have found, in old fistulous passages, an exceedingly delicate membrane, lining the false mucous membrane, and insensibly terminating at a certain distance from its cutaneous orifice, thus accurately representing, both in appearance and situation, the epithelium of the natural mucous membranes.

No mention, that I am aware of, has been made of the existence of follicles in any of those

false membranes which have hitherto been de-scribed as appertaining to the mucous class; and in the dissections which I have myself made, I have never been able to detect their presence, although I searched most minutely for them. Should we consider this absence of follicles, a sufficient reason for disallowing the right of these productions to rank as accidental mucous membranes? To this I reply, that, in many parts of the natural mucous membranes, the existence of follicles is equally doubtful, and that if we admit it, it can be only from analogy, supposing them too small to be per-ceived. In fact, it would be absurd to imagine that the mode of organization which constitutes a mucous membrane is changed because the depressions it presents are less numerous or less apparent.

The absence of villi can scarcely be con-sidered a sufficient reason for excluding the membranes of fistulæ from the class of mucous membranes; for, even in the natural mem-branes, these villosities do not exist except in one, in that, namely, which lines the stomach and small intestine; and even there they are not visible during the earlier period of fœtal life. If one of those false membranes taken from a fistulous passage or abscess, be examined under water, it generally presents a smooth surface,

similar to that of all the mucous membranes except the digestive. Occasionally, however, the false membrane does not present this smooth aspect, but, when plunged into water, seems studded over with a number of minute filaments, which have neither the form nor the regularity of arrangement of the intestinal villi, but bear a much stronger resemblance to the filamentous appendices attached to the tongue of certain animals. On close examination they have appeared to me principally composed of parcels of minute vessels elevated perpendicularly above the surface of the membrane.

To sum up, we do not find follicles and villi in every part of the natural mucous membranes, and consequently their absence or presence cannot be considered a sufficient reason for refusing or allowing the membranes of fistulæ, &c. to be ranked in the class of mucous membranes. The essential characteristic of these membranes is the faculty they possess of secreting mucus; it therefore becomes a point of importance to determine whether this fluid has been found in fistulous passages. It is extremely difficult to ascertain this point satisfactorily, because various fluids generally pass through these fistulæ, and unite with any mucus which may exist there. The purulent matter, too, which is secreted by the walls of the fistula, may readily

be mistaken for mucus. However, M. Vil-
lermé states positively, that he has frequently
seen chronic fistulæ, not at the time in a state
of irritation, furnish a viscid glairy fluid, per-
fectly identical with mucus; and that he has
also seen these fistulous secretions present all
the varieties which are usually observed in the
healthy or morbid secretions of the true mucous
membranes; as for instance, all the various
appearances which are presented in the dis-
charge from the urethra in a state of acute or
chronic inflammation. I recollect having ob-
served in a case of necrosis of a rib, in a phthi-
sical patient who came under my observation in
the year 1819, that a viscid ropy fluid, of a
greyish white colour, like the mucus of the
nasal fossæ, constantly exuded from the orifice
of the long fistulous passage which led to the
carious bone. I submitted this fluid to some
chemical tests, and obtained the following re-
sults. It was slowly dissolved in water, but
the solution did not coagulate by heat; conse-
quently it was not albumen : it did not form a
jelly on concentration, nor on exposure to cold;
so it could not be gelatine. The infusion of
nutgalls caused no precipitate, as it should have
done, if the solution contained either albumen
or gelatine; on the contrary, a precipitate was
caused by the acetate of lead, which produces

no such effect on either of these substances; and, lastly, it was precipitated from its watery solution by alcohol. These are the different characters which chemists assign to mucus. They were not, however, constantly present, but varied from day to day; and the appearance of the secretion was altogether as variable as its chemical composition, and in some degree, seemed to coincide with it. Yet, the secreting membrane remained constantly the same, and the only variation could be in its vital properties, in the quantity of blood which it received, and in its mode of elaborating that blood to separate from it those different secretions. The diseased bone might likewise have furnished different principles, which would no doubt modify the composition of the secretion. Such are the difficulties that must ever be experienced in investigations of this description; but, in the present case, there is still another, for we now know that the composition of mucus itself is not uniformly the same in all parts of the body, but presents some variety in each of the different membranes which secrete it. According to the situations where it is examined, mucus is found to contain, in addition to the matter *sui generis* which characterizes it, and which Berzelius calls *mucous matter*, various principles, extremely different from each other,

which by their combination with the true mucous matter, produce the most remarkable varieties in its physical and chemical properties.*   To the physiologist acquainted with these circumstances, it cannot appear a matter of surprise, that the membranes of fistulæ, although organized like mucous membranes, do not always present an identical fluid as the product of their secretion, or even a fluid similar to that exhaled by any particular portion of the natural mucous membranes.†

From the facts we have stated on this subject, the following conclusions may be drawn.

1. The cellular tissue which exists in the walls of chronic abscesses, or old fistulous passages, may put on an appearance similar to that of certain mucous membranes. I think, notwithstanding, that Meckel has gone too far

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* Thus, for instance, if we are to believe Bostock, there is nothing easier than to distinguish between gelatine, albumen, and mucus, by the different effects produced on these substances, by infusion of galls, corrosive sublimate, and acetate of lead ; M. Chevreul, however, no bad judge in subjects of this nature, does not agree with him, because he considers there has not been sufficient allowance made for the effects of other substances which accompany them in the fluids in which they are dissolved. (*Dict. Des Sciences Naturelles*, vol. xxxiii. page 72.)

† According to M. Chevreul, new researches are absolutely necessary to decide whether mucus is a species or a genus containing species, or whether we have not confounded under the same name substances quite too distinct to be considered as belonging to the same genus.— *Dict. Des Sciences Nat.* vol. xxx. page 273.

in comparing every suppurating surface to an imperfect mucous membrane.

2. In this transformation, we must admit several gradations, according as the cellular tissue, not yet having arrived at the form of a membrane, presents only a series of vascular granulations, or, as it advances to a cellulo-vascular layer still inseparable from the sub-jacent tissues, or finally, as it attains the rank of a distinct membrane which may be easily detached, and which, in some cases, pre-sents a smooth, in others a filamentous surface.

3. Neither follicles, nor villi similar to those found in the intestines, have ever been dis-covered in any of these accidental membranes.

4. The circumstances which influence the composition and production of the fluid secreted by these membranes, are too complicated, and, as yet, too little understood, to authorize us in determining the nature of the secreting mem-brane from the nature of the fluid it secretes.

5. These membranes, in their most perfect state of organization, can only be compared to the most simple mucous membranes, such as those which line the ureters and the minute ramifications of the biliary ducts.

6. No accidental mucous membrane has as yet been observed, which could admit of com-parison with the complex structure of the gas-tro-intestinal mucous membrane.

The lining membrane of fistulous passages presents several appearances which may contribute to prove its analogous nature with that of the true mucous membranes. When it is not in a state of irritation, it presents the pale greyish aspect of a mucous membrane in its healthy state; when, on the contrary, its local action is excited, we find in it the same shades of vascular injection, as in the natural mucous membranes, when suffering under an acute or chronic process of irritation. Different morbid affections also, which are almost exclusively confined to mucous membranes, such as vegetations, fungous excrescences, callosities, &c. are likewise found on the walls of old fistulæ. The cellular tissue immediately subjacent to this lining membrane may become thickened and indurated, so as to answer to the description of scirrhus in the true submucous cellular tissue. Lastly, as adhesions are never formed between the parietes of a cavity lined with mucous membrane, unless where there has been a solution of its continuity, so likewise, when we desire to produce adhesion between the parietes of a fistula, in order to obliterate its cavity, it is necessary to make incisions through the lining membrane, and bring the subjacent tissues into contact.

The formation of such accidental mem-

branes as I have now been describing, is not confined to those parts of the cellular tissue which are free and uncombined; similar membranes have likewise been observed in the substance of parenchymatous organs. I have cited some cases of this description in the 4th vol. of the *Clinique Medicale*, in my observations on abscesses of the liver. I once found in one of the hemispheres of the brain, two cavities filled with pus, and connected by a fistulous passage : their internal surface, as well as that of their fistulous communication, was lined by a delicate membrane of a greyish red colour, soft and smooth to the touch, and susceptible of being easily detached in shreds from the subjacent tissue, as if it were merely laid on it. When examined under water, it presented a villous appearance, and seemed to be studded over with minute filaments. The cerebral substance in its vicinity presented its natural appearance. I have sometimes seen the parietes of ovarian cysts composed of a membrane which bore a much stronger resemblance to a mucous than to a serous membrane : the same remark has also been made by Meckel. I once found in the kidney of a horse, a cyst of the size of an orange, filled with a whitish viscid fluid like the white of an egg. The walls of this cyst were composed of two distinct membranes ; the outer

one was fibrous, the inner, of a soft spongy texture, and greyish colour ; viewed under water it presented all the characters of mucous membrane, nor was there the slightest difficulty in detaching it from the external coat. In this case the structure of the cyst corresponded with the nature of the fluid it contained, and both agreed in establishing the mucous nature of the lining membrane.

Lastly, these accidental membranes presenting the mucous character may be formed in the false membranes secreted by the serous tissue ; as appears from the following case. A boy, three or four years of age, died at the *Hopital des Enfans*, with all the symptoms of chronic peritonitis. I should remark, that close to his umbilicus there existed an orifice, through which, during life, there was a constant discharge of foetid mucus. The body was examined in my presence by Doctor Senn, of Geneva, who was then an intern pupil at the hospital. The different portions of the peritoneum were united by an infinite number of cellular adhesions ; in the midst of which we discovered a well defined fistulous communication, of about two inches long, leading from the umbilical orifice already mentioned, to the interior of one of the coils of the small intestine. This duct was lined throughout by a smooth reddish membrane, in

every respect similar to mucous membrane. There was no difficulty in detaching it from the subjacent parts formed by the cellular adhesions. It was continuous, at one end, with the mucous membrane of the intestine, and at the other, with the skin.

ARTICLE III.

Of the Cutaneous Transformation.

WHEN the skin has suffered a solution of continuity with loss of substance, a process of active hyperæmia is set up in the sub-cutaneous cellular tissue, the result of which is the production of a new tissue more or less analogous to that which had been destroyed. In general the newly formed skin is incomplete, being only composed of a cellulo-fibrous layer, similar to the corium, and of the epidermis. When thus constituted, it is of a duller white colour than the surrounding skin, and evidently wants the vascular layer in which the colouring matter is deposited : this deficiency is particularly evident in the negro, the cicatrices of whose skin are frequently white, and continue so always. Sometimes, however, the newly formed skin differs in no respect from the rest of the cutaneous

envelope ; having, though at first very dissimilar, become insensibly assimilated to it. In this way, cicatrices, which were long remarkable for their extreme paleness, have subsequently been seen to assume a more natural colour, and sometimes to acquire even a deeper shade of red than the surrounding skin, in which case we may suppose either that an increased secretion of colouring matter has been produced by the temporary excitation of the nutritive action of the part ; or, that the deep colour of the cicatrix depends on the retardation of its capillary circulation, as has already been explained in Section I.

When a mucous membrane is accidentally exposed to the air, and continues for some time in this state of exposure, we observe a series of remarkable changes in its colour, which becomes gradually paler ; in its consistence, which increases considerably ; and in its organization, which constantly approaches that of the skin. Anatomy has not as yet demonstrated in those mucous membranes which are apparently converted into skin, the existence of those different layers which, taken together, constitute the true cutaneous tissue.

ARTICLE IV.

Of the Fibrous Transformation.

THE fibrous productions, so named from the strong analogy which they bear in their structure and properties to the natural fibrous tissue, are one of the morbid growths which are most evidently formed at the expense of the cellular tissue, for we can trace this tissue through all the successive gradations of its metamorphosis, until it finally attains the rank of perfect fibrous structure. It, however, retains, for a long time, a certain degree of softness and extensibility, and partakes of the nature of both tissues, so that it may be denominated cellulo-fibrous. Such is also the state in which the fibrous tissue is found in the embryo; and in the adult, where it has undergone a solution of continuity. In both these cases, as well as in the formation of fibrous tissue where it does not naturally exist, we shall find, on tracing its formation to its source, that cellular tissue had previously existed where the fibrous tissue is subsequently developed.

The structure of the accidental fibrous tissue presents greater varieties than that of the natural. It is composed of an assemblage of delicate filaments, which are sometimes parallel,

sometimes interlaced and matted together, and
sometimes rolled up, coiled, or convoluted.
Between these filaments there exists some cel-
lular tissue which may occupy either more
or less space than the fibrous tissue. Accord-
ing to the mutual arrangement of these two
tissues, the latter (the fibrous) may present a
continuous whole, or may assume the form of
bands, isolated patches, or of small, round, or
irregularly shaped bodies, disseminated through
a mass of cellular tissue, which may itself be
either dry, or saturated with serous fluid,
colourless, or traversed by a number of minute
red vessels. There are some cases in which the
cellular tissue is scarcely, if at all, perceptible,
and the fibres are so condensed and agglutinated,
as to present to the eye the appearance of a ho-
mogeneous mass ; by maceration, however, they
may be made to appear. The vessels which are
distributed on these fibrous productions, in ge-
neral belong to the cellular tissue which enters
into their composition ; but in some cases they
seem to penetrate the fibrous tissue itself, which,
in a few instances, has even been found exceed-
ingly vascular. In this respect, accidental fibrous
tissue may be divided into three classes, corres-
ponding to those of the natural fibrous tissue,
which is sometimes entirely destitute of red ves-
sels, sometimes receives only a few, and some-

times, again, is exceedingly vascular, as is exem-
plified in the periosteum.

Accidental fibrous tissue may be divided,
with respect to its physical properties, into im-
perfect and perfect. The first participates more
or less of the qualities of cellular tissue, and
in this respect approximates, as I have already
remarked, to the structure of the fibrous tissue
in the foetus. It possesses a certain degree of
softness, which allows it to be easily torn asun-
der, crushed, or reduced to a pulpy mass; it
possesses considerable extensibility, yields, when
cut or pressed, a considerable quantity of fluid,
and is readily dissolved in boiling water. On
the other hand, the accidental fibrous tissue
which may be denominated perfect, is remark-
ably hard and tenacious, contains less humidity
than the preceding, and is also less soluble in
water at 212° Fahrenheit. It is of a dull white,
of a bluish, pearly, or silver white, of a yellow-
ish tint, or of a red, more or less deep.

Accidental fibrous tissue is principally met
with in the following forms.

1. *The funicular form.* In this case, it ap-
pears arranged in irregular fasciculi; or else in
the form of bands traversing masses of cellular
texture, and interposed between the different
organs, or parts of the same organ; or, finally,

in circular cords surrounding the margins of various apertures.

2. *The membranous form.* Under this form we frequently find a variety of laminæ, partitions, and layers composed of accidental fibrous tissue, and even complete envelopes, analogous to the natural aponeuroses, and capsules. These fibrous expansions often form an additional layer round other accidental tissues, particularly those of the serous and mucous class.

3. *The tumour form.* Accidental fibrous tissue developed in this form may be divided, with respect to its texture, into three varieties.

First variety. A tumour, homogeneous in its composition through its whole extent. The fibres are very much condensed, and do not seem to be separated by any layers of cellular tissue.

Second variety. A tumour divided into lobules of various shapes and sizes ; the interposed cellular tissue being either loose, or condensed, colourless, or injected. These lobules sometimes present no appearance of distinct fibres, but, in other instances, they are evidently composed of numerous filaments mutually interlaced and matted together, or else rolled up regular round masses.

Third variety. A tumour formed by an assemblage of lobular granulations separated by cellular tissue. These granulations may be

again subdivided into others of smaller size. They are sometimes arranged in such a manner as to give the tumour a remarkable resemblance to the structure of the salivary glands and pancreas. The tumours denominated *pancreatoid* by M. Maunoir of Geneva, and which he considers as a morbid degeneration, *sui generis*, appear to me simply fibrous growths belonging to this third variety.

Accidental fibrous tissue, when arrived at its perfect state, or even before that period, not unfrequently undergoes different modifications of nutrition, which alter its texture to a greater or less degree. Of these modifications, some appear to consist simply in the continuation of the preternatural excitement of the local nutrition, which, after creating fibrous tissue, where only cellular should naturally exist, subsequently produces cartilage, and eventually a deposit of ossific matter. These different modifications in general occur without any concomitant pain, and without exciting any morbid sympathies, or reaction, in the system at large. But, in other cases, after an acute or chronic attack of active hyperæmia, another class of morbid changes takes place, which may affect either the fibrous tissue itself, or the cellular tissue which enters into its composition and serves to separate its constituent parts. The cellular tissue becomes injected and swollen, and then suppurates and becomes

the seat of different morbid secretions ; while
the blood which is determined towards the part,
sometimes escapes from its vessels, and so pro-
duces either copious hæmorrhages, or effusions
of fibrine, which may subsequently become
organized, and give rise to different morbid pro-
ductions. When the cellular tissue which en-
ters into the composition of these fibrous growths
becomes thus diseased, the minute filaments or
lobules which it served to invest, become de-
tached from each other, lose their natural con-
sistence, assume a flocculent appearance, and
finally disappear altogether ; so that after a cer-
tain period the tumour appears to have changed
its nature. These diseases of accidental fibrous
tissue, which are very different from the simple
cartilaginous or osseous transformations it may
also undergo, are generally accompanied by many
of the symptoms, local, as well as general, which
authors have attributed to cancer.

The organs in which fibrous growths are ac-
cidentally developed, may present any of the
following conditions.

1. They may be perfectly healthy. This case
is by no means uncommon ; indeed it often affords
matter of surprise to see the almost perfect de-
gree of isolation in which certain fibrous tumours
are found, with respect to the organs in which
they are developed ; insomuch that they may

with the greatest ease be separated from them, by breaking a few delicate cellular or vascular connexions, without in the slightest degree interfering with the texture of the organ itself, with which they appear simply contiguous. From what source are we to suppose that tumours thus circumstanced derive the materials for their growth and nourishment? Does this mass of cellular texture, which by some modification of its nutrition has been converted into fibrous tissue, does it, I would ask, at the time of its conversion, acquire an independent vitality?

2. The organs may be the seat of an active hyperæmia, which may, or may not, be accompanied with other alterations of nutrition. In this case it is often difficult to decide whether the inflammatory action preceded the fibrous transformation, or was consecutive to it.

3. They may have undergone a true atrophy; or, in other words, the proper tissue of the organ may have disappeared, at the same time that the cellular tissue which entered into their composition, underwent the fibrous transformation. Thus, for example, I have sometimes found, especially in old horses, the pulmonary parenchyma in certain points replaced by fibrous masses; the testicle has likewise been found transformed into fibrous tissue; and a similar transformation has still more frequently been

observed in the ovaries.   In the case recorded
by M. Magendie, in which the retina was trans-
formed into fibrous membrane, I think it highly
probable that this transformation occurred, not
in the nervous expansion itself, but in the fine
cellular tissue which exists between it and the
choroid.   I am the more inclined to adopt this
opinion, in consequence of the firm conviction I
entertain, that such must also be the seat of cer-
tain osseous capsules, which are occasionally
found in the bottom of the eye, and which are
generally considered as ossifications of the retina:
in all such cases, the retina is reduced to a state
of atrophy, but is never metamorphosed into
another tissue.

In some cases, the portion of the organ
which yields its place to the fibrous growth, is
not simply reduced to a state of atrophy, but
has been destroyed by some external violence,
or other injury ; and the cellular tissue, whose
business it was to furnish the proper materials
for the reparation of the injury, has only sup-
plied such as were fitted to form fibrous tissue.
In this way are formed those fibrous produc-
tions which have been found in cicatrices of the
skin, of the muscles, of the bones, and of the
liver, and in the site of old fistulous passages
which have been obliterated.

In many cases of fibrous growths, it is easy

to demonstrate the previous existence of irrita-
tion in the tissue, or organ, where this acciden-
tal production is formed. But in general this
irritation is not followed by the appearance of
an accidental fibrous production, unless under
such circumstances as fulfil one or more of those
laws which have been already laid down, as re-
gulating the nature and mode of the transfor-
mations of tissues. Thus, if a portion of fibrous
tissue is divided, the irritation which necessarily
succeeds, is followed by a reproduction of this
tissue. If the head of a bone is displaced from
its natural situation, and placed in contact with
another bone ; or, if the extremities of a frac-
tured bone are not speedily re-united, the irri-
tation which follows these accidents produces,
in the first case, a fibrous capsule, and in the
second, ligamentous bands by which the frac-
tured extremities are re-united. In the same
way, when a muscle is divided, its solution of
continuity is often repaired by accidental fibrous
tissue. But in all these cases it will be found,
on reference to the laws of transformation laid
down at the commencement of this chapter, that
their conditions have been fulfilled.

There are some cases, however, in which
the production of fibrous growths, occurring as
a consequence of irritation, cannot be referred
to any of these laws. In the mean while, until

we shall have discovered the laws which in such cases regulate their formation, we must be contented to admit, as the simple enunciation of a fact, a peculiar pre-disposition, by virtue of which the same irritation which in one individual is followed by aberration or some other alteration of nutrition, in another gives rise to a fibrous transformation, of which, though it may be the occasional, it is not the essential cause.

There is again another class of cases, in which we have no evidence whatever of this species of transformation having been preceded by any irritative action; but in this there is really nothing surprising. Have we not already seen that, in every morbid change, the only effect which can rationally be attributed to irritation, is the tendency to deviation from the natural type which it produced in the function of nutrition? But reason and experience both prove, that this alteration may be as effectually produced by various other causes. For instance, I once saw the sterno-cleido-mastoid muscle of the right side wholly converted into a perfect fibrous tissue, exactly similar to the broad tendon in which it terminates inferiorly. In this case, the condition of the muscle previously to its transformation, was quite the reverse of that of a part labouring under in-

creased vascular action, or irritation; for, it
had been for a length of time in a state of total
inaction, in consequence of an attack of hemi-
plegia, accompanied with permanent contrac-
tion of the left sterno-cleido-mastoid, under
which the individual had laboured for a number
of years. The muscle was in this case con-
verted into a fibrous organ, on the same prin-
ciple, and probably by the same process, as
that by which we frequently see, in the animal
kingdom, fleshy parts converted into fibrous
tissue, when the muscular contractility of the
part has by some modification of function been
rendered unnecessary. Several facts induce me
likewise to think, that in certain cases of atro-
phied organs, there is a disposition to the for-
mation of fibrous tissue in the room of the pro-
per tissue of the organ which has disappeared.

ARTICLE V.

Cartilaginous Transformation.

THIS species of transformation is, at least,
as common as the preceding, and is found al-
most under the same circumstances; in many
cases the cartilaginous succeeds the fibrous trans-
formation.

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Cartilaginous productions are found, 1st. in the cellular tissue interposed between the different organs; 2d. in some parenchymatous organs; 3d. and lastly, loose and unattached in certain serous cavities. In the two last cases, they are sometimes found single and uncombined, sometimes they exist in combination with accidental fibrous or osseous tissues, and sometimes they enter as a constituent part into the composition of tumours of various descriptions.

I. *Cartilaginous Productions developed in the Cellular Tissue.*

THERE are few parts of the cellular tissue which is interposed between the different organs, or tissues, in which the development of accidental cartilages has not been observed. Thus, for instance, the cellular tissue which is subjacent to serous membranes is frequently the seat of these productions. Cartilage has been found in the form of isolated grains, large spots, and irregular incrustations; in the cellular membrane which lines the arachnoid, the pleura, the pericardium, the peritoneum, the tunica vaginalis, and the synovial membranes. In these different situations, accidental cartilages may be found, 1. unattended by any

other appreciable lesion; 2. co-existing with different alterations of the serous membrane under which they are formed, such as adhesions, effusions, &c.; 3. along with various morbid changes in the substance of the organs which are enveloped by the serous tunic. In many cases of this description, it is possible to follow the different degrees of modification which the texture of the cellular tissue undergoes during its transformation into cartilage. For example, behind the same pleura it is by no means uncommon to observe some spots in which the cellular tissue is condensed and indurated, but still retains its natural organization; others in which it is become evidently fibrous; and lastly, others in which it presents merely a homogeneous white mass, the texture of which is perfectly analogous to that of cartilage. In such cases, we sometimes also find a serous fluid effused between the condensed laminæ of the cellular tissue; and, not unfrequently, a gelatinous yellow fluid, which has been set down as *softened scirrhus.*

The submucous cellular tissue differs materially from the subserous in this respect; for it is seldom, if ever, transformed into cartilage; although it is constantly found in a state of hypertrophy and induration. I recollect having seen a solitary instance of a true cartilaginous

mass developed in the subcutaneous cellular tissue of the stomach. This mass passed by insensible gradations into the adjacent cellular tissue, which was thickened and indurated. It cut precisely like a piece of costal cartilage.

The sub-cutaneous and intermuscular cellular tissue may likewise undergo the cartilaginous transformation. One of the lower extremities of a woman who died at *La Charité*, in the year 1820, was affected with elephantiasis. Underneath the skin, and occupying the place of the muscles, which were reduced to a few pale fibres, was found an enormous mass of condensed, hard, cellular tissue, containing here and there small cavities filled with serum, and possessing in many places all the physical qualities of cartilage.

The cellular tissue interposed between the internal and the middle coats of arteries, is very frequently the seat of cartilaginous incrustations, which shall be described at length hereafter. (Vol. II. Diseases of the circulating Apparatus.) Lastly, wherever cellular tissue exists free and uncombined with other tissues, accidental cartilaginous productions may be developed, either as amorphous solid homogeneous masses, or in the form of membranes, enveloping various morbid secretions, thus contributing to form cysts with cartilaginous parietes. The

following cases present some remarkable ex-
amples.

Case I. A cyst, with cartilaginous parietes,
containing fatty matter and hair, developed be-
tween the layers of the mesentery.

I found this cyst in a negress of 57 years of
age. It was as large as an infant's head, and its
parietes, which were perfectly cartilaginous, were
surrounded on the outside by an envelope of
loose cellular membrane, which served as a me-
dium of connexion between the cyst and the
neighbouring parts. The matter which it con-
tained was like suet, and was mixed up with a
great number of hairs. (For more ample de-
tails of this case see *Clinique Medicale*, tom. 4.
p. 680.)

Case II. A cartilaginous cyst, filled with
matter similar to honey, found in the anterior
mediastinum.

In a middle aged man I once found, behind
the sternum, in the situation occupied by the
thymus in the infant, a tumour of the size of a
small orange, which was hollow in the centre,
and contained a fluid resembling honey. The
parietes of this cyst were composed of three
distinct layers: the interior presented all the
characters of serous membranes; the exterior
was cellulo-fibrous; and the middle layer was
perfectly cartilaginous.

Case III. A multilocular cyst with cartila-
ginous parietes developed in the neck of a
female.

This tumour, which was of considerable di-
mensions, was removed by M. Roux from the
side of a woman's neck. On laying it open,
I found its texture in some parts fibrous, in
others, fibro-cartilaginous. These different tis-
sues, arranged in laminæ and septa of various
forms and dimensions, divided the interior of the
cyst into a number of separate compartments
or cells, containing a semifluid unorganized sub-
stance, not unlike a thick solution of starch.

Case IV. A tumour of the same nature de-
veloped on a man's arm.

M. Roux likewise removed this tumour,
which weighed nearly nine pounds, from the
arm of a man fifty years of age, in the hospital
of *La Clinique de Perfectionnement*. On exami-
nation it presented the following structure. The
skin over the tumour was perfectly healthy;
the aponeurotic tissues situated between the
skin and the muscles appeared somewhat thicker
than ordinary. The muscular fibres, spread in
bundles over the surface of the tumour, were
thin and pale-coloured. Immediately under
this muscular expansion, I found a cellulo-
fibrous layer, which completely surrounded the
tumour, and formed a perfect envelope for it.

The tumour, when felt through this layer, ap-
peared firm and elastic, and in some points
conveyed an indistinct sense of fluctuation.
When cut into, it appeared at first principally
composed of a grey semi-transparent substance,
resembling starch in many of its physical cha-
racters; and in several places presented the
appearance of being subdivided into a number
of minute polished grains clustered together.
In the midst of this substance, which, as I have
just described, was in some parts homogeneous,
and in others presented a granular structure,
we found a number of septa or laminæ com-
posed partly of fibrous, and partly of cartilagi-
nous tissue. These septa divided the interior
of the tumour into a number of cells or regular
areolæ in which the unorganized substance
above described was deposited. In this manner,
the whole of the tumour was divided into seve-
ral compartments, each of which presented, 1st,
a part containing, formed of fibrous or cartila-
ginous tissue; and, 2d, a part contained, formed
of an unorganized substance apparently the
product of secretion. In many points we found,
instead of simple partitions, solid masses of
considerable thickness, presenting all the cha-
racters of perfect cartilage, throughout the sub-
stance of which, calcareous matter was found
deposited; and in some parts these calcareous

deposits were so crowded together, as to constitute considerable masses which could not be divided by the scalpel.

A number of red vessels of considerable diameter were found in this tumour; they were not, however, distributed indifferently to every part of it. Not one, for instance, was observed ramifying through the starch-like secretion; on the septa or partitions, several were distributed; but by far the greater number were found in the substance of the solid cartilaginous masses, especially where the calcareous matter was deposited in them.

The periosteum, which was in immediate contact with the tumour, was exceedingly vascular, but in other respects perfectly natural. The external appearance of the bone was not at all changed, except in one part, where it presented a species of swelling or enlargement, the nature of which I shall presently describe. The interior presented some morbid alterations which were particularly interesting, from the striking analogy they presented to the alterations found externally in the soft parts. The medulla was replaced by a substance analogous to the accidental production above described, consisting of a starch-like matter contained in numerous cells, the partitions of which were

composed of cellulo-fibrous tissue. The me-
dullary membrane was red and thickened, and
somewhat fungous; and was plainly visible on
the internal surface of the bone. At a short
distance from the head of the humerus, at its
inner side, the morbid matter which had taken
the place of the medulla, was found more abun-
dantly than elsewhere, and had even insinuated
itself between the fibres of the bone, and caused
them to protrude externally; in this manner
the enlargement of the bone above alluded to
was formed.

II. *Cartilaginous Productions developed in the
Structure of Parenchymatous Organs.*

THE observations which I have already
offered respecting the accidental development
of fibrous tissue in parenchymatous organs, are
equally applicable to the formation of cartilagi-
nous tissue : they both seem to be formed at the
expense of the cellular substance which enters
into the composition of these parts. When
cartilage is accidentally developed in the sub-
stance of an organ, it may either assume the
form of an envelope containing various morbid
secretions, between which and the surrounding
parts it forms a sort of barrier ; or it may be
deposited in amorphous masses, which occupy

the place of parts of organs that had previously been destroyed.

It is exceedingly rare to find any tissue except the cellular undergoing a real transformation into cartilage. Thus, although we constantly observe the formation of plates of cartilage, immediately under the serous membranes, there is not a single case on record, in which the serous membrane itself has been converted into that substance; and thus, also, when these same plates or patches are found on the surface of the liver, or spleen, or between the serous and fibrous layers of the pericardium, or even between the arachnoid and dura mater, it is invariably between these membranes that this transformation takes place, and not at the expense of either of them. In like manner, the cartilaginous incrustations found in the arteries are invariably formed *between* their middle and internal tunics, which are never themselves transformed, though they may present other morbid alterations. The cellular tissue subjacent to the mucous membranes is sometimes, though rarely, transformed into cartilage; nor are these membranes themselves totally exempt from this species of transformation. Laennec relates a case of a child, in the membranous portion of whose urethra was found a urinary calculus of the size of a hen egg. The mucous

membrane of the part presented several white patches of the size and thickness of a man's nail, which in their texture appeared to him semi-cartilaginous; and he adds, that they were evidently incorporated with, and formed a part of the mucous membrane. In a case of prolapsus uteri, Beclard found the mucous membrane of the vagina in like manner studded over with a number of small cartilaginous spots; and he also observed a similar appearance on the prepuce of an old man, who had had phymosis from the time of his birth.

The osseous tissue may likewise undergo such a modification in its nutrition, that its cellular network shall receive a deficient supply of calcareous matter, and shall separate from the blood the materials necessary for the formation of cartilage. Beclard used to mention in his lectures the case of an old woman, who had a horny excresence on her forehead, at the base of which the bones of the skull were converted into cartilage. Several authors have spoken of the metamorphosis of muscle into cartilage: there is certainly no more difficulty in supposing the possibility of such an occurrence, than of the conversion of muscle into fibrous tissue, of which I have already given a remarkable example; but, in reality, I do not think that a genuine case of this description has as yet been observed,

inasmuch as all those cases of cartilaginous transformation of the diaphragm, which are recorded in various authors, appear to me nothing more than cases of cartilaginous incrustations, formed on the superior or inferior surface of that muscle. The muscles of animal life may be separated, compressed, diminished, or reduced to a state of atrophy, by means of cartilage developed between their fasciculi ; but I am not aware of any well authenticated case, in which the muscular fibre itself has been found converted into cartilage. The cartilaginous transformation of the fleshy substance of the heart, is, in my opinion, equally doubtful. Perhaps we may, without incurring the imputation of scepticism, be permitted to doubt the accuracy of Columbus's observation, in the case he records, of his having seen the septum of the ventricles converted into cartilage ; and I am disposed to think, that what has generally been described as cartilaginous transformation of the heart, is (at least in a great majority of cases) merely a deposition of cartilage, either on the external surface of the heart, between it and the pericardium, or, on its internal surface, in those parts where layers of cellular or fibrous tissue naturally exist. The manner in which cartilage is formed in the thyroid gland, requires to be further elucidated by additional observations.

With respect to the cartilaginous transformation of some other parenchymatous organs, such as the brain, liver, lungs, spleen, kidneys, uterus, and testicles, I do not think it better established than that of the heart; and in all these cases, the development of cartilage in the cellular tissue which invests or enters into the composition of the respective organs, has frequently been mistaken for the conversion of their proper texture. If, however, I were to name any parenchymatous organ, in which my own observation would induce me to admit the reality of this transformation, I should decidedly say, the brain. My friend Doctor Blandin and I once found, in a little girl about two years old, several convolutions on the superior surface of both lateral hemispheres in a state of extreme induration. When strongly compressed between the fingers, they offered the same resistance as cartilage, of which substance they also presented the elasticity, the homogeneous texture, and the ivory-white colour. In the centre of both hemispheres, and at the base of the brain, we found several other parts in the same indurated state. This child, during the whole time of her stay in the hospital, presented no remarkable alteration in any of the actions of animal life, except a constant oscillation of the head from one side to the other. In this case there were also some

morbid appearances found in the cerebellum, but they were foreign to the present subject.

III. *Cartilaginous productions existing loose in Cavities.*

THESE have been principally observed in those cavities which are lined by serous and synovial membranes. Sometimes they are perfectly isolated; in other cases, they are attached by a membranous prolongation, or pedicle, to some point of the parietes of the cavity in which they are situated. Their form may be either spherical, oval, flattened or irregular. Their size is in general not considerable; some, for instance, are scarcely as large as the head of a pin, and I am not aware that any have been found exceeding the dimensions of a pea, or, at the largest, of a bean. They are composed of an elastic, homogeneous substance, similar to cartilage; and it is not uncommon to find some osseous points disseminated in their interior. I recollect having once found in the centre of one of them, a cavity filled with a sebaceous substance. The production to which I allude, was found floating loose in the sac of the peritoneum. Laennec has seen some of them, which were divided into several lobules, connected by fibrous, or cellular tissue. The knee-joint is the

one in which these cartilaginous concretions have been most frequently observed ; they have likewise been found in the articulations of the lower jaw, of the ankle, of the head of the fibula with the tibia, and of the pisiform with the cuneiform bone. They have not been observed by Laennec in any of the serous membranes, except in the tunica vaginalis testis ; but he mentions having seen one on the external surface of the arachnoid, where it lines the lateral ventricles. I have myself seen three of these bodies in the serous membrane of the brain : one of them floated loose and unattached, in the sac of the arachnoid ; the other two were attached to the choroid plexus, by a delicate cellulo-vascular prolongation. I have never met with either of them in the pleura, or pericardium ; but I have often found them in the peritoneum, sometimes perfectly isolated from all the solid parts, and at other times appended to a peculiar prolongation of the serous membrane. Littre likewise mentions having found a cartilaginous body floating loose in the peritoneal cavity.

It was for a long time supposed, that these concretions were formed of fragments of cartilage, detached from the articulating surfaces of the joints in which they were found ; but, in addition to the objections which this supposition is liable to, from the form and texture of these

bodies, it is totally subverted by the fact of their having been found in serous membranes also. Are we then to suppose that they derive their origin from the fluid which is exhaled in these serous and synovial cavities? this mode of accounting for their origin, is certainly far from being absurd, and may be supported by some strong analogies. Another origin, and apparently a more probable one, has, however, been assigned to these concretions by Laennec and Beclard. They suppose that these bodies are not originally formed in the cavities where they are found, but on the external surface of the serous or synovial membrane, which they gradually protrude before them, so as to transform that portion of the membrane behind which they were situated, into a prolongation or pouch in which they become enveloped. In this way (say they) is formed that variety of these concretions which is attached, as it were, by a footstalk, to the parietes of the cavity; and in order to account for the other variety, they add, that, at a subsequent period, a solution of continuity takes place, the concretion becomes detached from the serous membrane, and drops into the cavity. Laennec has followed all the degrees of the displacement of these concretions, in the tunica vaginalis, from the incipient stage in which they form a slight projection behind the

serous membrane, to the period when they be-
come perfectly isolated bodies.

I do not pretend to deny, that those concre-
tions may be occasionally formed in this man-
ner; but I feel thoroughly convinced that their
origin is in some cases very different.

In fact, it is not alone in serous membranes, or
in the joints, that isolated cartilaginous bodies are
found. I recollect having found one as large as
a pea, in the midst of the adipose tissue of the
orbit. Another has been found by Professor
Fizeau, in the interior of the globe of the eye,
between the capsule of the crystalline lens
and the layer of the hyaloid membrane which
invests its posterior surface. I have likewise
found, in two individuals, serous cysts contain-
ing a number of these cartilaginous concretions,
floating without any attachment in a serous
fluid, which, in one case, was limpid and co-
lourless, and in the other, was turbid and of a
dirty greyish colour. The first of these cysts,
of about the size of a walnut, was situated
along the course of one of the spermatic cords,
and contained five cartilaginous bodies, the
largest of which scarcely equalled the size of a
small pea. The second was found in the pelvis
of an old woman, where it was attached to the
fimbriated extremity of one of the Fallopian
tubes; it was about the size of a hen egg, and

contained eight little round cartilaginous con-
cretions.   Is it not highly probable that in
these, and other such cases, those concretions
are formed in the midst of the fluid in which
they are found ?

IV. *Cartilaginous Productions supplying the Place
     of Natural Cartilages that had been de-
     stroyed.*

In many cases, where cartilages have suf-
fered a solution of continuity, we do not ob-
serve any process established for the reparation
of the injury ; sometimes, again, the loss of sub-
stance is repaired by the deposition of osseous
matter, as is not unfrequently seen in fractures
of the costal cartilages ; and sometimes, lastly, a
new cartilage is formed for that purpose.   This
latter mode of reparation has been particularly
described by Laennec in the cartilages of the
articulating surfaces.   " These new cartilagi-
nous productions," he remarks (*Dict. des
Sciences Médicales*, art. *Cartilage Accidentel*)
" are thinner than the old cartilage, with which
however they are continuous ; they conse-
quently have the appearance of being depressed,
and their tenuity is often so great, that, from
their transparency, the bone over which they
are situated imparts to them a violet tinge.   It

is not uncommon to find fringed prolongations of the old cartilage covering the new tissue without adhering to it."

I really do not see any satisfactory evidence of the existence of a newly formed cartilage in this description of Laennec. Is it not just as probable, that those thin plates which he describes may have been the old cartilage partially thinned, and reduced to a state of atrophy, as that they are an accidental production? Be that as it may, this species of alteration which Laennec calls *a cicatrix*, is, according to his statement, of very frequent occurrence; from whence he concludes, that the erosions to which it succeeds are not in all cases a very serious affection. We might ask, what proof there is of such erosions having ever existed. He also remarks, that this alteration is almost uniformly found in several joints at once.

Accidental cartilaginous productions present several varieties of form, which in general correspond with the varieties of their situation. For example, when they are developed round the head of a bone dislocated from its socket, they assume the form of articular cartilages. When deposited round certain accidental cavities, they either form a complete envelope, such as naturally exists in the larynx, or in the Eustachian tube; or else they appear as scattered

grains, dispersed up and down on the surface, or in the substance of the surrounding cellular, fibrous, or other tissues. These cartilaginous grains, of irregular form, and various sizes, bear a considerable resemblance in their texture, situation, and appearance, to the small detached spots which, in the minute bronchial divisions, succeed to the cartilaginous rings of the larger bronchi. Accidental cartilages may also assume the form of membranes when developed between membranous tissues ; as, for instance, when they are formed under serous membranes, or between the coats of an artery.

Accidental cartilages may be divided, with reference to their texture, into three classes. Those of the first class partake of the nature both of the fibrous and of the cartilaginous tissues ; thus representing the natural fibro-cartilages. In some cases the fibrous tissue predominates ; thus, I have seen it arranged in concentric or parallel layers, between which the cartilaginous tissue was, as it were, deposited. In other cases, again, the texture becomes more homogeneous ; the cartilage then becomes the predominant part, and only a few traces of fibrous tissue can be observed, which may occur either on the surface of the cartilaginous mass, in its centre, or dispersed through its substance.

Accidental fibro-cartilage has been observed, 1. in false articulations; 2. at the extremity of bones which had been long amputated; 3. in the place of the ligaments belonging to ankylosed joints; 4. in cicatrices of the skin, and of some parenchymatous organs; 5. in the compound tumours of the thyroid, the ovaries, and the uterus; 6. and lastly, in serous cavities where it is found in the form of isolated masses. Beclard saw a tumour of this description, of the size of a walnut, contained in the cavity of the peritoneum; its interior was fibrous, and it was as soft as intervertebral ligament towards its centre, which contained a small bone of about the size of a pea.

We should also observe, that the natural fibrous tissue presents in some parts a remarkable disposition to be converted into cartilage: for instance, that portion of the tendon of the peroneus longus which rubs against the bones, is almost constantly transformed, in advanced age, into cartilage; and, in many animals, the fibrous tissue of the sclerotica is replaced in several points by cartilaginous tissue.

The accidental cartilages belonging to the second class present no appearance of fibres: they do not, however, altogether resemble the natural cartilaginous tissue as it is found in the adult; but rather present a stronger analogy to

the structure of that tissue as it exists in the
fœtus before its development is fully com-
pleted. This second class may, with propriety,
be termed *imperfect cartilages*, or *semi-cartilages*.
They possess a considerable degree of softness
and flexibility, their consistence being some-
times no greater than that of the white of egg
boiled. Their colour is either a dingy yellowish
white, a milk white, or a brilliant pearly-grey.
Depositions of osseous matter are very often
formed in this tissue, without its having pre-
viously acquired a greater degree of consistence
than before. Laennec has remarked, that the
yellow variety is most prone to ossification.

Imperfect cartilaginous tissue has been ob-
served, 1. in the form of incrustations, or irre-
gular patches, in the coats of arteries ; 2. in the
form of cysts, in certain parenchymatous or-
gans ; 3. in these organs likewise, as amorphous
masses, either existing singly, or in combina-
tion with other morbid productions ; 4. in the in-
terior of certain articulations. Laennec states,
that he has found in the shoulder and knee
joints, semi-cartilaginous bodies, some round
and others flat like ribands. They were unat-
tached, and floated loose in the joints. He like-
wise found some of these bodies attached by
their whole surface to the synovial membrane of
the same joint in which others were floating

loose.; but he was not able to ascertain satisfactorily whether they existed on the internal or external surface of the membrane.

The accidental cartilages which we range in the third class, are those whose texture is perfectly analogous to that of the natural cartilages. They are of a beautiful silvery white colour, or like mother of pearl, or tinged with a slight shade of blue ; are perfectly homogenous in their structure, and cannot be divided into laminæ or fibres, neither do they contain any canals, cells, or areolæ. They also possess a remarkable degree of elasticity. Like the natural cartilages they never present any traces of vascularity, unless when they are converted into bone.*

ARTICLE VI.

Osseous Transformation.

THIS species might, with more propriety, be denominated *the ossiform transformation,* for it very seldom happens that the newly formed

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* Comparative anatomy proves, however, that cartilages may be vascular without possessing any tendency to ossification. Vessels of considerable size are found in several parts of the cartilaginous tissue of chondro-pterygious fishes, although their skeleton, as is well known, never becomes ossified.

tissue exactly resembles the osseous tissue of the natural state ; it is true, that it presents the same colour and consistence ; its chemical composition too, though not exactly identical, approaches very nearly to that of bone, but its form is rarely that of the natural bones, and its texture is still more dissimilar.

The osseous transformation is almost exclusively confined to three tissues ; the cellular, the fibrous, and the cartilaginous. This fact, which is established by observation, is in perfect accordance with the laws of transformation already laid down.

Wherever a solution of continuity occurs in the osseous tissue, the breach is repaired by a new production of osseous matter, which at first assumes no regularly defined shape, but afterwards becomes gradually assimilated in form to the portion of bone which it serves to replace. The numerous and interesting researches which have been made on this subject, shall be detailed hereafter. For the present, I shall only observe, that, whenever a bone repairs the loss of substance it has suffered, the reparation invariably takes place at the expense of fibrous or cellular tissue. I may also remark, that, whenever nature commences her operations for the purpose of repairing a fractured bone, there is at the commencement of the pro-

cess an exuberance (if I may use the expression) in the production of the new osseous matter. It is deposited in all the parts surrounding the fractured point, and thus the neighbouring cellular tissue, the tendons, and the aponeuroses, become incrusted with phosphate of lime : these depositions subsequently disappear, and the ossific deposit is confined within the limits which the bone should naturally occupy ; and at the same time that the new bone is thus circumscribed in its limits, it likewise assumes the form and structure of the original bone.

I shall now proceed to consider ossification as it occurs in each of the three tissues to which, as I have already stated, this process is almost exclusively confined ; at least I have never been able to learn a single fact that could prove to my satisfaction the ossification of any of the other tissues.

I. *Ossification of the Cellular Tissue.*

ALL parts of the cellular tissue are not equally susceptible of this species of transformation. I have never met with an instance of ossification of the submucous cellular tissue. Baillie mentions a case in which the mucous membrane of the stomach was transformed into bone ; in this case, it is highly probable that the

submucous tissue was the seat of the disease ; but the description given by Baillie is so short, and at the same time so vague, that no conclusion can be drawn from it, either as to the precise situation of the ossification, or even as to the reality of its existence. The mucous membrane of the gall bladder has, in several well authenticated cases, been found invested with an ossiform layer, forming so complete an envelope as to convert the part into an unyielding, inflexible pouch ; but, in this instance, the submucous cellular tissue in which this osseous layer was formed, was likewise in contact with a serous membrane, and we shall presently see, that the subserous is one of the divisions of the cellular tissue in which osseous matter is the most frequently deposited.

It will, I think, be found, that all those cases of ossification which were long considered as the result of an osseous transformation of the serous membrane itself, are in reality seated in its subjacent cellular tissue ; at least, in all the cases of this description which I have examined, I have constantly found those concretions presenting a smooth pale surface on their serous side, from which I inferred that the serous membrane still existed over the surface of the ossification.

The subserous cellular tissue generally un-

dergoes some other modifications of nutrition before it is converted into bone. At first we observe an alteration in its transparency, and a whitish spot is formed, accompanied with some degree of thickening of the part; sometimes it appears as if a turbid fluid were infiltrated into the areolæ of the cellular tissue, which itself appears to remain unaltered; thus rendering it probable that a vitiated secretion was the first step of the morbid process. The appearance of the part then gradually changes, cartilaginous tissue is formed, and in it several osseous points are subsequently developed. Such is, in the generality of cases, the process by which ossification of the subserous cellular tissue is accomplished; but, if I am not mistaken, there are also some cases in which the deposition of matter takes place all at once, without any antecedent alteration in the structure of the parts.

The ossifications of the subserous cellular tissue generally occur in the form of minute granular bodies, or else of patches of various shapes and sizes. Their thickness is sometimes considerable, in which case they compress; and, as their size increases, reduce to atrophy the tissue of the organ with which they are in contact; in this way, the spleen is sometimes greatly reduced below its natural dimensions. There is no portion of the serous membranes under

which these ossifications have not been found. In the skull, and the spinal canal, they have been observed disseminated through the cellular tissue which lines the arachnoid in both these cavities ; and I have occasionally found them on the convex surface of the cerebral hemispheres, presenting a striking resemblance to splinters of bone, for which they might, indeed, have readily been mistaken, if their situation under the arachnoid, and their connexion with the pia mater, did not prevent the possibility of such a mistake. In the thorax, these incrustations are found lining the internal surface of the ribs, or investing the lungs, or heart. In the abdomen, they are never seen on the surface of any portion of the alimentary canal ; but are frequently found on the spleen, the liver, and the inferior surface of the diaphragm. They sometimes invest the tunica vaginalis, and lastly, they have been observed in the sacs of old hernias.

The cellular tissue situated between the internal and the middle coats of the arteries, is even still more subject to ossification than the subserous cellular tissue. This subject shall be more fully discussed with the other diseases of the circulatory apparatus, in the 2nd volume.

The intermuscular cellular tissue has occasionally been found ossified in several points. Those cases in which it has been stated that the mus-

cles themselves have been seen transformed into a bony substance, belong in all probability to this class, the ossification of the intermuscular tissue being accompanied with the atrophy and absorption of the true muscular texture. I have seen a remarkable instance of ossification of the cellular tissue interposed between the layers of muscle, in a limb affected with elephantiasis. The muscles were perfectly colourless, and could with difficulty be disovered amidst the masses of thickened and indurated cellular tissue, to which the increased bulk of the limb was principally owing. Spiculæ of osseous matter were dispersed in rows through the whole mass, and appeared to follow the intervals between the muscles; some of them joined the osseous vegetations which sprung up from the surface of the periosteum.

In the cellular tissue is likewise formed the osseous capsule sometimes found in the back part of the eye, in certain cases of blindness; and which was long considered as ossification of the retina. I am convinced, from a minute examination of several of these cases, that the retina itself is never transformed into bone; for, I have found it in front of the osseous capsule, presenting its usual grey colour; and, behind the capsule, the choroid; consequently, the osseous matter must

necessarily have been deposited in the cellular tissue between these two membranes.

To conclude, wherever an accidental cavity, or a preternatural passage, has been formed, the cellular tissue of which their parietes are composed may become incrusted with depositions of osseous matter, either in the form of isolated grains, or of small plates. Sometimes they even form a layer round the entire circumference of the parietes of the cavity. In this way we find tubercles and hydatids surrounded with an osseous envelope; as also spiculæ of bone in the parietes of fistulous passages. I once, on opening the body of a dog, which had been killed for the purpose of making some physiological experiments, found in the abdomen, on one side of the vertebral column near the kidneys, an osseous cyst, containing in its interior half a dozen grains of lead.

II. *Ossification of the Fibrous and Cartilaginous Tissues.*

IF we trace the formation of the human skeleton, from the earliest period of its development in the fœtus, to extreme old age, we shall find the fibrous, and still more, the cartilaginous tissues, presenting a constant tendency to ossification. It is by the transformation of cartilage

into bone, that a great part of the skeleton is formed in the fœtus. After birth, we may observe the same process in operation, producing the obliteration of the fontanelles, the completion of the sutures, and the union of the epiphyses, &c. During the age of maturity, the formation of osseous matter continues, but is confined to those parts where bone already exists; hence it is, that the bones of the adult are constantly augmenting in substance. Lastly, in old age, ossification acquires a new disposition to seize on other parts of the fibrous and cartilaginous tissues; and thus, the same process which begins with the individual when his existence first commences, seems to acquire a fresh degree of activity when that existence approaches its final termination. At this period, the fibrous tissue of the sutures resigns its place to the osseous tissue, and thus the sutures become obliterated; the cartilages of the ribs, larynx, trachea, and bronchi, are successively converted into bone; the bones of the pubis become united by the ossification of their intermediate cartilage, just as happened in the fœtus with the two inferior maxillary bones; and lastly, there is a remarkable tendency to the formation of calcareous depositions in every part of the arterial system, which, be it observed, contains a much greater proportion of fibrous tissue than is to

be found in the venous system. Thus, then, we find that the process of ossification naturally increases in extent as the individual advances in life : but, notwithstanding the general physiological nature of this process, it may constitute a true pathological condition, by interfering with the due accomplishment of any vital function, as in certain cases of ossification of the heart and arteries.

When the ossification of the fibrous or cartilaginous tissue takes place at a premature period, or in parts where it does not usually occur in the progress of life, it ceases to be a physiological phenomenon, and must be considered as the result of a morbid action.

A state of active hyperæmia generally precedes the osseous transformation of the fibrous, cartilaginous, and fibro-cartilaginous tissues. M. Rayer observed, that when he excited an artificial irritation in the fibro-cartilage of a rabbit's ear, the part was at first softened, a yellow matter was next deposited in its texture, and, finally, a calcareous deposit was formed, and a true ossification produced. M. Cruveilhier likewise observed different portions of periosteum, ligaments, and cartilages, pass into the osseous or ossiform state, under the influence of different stimulating applications. He also ascertained, by fracturing the limbs of animals, that

the fibrous tissues around the fracture were frequently converted into bone. In many cases of fractures occurring in the neighbourhood of joints, the ligaments of the articulation have been found ossified. Fractures of the patella are frequently followed by ossification of the adjacent fibrous tissues. It has been observed, that in phthisical patients the cartilages of the ribs, and of the larynx, are prematurely ossified; and I have myself remarked the ossification of the cartilages of the nasal fossæ and of the surrounding periosteum, in glandered horses. It is now perfectly ascertained, that some exostoses have in reality no connexion with the bone from whose surface they shoot up; but are formed exclusively at the expense of the periosteum, which, after an attack of chronic irritation, attended with pain and tumefaction, is eventually converted into bone. Fractured cartilages are in general re-united by a hoop of osseous matter, which is formed at the expense of the perichondrium. In some individuals attacked with caries of the vertebræ, the anterior vertebral ligament, and even the intervertebral fibro-cartilages, have been found in a state of ossification. Whenever a tendon rubs against a hard part, an osseous point is developed in that part of the tendon where the friction takes place.

In all these instances we find the ossification of the fibrous and cartilaginous tissues evidently succeeding the irritation, or increased vascular action of the part; but in a variety of other cases, no morbid action whatever can be discovered previously to the deposition of osseous matter. How often, for example, do we find these depositions in the middle coat of arteries, in the fibrous tissue situated at the different orifices of the heart, in the dura mater, the pericardium, the capsule of the spleen, &c. without our ever having had the slightest evidence of the existence of any antecedent irritation of the part, either from the examination of symptoms during life, or of the morbid appearances found after death. No doubt, it may be argued that the irritation might have existed in a latent form; but before I can adopt such an hypothesis, it must first be clearly and satisfactorily proved that this irritation is an essential element in the production of ossification; in which case I must of necessity admit its existence, for then, the effect being produced, its cause must have existed either in a manifest or latent form. In my opinion, however, we have no more grounds for admitting an increase of vitality as the cause of the osseous, than of the fibrous or cartilaginous transformation. We learn from observation that the nutrition of the

part is perverted, and altered from its natural type, but neither theory nor observation shews any necessary connexion between this alteration and the exaltation of the vascular action of the part.

Ossifications may be considered with reference to their form, their texture, and their chemical composition. We shall now proceed to examine how far the accidental bones agree with the natural in these respects, and we shall find that the number of cases is very small indeed in which a perfect analogy can be established between them.

The principal varieties of form which morbid ossifications present, are the following.

1. *Graniform ossification.* Osseous granules are found, either isolated or in clusters, in the cellular tissue which lines the different membranes, as well as in that which enters into the composition of the parenchymatous organs; they have also been found floating loose in some serous cavities. Their origin, in this latter situation, is in all probability the same as that of the cartilaginous bodies which are found in the joints and in the peritoneum. (See the preceding article on cartilaginous transformation.) The number of these granular bodies is exceedingly variable : I once found in a woman forty-seven years of age, who died of encysted dropsy

of the ovary, the entire surface of one lung studded with a prodigious number of minute ossiform grains; they were developed between the pleura, which they elevated, and the pulmonary parenchyma. In another individual, I found in the pia mater, on the anterior part of the right hemisphere of the brain, close to the median fissure, an osseous granule about the size of a pea, causing a corresponding depression in the cerebral substance : this tumour did not produce any appreciable symptom during the life of the person. In the ovary of a middle aged woman, who died of phthisis, I found half a dozen white polished grains, of the same consistence as bone, and about the size of peas ; in the centre of two or three of them was a small cavity filled with a few drops of a clear colourless fluid. It appeared to me highly probable that these granular ossifications were formed of so many ovarian vesicles transformed into bone. In a little girl of three years of age, who died in the *Hospital des Enfans*, under the care of M. Jadelot, the centre of the right lobe of the cerebellum was occupied by a dozen small bodies of an irregularly rounded form, and exactly similar in all their physical properties, to so many fragments of bone. They were imbedded in the substance of the cerebellum, which appeared perfectly healthy all round them.

The size of these granular ossifications is in general but small; they very seldom exceed the dimensions of a large pea, and are frequently less than the head of a small pin. Their form may be more or less perfectly round; their surface is sometimes smooth and pale; in other instances it is uneven and rugged.

2. *Lamelliform ossification*. The accidental osseous tissue which assumes this form is arranged in laminæ, or irregular plates, on the adherent surface of the different membranous tissues. Patches of this description are found in the cellular tissue subjacent to the arachnoid in the skull and spine; they are likewise found on the outer surface of the pleura, the pericardium, and the peritoneum, and between the middle and the internal coats of arteries. Their colour is generally of a dull white, sometimes inclining to a yellowish cast; their size is very variable. They are sometimes so large as to line an entire side of the thorax with one continuous incrustation. An inflexible plate of bone is sometimes found occupying the place of the falx cerebri. I have myself found, on one occasion, a similar plate interposed between the lobes of the cerebellum and the posterior lobes of the cerebrum. The osseous tissue which is sometimes accidentally formed between the cho-

roid and retina, is an exact representation both in form and size of the latter membrane.

3. *Membraniform ossification.* I apply this denomination to that species of accidental osseous tissue, which follows the ordinary arrangement of membranes, and constitutes the parietes of various cavities, of which I have already given some examples. I once found a hard body occupying the place of the thyroid gland, whose size it nearly equalled. This body consisted of a true osseous envelope, composed of distinct fibres mutually interwoven: its internal surface was uneven and corrugated, and it contained a cavity which was traversed by a number of very delicate filaments, similar to those of the spongy part of the natural bones. They were attached at both extremities to the general osseous envelope, and between them was deposited a small quantity of reddish fluid of the consistence of syrup.

4. *Amorphous ossification.* To this class should be referred those osseous masses which are often found by themselves, or in combination with other accidental productions, in the different parenchymatous organs, especially in the ovaries and uterus. In these cases, however, the morbid alteration consists rather in the deposition of one of the elementary ingredients of bone, the phosphate of lime, than in a

true osseous transformation; they will therefore with propriety be considered when we come to speak of the alterations of secretion.

The texture of the accidental osseous tissue presents the following varieties.

1. It may present a homogeneous mass, without any appearance of fibres, or division into compact and spongy texture. The consistence of these masses is in some cases less than that of the natural bones; in other cases it is the same; and, lastly, in some instances it is much more considerable, so that the greatest difficulty is experienced in breaking or sawing them asunder. When treated with acids they are in many cases perfectly dissolved. In fact they only resemble the natural bones in colour, consistence, and the presence of certain calcareous salts.

2. Instead of the homogeneous mass above described, we sometimes find, in the osseous deposit, certain arrangements of structure which approximate more or less to those of the natural bones. For instance, several of the plates or bony patches already described, present a perfect identity of structure with the compact osseous substance which is found in the flat bones of the skull, where the diploe is wanting; and they sometimes exhibit an appearance of fibres regularly radiated, or irregularly inter-

laced, just as in the flat bones of fishes. There are some of these osseous laminæ which bear the strongest resemblance both in form and texture to the os unguis. An appearance of the spongy or reticulated structure is in some cases found combined with the compact solid texture. These cases comprehend all the analogies of texture which can be established between the natural and accidental osseous tissues; the only instance in which the newly formed tissue re-presents exactly the texture of the natural bone, is that in which the periosteum, or the medul-lary membrane, is transformed into a new bone, in order to replace a portion of bone which had been destroyed; and even in this case, the ap-proximation of structure takes place but gra-dually; thus, in the long bones, when newly formed, there is at first no medullary cavity.

Chemical analysis establishes in the acciden-tal, as well as in the natural bones, the pre-sence of two salts, namely, the phosphate and the carbonate of lime, and of an animal matter of the nature of gelatine. In the natural bones, however, these substances, combined with others which have not as yet been discovered in the ac-cidental osseous tissues, are invariably found to-gether, and in the same proportions, some al-lowance being of course made for the difference of age, sex, idiosyncrasy, and disease; whereas

in the accidental bones these substances may exist either singly or in combination, and, when combined, nothing can be more variable than their relative proportions. Thus the calcareous salts are sometimes found without the combination of any animal matter; at other times they are united with a small proportion; and, again, in other instances, this matter forms the predominant ingredient. I recollect, on one occasion, immersing a cyst with osseous parietes into sulphuric acid, and finding it thereby transformed into a cartilaginous cyst.

SECTION III.

LESIONS OF SECRETION.

THE blood which circulates through an organ may be submitted to three species of elaboration. By the first, it is deprived of a series of molecules, which, being acted on by the plastic force that regulates the formation of each individual tissue, are appropriated to the organ itself, become an integral part of its structure, and thus repair the losses which it is constantly sustaining. This constitutes the process of nutrition, properly so called. By the second species of elaboration, an albuminous matter, in the state of liquid or of vapour, is constantly produced in every part of the system. This species of secretion appears to be no less essential to the maintenance of life, than the nutritive secretion itself. Its existence is most evident, 1. in the areolæ of the cellular tissue ; 2. in the serous cavities, which may be compared to so many cellular areolæ magnified ; 3. on the surface of the tegumentary membranes, where it should be distinguished from the mucous and

sebaceous secretions; 4. on the internal surface of the vascular system. From this enumeration it appears, that wherever an organ presents a surface, there this secretion or transpiration takes place. There can no doubt be entertained that this perspirable matter is furnished directly by the blood; for, the presence of different substances may be detected in it, at a very short interval after they have been mixed with that fluid. If, for example, some prussiate of potash be injected into the veins of a living animal, its presence in the fluid of the serous membranes may almost immediately be detected by the sulphate of iron. Camphor, or phosphorated oil, when mixed with the blood, may with equal facility be recognized in the pulmonary vapour which escapes at each expiration. I have thought it necessary to allude to these physiological facts, because it is of the utmost importance, in a pathological point of view, to have a clear conception of the origin of this perspirable matter, the alteration of which appears to play a very important part in causing several accidental productions. Lastly, the third species of elaboration which the blood undergoes, by far less general than either of the preceding, takes place, at least in the natural state, only in certain organs of a particular organization, which present

various degrees of complication of structure, from that of a simple follicle, to that of the liver.

In the preceding section, I have attempted to describe the different organic lesions which result from a morbid modification of the first of these three species of elaboration. The reader will, I trust, recollect, that in all these lesions we could discern only various alterations in the nutrition of the tissues affected, or, in other words, alterations in the quantity or quality of the molecules of which these tissues were composed. It now remains for us to consider the morbid modifications of the other two species of elaboration which the blood undergoes. These constitute a very numerous class of diseases ; for, in whatever part of the body we find any productions, whether solid, liquid, or gaseous, which have nothing analogous to them existing naturally in the system, it is impossible to conceive their formation in any other way than by supposing them the product of some organic action, more or less analogous to that which, in the healthy state, separates from the blood the materials for repairing the several tissues, or forming the different secretions. This mode of accounting for the formation of the different accidental productions, is not without some practical utility ; for, *a priori*, it leads us to suppose, that the same conditions which, in the

healthy state, exert an indisputable influence over the secretions, should likewise influence the formation of accidental productions, if these productions be in reality only morbid secretions. Now, in the healthy state, the secretions are influenced, 1. by the quality of the blood, as is proved by the modifications which may be produced in the bile, the urine, the milk, &c., by altering the composition of that fluid; 2. by the condition of the secretory organ; 3. by the state of innervation: the fact must be familiar to every one, that any slight derangement in the functions of the nervous system materially affects the secretion of the tears, of mucus, bile, milk, sweat, urine, and saliva. In the same manner, the different morbid secretions may be materially influenced, 1. by the state of the blood; 2. by the condition of the solids where the secretion takes place; and 3. by the nervous system.

In order to study with more accuracy the different morbid secretions, I shall divide them into three principal classes.

In the first, shall be placed those morbid secretions which retain the qualities of the natural secretions, but are much more abundant in quantity than usual. These secretions sometimes remain in the cavities where they have been formed, constituting the different varieties

of *effusion* : in other cases, they are eliminated from the system, as fast as they are formed ; hence arise the various species of *flux*.

In the second class, the qualities of the natural secretions are likewise retained ; but they, or some of their elements, are found in a part of the body different from that in which they are generally formed or deposited : they may either have been actually formed in this new situation, or may have been translated thither by different ways.

The third class comprehends those cases in which, in place of the natural secretion, other products are formed, which sometimes appear to be merely modifications of the natural secretion, or at least bear some resemblance to it ; and, in other instances, bear no resemblance whatever to it, and seem to be perfectly novel productions. These morbid secretions may be developed in any part of the body ; for, the only condition requisite for their formation, is the power of secreting, which, as we have already seen, is possessed by every tissue in the body. These products of morbid secretion may be perfectly identical, though furnished by the most different tissues ; for, wherever they occur, they seem to depend principally on some modification of the perspirable matter, which is exhaled in the form of fluid or of vapour by every tissue, and is apparently identical in them all.

Even the blood itself, when organized, acquires the faculty of secreting; for, throughout all animated nature, the first of these facts (organization) necessarily infers the second (secretion.) Hence it appears, that, in the blood, while in its fluid state, as it circulates through the vessels of the living animal, the materials of different morbid secretions may be formed, and, in the blood, when coagulated, those morbid secretions themselves may be developed.

In a fourth and last class, I shall describe the morbid gaseous secretions; which, in their history and etiology, have some resemblance to the morbid productions of the preceding class, but yet differ from them so much in many particulars, as to render it necessary to set apart a distinct chapter for their consideration.

CHAPTER I.

Modifications in the Quantity of the Secretions.

THE quantity of the secretions may be either increased or diminished; hence this class of morbid alterations may be divided into two species; the first consisting in an increase in the quantity of the secretions (*hypercrinia*); the

second, in their diminution of quantity, or total suspension, (*acrinia*).

I shall at present treat only of the first of these species, being compelled to pass the second over in silence, for want of sufficient data to illustrate its causes and effects. I may, however, remark, that one of the first effects of irritation, is to produce in the affected organ a suspension of the secretory process; at a subsequent period the secretion is re-established, but is almost constantly either increased in quantity, or altered in quality. I have more than once had occasion to observe, in my dissections of individuals who, during their illness presented different nervous symptoms, such as delirium, convulsive motions, &c. that the only appreciable lesion to be detected in the encephalic organs was a remarkable dryness of the membranes, which certainly was not their natural state. The secretions may likewise be suddenly suspended by certain modifications of the nervous influence. For instance, the bile often ceases to flow into the intestines, and the tongue becomes suddenly parched, in consequence of a strong mental impression; and, in typhoid diseases, the secretion of urine is often totally suspended.

ARTICLE I.

Hypercrinia with Retention of the Secretion.

WHEN a fluid is separated from the blood in a greater quantity than usual, it may either be retained in the cavity where it is formed, or may make its escape externally.

In order that the first species of hypercrinia may take place, it is necessary that the cavity where the secretion is formed should be close at all points, or, at least, that it present no outlet whereby the effused fluid may make its escape. The only parts which present these conditions are, the adipose and cellular tissues, and the serous membranes ; and in these parts exclusively can those collections of fluid be formed, which are designated by the generic appellation of dropsy. I am aware that cases of dropsy of the mucous membranes have been recorded by Nosologists ; but they can only take place when the communication of these membranes with the exterior is accidentally closed. Thus, in those cases which have been described as *dropsy of the stomach*, the pyloric orifice, being nearly closed, with difficulty admits the passage of a small proportion of the substances which have been swallowed; consequently these, when mixed with the products of the gastric

secretion, form a prodigious accumulation in this organ. In like manner, the name of *dropsy of the uterus* has been applied to those cases in which an unusual quantity of fluid is formed in its cavity, at the same time that the narrow orifice of the os tincæ does not allow it to escape. I once saw the gall bladder form a considerable tumour below the cartilaginous margin of the ribs, in consequence of the obliteration of its duct : instead of bile, its cavity, which was enormously dilated, contained a large quantity of clear serous fluid. This case, however, is far from common ; for, in general, when a reservoir ceases for a considerable time to receive the fluid which should be deposited in it, all secretion there gradually ceases, its cavity becomes obliterated, and the texture of the viscus is sometimes even resolved into simple cellular tissue.

There is no part of the cellular tissue which may not become the seat of serous collections to a greater or less extent. They in general occur most frequently in those parts where its texture is loosest, and its position the most dependent. The dense compact cellular tissue which lines the mucous membranes, is not exempt from this affection, notwithstanding Bichat's opinion to the contrary. In such cases, the membranes, being raised by the accu-

mulation of serum behind them, present a tremulous appearance, and sometimes even convey a distinct sense of fluctuation. The peritoneum is, of all the serous membranes, that which is most frequently affected with dropsy. I shall presently have occasion to enumerate some of the causes of this tendency to ascites.

The fluid which is found in the serous membranes investing the brain and spinal cord, should not be considered a morbid production; it is, in fact, a healthy secretion destined to fill the space which intervenes between these centres of the nervous system and the osseous parietes by which they are protected. The existence of this fluid, first positively ascertained by Magendie in living animals, and in human subjects examined at a short interval after death, might have been inferred from comparative anatomy. From this source we learn, that the capacity of the skull does not decrease exactly in the same proportion as the size of the brain; and that when the cerebral mass is very small, the cranial bones are not so exactly moulded to its surface, but that there remains between them and it a space filled with a serous or adipose fluid, the quantity of which is in the inverse ratio of the cerebral mass. Now, in man, whose spinal marrow is but little developed, in comparison with his brain, or with the spinal

marrow of other animals, there is a considerable space intervening between it and the parietes of its canal; which space, we might from analogy have inferred, must also be filled by a fluid. This subject I shall fully resume when I come to treat of the diseases of the nervous system.

Neither should we regard as a morbid production, the fluid which is almost invariably found in small quantities in the different serous membranes, when the body is opened more than thirty hours after death. In the preceding case, the fluid existed during life; in the present instance, on the contrary, it is when the influence of the vital laws has completely ceased, and when the putrefactive process commences, that these membranes begin to present this phenomenon. In consequence of the diminution of cohesion at this period sustained, both by the blood, which no longer enjoys its vitality, and by the parietes of the blood-vessels, the molecules of which have lost their vital force of aggregation, the thinnest part of the sanguineous fluid, the serum, soaks through the solids with which it is in contact, and transudes into the different cavities of the body. If these cavities communicate with the external atmosphere, the effusion evaporates; if no such communication exists, the serum continues to

accumulate, either pure or mixed with a certain proportion of colouring matter. According to M. Gendrin, *(Histoire Anatomique des Inflammations)* a greater quantity of this effusion is in general found after death in the serous cavities of young persons, than in those of adults, and especially of old men.

The fluid which is effused in superabundant quantity, into the serous membranes, or cellular tissue, presents almost all the physical properties of the serum of the blood. Like it, it may be found either perfectly colourless, or of a green, yellowish, or reddish tint. All these varieties of colour seem to depend on the presence of a certain quantity of the colouring matter of the blood. In jaundice, the dropsical fluid contains a yellow colouring matter analogous to that of bile; it has also in some cases been found to contain uric acid. Like the serum of blood, it does not coagulate spontaneously; but may be, like it, coagulated by the application of heat, acids, alcohol, or electricity. The dropsical fluid is sometimes exactly analogous in its chemical composition to the serum of blood, like it containing, on an average, in one thousand parts, nine hundred of water, eighty of albumen, and the rest of soda, various salts, and an animal matter resembling mucus. In other cases, this fluid contains less water, and a much greater pro-

portion of albumen ; and in others again, it is the albumen which is deficient. When that is the case, it may vary in quantity, from twenty or twenty-four parts in a thousand, to a mere trace, the effused fluid being then almost wholly composed of pure water holding a few salts in solution. Under some peculiar circumstances, this fluid is found to contain, in addition to albumen, another animal substance, the precise nature of which has not yet been exactly ascertained, which gives it a turbid appearance. This substance, which has been denominated *extracto-mucous*, may either be arranged in the form of minute molecules, uniformly combined with the serous fluid, which thence acquires a slight opacity throughout ; or it may be disposed in filaments or flocculi floating in the midst of the fluid, which then has its transparency altered in those points only where these little flocculi exist. I do not think that this peculiar modification of the fluid of serous membranes has any necessary connexion with the irritation or inflammation of these membranes ; for I have repeatedly found a slightly turbid fluid, or mixed with some flocculi, in the different serous cavities of individuals who had died of chronic diseases, and in whom neither the symptoms presented during life, nor the morbid appearances found on dissection, afforded the slightest proof of the existence

of any recent or former attack of inflammatory action in the membranes lining those cavities.

From the preceding observations it appears, that the serous membranes are capable of producing three different modifications of secretion, without themselves undergoing any alteration of texture, or presenting the slightest appearance of sanguineous congestion. 1. A portion of serum appears to escape from the blood, in the same state as it exists in that fluid. 2. A sort of choice or selection is made in the ingredients of which this fluid is composed, so that, according to the nature of the selection, some one of the elementary ingredients of the serum of the blood predominates in the composition of the effused fluid. 3. A new substance, to which the blood contains nothing analogous, is generated either in the effused fluid, or in the serous membrane from which the effusion proceeds.

There are several kinds of causes which favour the accumulation of fluid in the different serous cavities, and in the areolæ of the cellular tissue. The following enumeration comprises those which are most efficient in the production of dropsy. 1. A degree of stimulus or irritation of the organ where the dropsy is formed. 2. The sudden disappearance of another dropsy. 3. The suppression of certain secretions. 4.

Various alterations in the blood. 5. Obstacles
to the venous circulation. 6. Lastly, dropsy is
sometimes found accompanying certain states of
cachexia, in which none of the conditions above
enumerated can be positively discovered, but in
which they may nevertheless, with some proba-
bility, be supposed to exist.

FIRST ORDER OF THE EXCITING CAUSES OF DROPSY.

Stimulus or Irritation of the Serous Membranes, or of the Cellular Tissue.

SUCH may have been the original source of
the disease, and it may have subsequently dis-
appeared, leaving behind it, as its effect, an
accumulation of serous fluid. In this case, the
disease, which was at its commencement inflam-
matory, and should then have been treated as
such, subsequently changes its character; and it
then becomes necessary to employ a plan of
treatment diametrically opposite to the anti-
phlogistic, in order to dissipate the same drop-
sical effusion, which, at an earlier period, might
have been removed by blood-letting. In other
cases, the irritation continues to the last, and
then the treatment of the collection of fluid
becomes only a secondary consideration. Again,
in other cases, the irritation, after having dis-

appeared for some time, returns again, and, what is particularly remarkable, the re-appearance of the local irritation not unfrequently effects the cure of the dropsy which it had originally caused.

The irritation which precedes the accumulation of a serous fluid, may either be seated in the same tissue in which the dropsy is formed, or may affect some of the adjacent tissues. For instance, hydrocephalus, both in its acute and chronic form, is often consecutive to an irritation in the proper tissue of the brain; and ascites sometimes occurs after an attack of gastro-enteritis. The submucous cellular tissue frequently becomes infiltrated after an acute or chronic inflammation of the membrane to which it is subjacent; in like manner, we constantly observe the formation of œdema in those portions of the subcutaneous cellular tissue which correspond to parts of the skin that have been irritated. Every person must be familiar with the serous infiltration which so frequently forms round old ulcers, or blisters when kept long open, or even under a simple sinapism, when applied to individuals worn down by protracted sufferings, or chronic disease. The induration of the cellular tissue of the extremities, which sometimes succeeds to the chronic inflammation of the skin of these parts, often commences by

a simple serous infiltration; and when the in-
duration subsequently disappears, the cellular
tissue, before returning to its natural state, is
again found infiltrated with serum.

SECOND ORDER OF CAUSES.

The Disappearance of another Dropsical Effusion.

WHEN the fluid which had been accumulated
in a serous cavity, or in the cellular tissue, sud-
denly disappears, some of the following pheno-
mena usually succeed. 1. Copious evacuations
are established from different secreting surfaces;
by which a great quantity of aqueous fluid is
discharged from the system, and no injury sus-
tained. 2. No such evacuations take place, and
yet the general health is re-established. 3. At
the same time that the effused fluid is absorbed,
without any corresponding evacuation being es-
tablished, various derangements of the principal
functions take place: the most remarkable of
these is the sudden modification which the ner-
vous influence undergoes; the patient experi-
ences an extraordinary sense of oppression, and
falls into a state of collapse, which not unfre-
quently proves fatal. Lastly, it sometimes hap-
pens, that the fluid which disappears from one

cavity, almost immediately accumulates in another, where its presence is announced by a new train of morbid symptoms. I shall never forget the case of a patient who was labouring under organic disease of the heart, and in whom the sudden disappearance of ascites was immediately followed by all the usual symptoms of a most violent attack of apoplexy, which proved quickly fatal. On opening the body, the following appearances were presented : the peritoneum did not contain a single drop of serum ; not the slightest vestige of hæmorrhage was to be found in the brain, but the ventricles were all enormously distended by a clear serous fluid, which existed in such prodigious quantities, that the roof of the lateral ventricles was considerably raised, and conveyed when touched, an evident sense of fluctuation.

If we compare these facts with the phenomena produced by injecting water into the veins, of animals, we shall find several points of analogy between them. If, before the water is injected, the animal has been copiously bled, a considerable quantity may be introduced into its circulating system, without producing any serious or dangerous consequences. But, if the water be injected without previously taking the precaution of diminishing the mass of blood in circulation, the animals quickly evince symptoms of extreme suffering ; their brain becomes

affected, and they fall into a state of immobility
and prostration of strength.   At the same time,
their respiration is accelerated ; and, if the in-
jection be continued, the severity of the symp-
toms increases, and the subject of the experiment
dies, either by the lungs, in a state of asphyxia,
or by the brain, in a state of coma.   On dissec-
tion, the lungs are found excessively congested
with a serous fluid, and effusions more or less
extensive are likewise found in different parts
of the cellular tissue, and in the serous mem-
branes.   When I come to treat of *fluxes* I shall
have occasion to revert to this subject, and con-
sider it more in detail.   I have merely alluded
to it here, in order to shew how, after the sud-
den disappearance of a dropsy, a new serous
collection may be formed at the expense of the
same fluid, which, being absorbed from the ca-
vity where it was originally effused, re-enters
the circulation, in order to be again effused on
the surface of some other serous cavity.

THIRD ORDER OF CAUSES.

The Suppression of certain Secretions.

It has been long remarked that dropsies are
particularly prevalent in cold and damp cli-
mates ; and that diabetes is also a frequent af-

fection in such countries. The researches of M. Edwards (*Influence des Agens Physiques sur la Vie*) have thrown considerable light on this subject : he has clearly proved, that, under the influence of a moist atmosphere, the perspiration which is constantly going on from the skin and mucous surface of the air-passages, is reduced to its minimum. May we not then reasonably suppose, that the serous fluid which the blood cannot throw off by these surfaces, is separated from it in the cellular tissue, the serous membranes, or in the renal parenchyma ? And may we not regard what occurs in this case, as the reverse of that which happens when the cutaneous transpiration attains its maximum, and a dropsical effusion disappears at the same time that the skin is bathed in sweat ? I have elsewhere related a case, in which the disappearance of hydrothorax was attended with an extraordinary exhalation of serous fluid from the bronchial tubes ; and I really see no reason why the dropsical affections which so frequently occur during convalescence from scarlatina, may not depend on the diminution of the cutaneous perspiration, which continues during the whole period of the desquamation of the epidermis.

One of the few instances of dropsy occurring without any appreciable organic cause, which I have had an opportunity of observing, was

where that affection accompanied the existence of only one kidney. (*Clinique Medicale*, vol. iii.) Was the aqueous fluid which in this case filled the cellular tissue and serous membranes, the same which ought to have been separated from the blood by the kidney which was wanting?

FOURTH ORDER OF CAUSES.

Alterations of the Blood.

SEVERAL of these alterations, though of diametrically opposite characters, alike contribute to the production of a certain number of dropsies. Thus, whether there be a superabundance of blood in the vascular system; or whether that fluid be deficient in quantity, or in fibrine; or so altered in quality as to facilitate the separation of its aqueous part; the constant effect of all these alterations, is a dropsical effusion.

It not unfrequently happens, that, in individuals in the flower of their age, and presenting all the signs of well marked general hyperæmia, the cellular tissue of the extremities becomes œdematous, and the serous cavities filled with fluid. In these cases, there is no evidence whatever of any inflammatory action in the parts where those serous collections are formed; neither can any symptom be discovered indicative

of any organic affection ; all that the most atten-
tive examination can discover, is the co-exis-
tence of a state of general plethora with the
dropsical effusions ; and it is only by diminish-
ing the mass of blood by low diet and copious
bleedings, that these effusions can be effectually
removed. I once had an opportunity of examin-
ing the body of an individual in whom the
dropsy was thus evidently connected with a state
of general plethora. The case I allude to, was
that of a man of about thirty years of age, who
had been for a month labouring under anasarca
and ascites, when he became a patient at *La
Charité.* I repeatedly examined him with the
most scrupulous care, but could never detect
the slightest symptom of any organic lesion ;
he was full of life and vigour ; his eyes were
habitually injected ; he had repeated attacks of
epistaxis, and his skin constantly presented a
florid colour, which contrasted strangely with the
doughy state of the subcutaneous cellular tissue.
The secretion of urine was not diminished ; the
pulse was full and bounding, and rather quicker
than natural. A few days after his admission,
and without any assignable cause, he was sud-
denly seized with delirium, and shortly after fell
into a state of coma, in which he died. On
opening the body, we found a large quantity of
clear colourless serum in the cellular tissue of

the extremities, and in the peritoneum ; but neither the abdominal viscera, nor the peritoneum, presented the slightest trace of disease. There was in each cavity of the pleura about half a pint of fluid, and there was also a small quantity in the pericardium ; but there was no more appearance of morbid alteration in the thoracic viscera than in those of the abdomen. In the skull, the cellular tissue which lines the arachnoid, where it is reflected over the convex surface of the brain, was infiltrated with a quantity of serous fluid ; the different ventricles were also filled with it ; but, neither in the membranes, nor in the substance of the brain, could we discover any morbid appearance. It appears to me highly probable, that the timely employment of copious bleedings might have removed the dropsy in this case, and at the same time have prevented the fatal and unexpected termination of the disease ; for, there was no alteration discovered in the solids sufficient to account for either the dropsy, the symptoms which succeeded, or the death itself ; so that it must have been a case of dropsy from plethora. As to the phenomena which ushered in the fatal termination, they were, doubtless, the consequence of the sudden extension of the effusion to the cerebral cavities.

The influence of a state of general hyperæmia

in producing certain dropsies, may be proved by the following experiment. If, in a living animal, we increase by artificial means the mass of fluid contained in the vascular system, and keep the vessels for some time in a state of over-distention, we thereby not only favour the formation of serous effusions, but likewise diminish the absorption of the fluids already effused into the cellular tissue : if, under such circumstances, we open a vein and allow some of the circulating fluid to escape, the serous effusions soon disappear, and the absorption resumes its accustomed activity.

From these, and many similar facts, it appears to me fully established, that many dropsies depend on a state of plethora, although it is not easy to determine how the effect is produced. I shall not take upon me to decide, whether the dropsy in such cases results from the mechanical transudation of the serous part of the blood through the parietes of its over-distended vessels, or from the diminished activity of the process of absorption.

A condition of the blood, altogether different from the preceding, that in which there is a notable diminution in its quantity, and even a tendency to anæmia, may likewise produce dropsy. In this way the disease frequently fol-lows too copious, or too often repeated ve-

nesections; and in this way also are produced those dropsies which assume an almost epidemic form during seasons of great scarcity, when the population are deprived of their natural sustenance, and are reduced to live on the roots and herbs of the field. One of the first effects resulting from the use of such diet, must necessarily be, that the qualities of the blood are modified, and it becomes *impoverished* from the diminution of quantity of its fibrine. I have elsewhere (*Clinique Medicale,* tom. iii.,) related some cases of persons dying dropsical, who presented no appreciable lesion of their solids, but in whom there was in reality no blood to be found, either in the large vessels or in the capillaries; for the term blood could not, with propriety, be applied to the reddish watery fluid which the blood-vessels contained. In these instances, the connexion between the aqueous state of the blood and the formation of the dropsical effusions, was particularly striking. In all such cases, the slightest irritation of the skin is sufficient to produce an infiltration of serous fluid into the subjacent cellular tissue. Not long since, I had an opportunity of seeing the application of sinapisms to the thighs produce this effect, in a case of acute peritonitis, which had been treated by copious and repeated venesections. Erysipelas is frequently accom-

panied with œdema in persons advanced in life, or whose constitutions are weakened by great losses of blood, or long abstinence from sufficiently nutritive diet.

To conclude, dropsies, both partial and general, have been observed occurring very speedily after the application of certain poisons, especially those of various reptiles. Now, on what part of the system but the blood can we suppose that the poison, in such cases, primarily acts? The truth of this position might be established by physiology, even though the effects of such poisons on the blood were not proved to demonstration by the alterations which the sensible qualities of that fluid invariably undergo. The most remarkable, and perhaps one of the most constant of these alterations is, that the blood loses altogether the power of coagulating: the effect of this is, that its serous part separates, and escapes with great facility from the vessels, either pure, or combined with a variable proportion of the colouring matter, and thus forms various dropsical effusions. Several points of analogy may be traced between these cases of poisoning by venomous animals, in which the dropsy is connected with a primary alteration of the blood, and those typhoid fevers in which the introduction of some molecules of morbid animal matter into the mass of blood, produces

such an entire change in its properties, that it escapes from its vessels, and is extravasated on every surface of the body.

FIFTH ORDER OF CAUSES.

Obstacles to the Venous Circulation.

THE obliteration of the principal vein of a limb, and of its chief collateral branches, so frequently co-exists with a dropsical affection of the part, that it appears extremely probable the first of these alterations is the cause of the second.* There is no difficulty in comprehending how the obliteration of the collateral veins is essential to the production of this species of dropsy ; and the want of this essential condition explains why dropsies have not been found in parts which had their principal veins perfectly obstructed ; and also why the ligature of the femoral vein in dogs does not always produce dropsy of the abdominal extremity. We must not however attempt to conceal, that doubts may reasonably be entertained as to the correctness of this etiology of local dropsies, and that it may be urged, that what we take to be the cause of the accumulation of serum, may in

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* This cause of local dropsy has lately received considerable elucidation from the scientific researches of M. Bouillaud.

reality have been its effect ; that the blood, being by some unknown cause deprived, in the capillary vessels, of its serous part, may have been rendered more prone to coagulate, and, in consequence, may have formed itself into a solid mass in the large veins, and thus obstructed their cavities. To these arguments it may be answered, that if the coagulation of the blood in the veins were merely the consequence of its being deprived of a portion of its serum, the coagulation should take place in the small as well as in the large veins ; whereas, in general, the small vessels are perfectly free and unobstructed, clots of blood first make their appearance in the veins of more considerable calibre, and it is only in the principal vessels that the coagula are so perfectly formed as to obstruct the passage altogether. Besides, the pressure of a tumour on the principal vein of a limb is capable of producing a similar state of œdema ; and in this case it is evident that the obstruction of the vein is the cause, and not the effect, of the dropsy. An additional proof is furnished by the fact, that the extent of the dropsy corresponds exactly with the point in which the venous obstruction exists ; thus, the obliteration of the femoral vein is attended with œdema of the lower extremity, and that of the axillary vein, with œdema of the corresponding upper

extremity. When the vena cava is obliterated, both lower extremities are infiltrated with serum; but there is no effusion into the peritoneum, unless at an advanced period of the disease, when it sometimes occurs as a consecutive affection. On the other hand, if it be in the vena portæ that the circulation is obstructed, whether in its trunk or in its subdivisions in the liver, the dropsy invariably commences in the peritoneum. Lastly, if the obstacle to the venous circulation exists in its central point, the heart, the effects of the obstruction should be felt in every point of the venous system, and consequently there should be a general tendency to the formation of dropsical effusions in every part of the body ; which is precisely what occurs in organic affections of the heart. It has been stated, but, as I conceive, erroneously, that congestion of the spleen was a frequent cause of dropsy ; it is true that these affections do frequently co-exist, but the cause of the dropsy really lies either in the liver, or some other part. I doubt likewise whether dropsy is ever produced by chronic affections of the lungs, even in those cases where a considerable portion of their parenchymatous substance is in a state of induration ; unless when they are combined with organic disease of the heart, or some other cause capable of producing dropsy.

Are obstacles to the lymphatic circulation capable of producing dropsy? The only case in which such a cause could possibly operate, would be when the thoracic duct was obstructed; for, as to the lymphatic vessels, they anastomose so freely, that the obliteration of a few of them could never obstruct the circulation. But, in the few cases of obliteration of the thoracic duct which have as yet been observed, dropsy has not been found an invariable attendant; and in those cases where it did exist, there were likewise found other morbid alterations capable of producing it. Besides, in all the cases of this description which I have myself had an opportunity of examining, the passage of the lymph through the thoracic duct was never completely interrupted; it was carried on by the aid of collateral vessels largely dilated, which were detached from the duct below the point where the obstruction existed, and again opened into it above that point. Thus, then, we have as yet no positive proof that an obstacle to the circulation of lymph is capable of producing dropsy; neither can the agency of this cause be supported by theory, since the functions of the lymphatic system, as well as the origin of the fluid which it contains, are far from being well known.

Hitherto we have seen dropsy produced under the influence of appreciable causes, residing

either in the solids, or in the fluids. But there are also some cases of dropsy, in which there is no evidence whatever of the agency of any of these causes ; in which the effusion cannot be traced to any irritation, present or antecedent, to the suppression of any secretion, to an altera- tion of the blood, or to any mechanical obstacle to the venous or lymphatic circulation. The individuals who present these dropsies which occur without any appreciable cause, may be divided into two classes : in the first, they con- stitute the primary disease ; in the second, they are consecutive, and occur as a complication in the last stages of various chronic disorders. In both these cases, the dropsy might reasonably be supposed to depend on a morbid condition of the blood, but of this there is no positive proof. It is true, that in those individuals who become dropsical during the course of chronic diseases, the condition of the blood bears a strong ana- logy to that which produces dropsy in persons that have been too largely bled ; that is to say, its quantity diminishes, and its proportion of fibrine constantly decreases. But, if such be the real and only cause of those dropsies which make their appearance towards the close of various chronic diseases, how comes it, that this affection is so rare in cases of tubercles in the lungs, in which the hæmatosis is so materially

altered, and is, on the contrary, so constant an attendant on cancerous affections of the uterus ? The conclusion at which we must arrive is, that there are some dropsies, with the causes of which we are at present perfectly unacquainted. As to saying that they depend on an irritation of secretion, it is a mere *petitio principii ;* as well might we attribute dropsy, with the older noso-logists, to an alteration in the organic sensibility of the absorbent vessels, or to a defect of propor-tion between the absorbents and exhalants. Be-fore, however, we venture to pronounce posi-tively that a dropsy does not depend on any of the causes above enumerated, we should ascertain, by actual dissection, the state of the parts ; for there are several of these causes which must escape detection during life. For example, how are we to ascertain, before death, the existence of coagula in the veins, or of certain morbid states of the liver, in which, without the slightest pain, or appearance of jaundice, that viscus diminishes in size, and its capillary system is reduced to such a state of atrophy, as with dif-ficulty to allow a passage to the blood which arrives by the vena portæ ? and yet this state of the liver, so difficult, not to say impossible, to be detected during life, is one of the most fre-quent causes of ascites.

The exhalation of fat may, like that of serum,

increase, under certain circumstances, to such a degree as to constitute a disease. This excessive secretion of fat may be either general or local ; in the latter case it forms tumours of various sizes constituting that affection generally known by the name of *lipoma*. The texture of these tumours is composed of fat of greater or less density ; in their interior are found numerous septa on which blood-vessels ramify, and which are only the parietes of the adipose cells increased in size and thickness.

Fatty tumours are most commonly formed in the subcutaneous and intermuscular cellular tissue ; they are sometimes found in considerable numbers under the skin. I had once an opportunity (the only one, I believe, on record,) of observing a fatty tumour in the submucous cellular tissue of the small intestine, near the duodenum : it raised the mucous membrane on its surface, and, both in its form and structure, was perfectly similar to those which are found under the skin.

We are altogether ignorant of the cause which thus produces, in a determinate point of the body, an excessive exhalation of adipose matter ; the only phenomenon which we can appreciate is an extraordinary increase of secretion, unaccompanied by any other morbid process. In some cases, however, the formation of

these tumours has been known to follow local irritation. For instance, in the *Mémoires de Chirurgie de Genève*, there is a remarkable case recorded of an individual in whom a blow received on the upper and inner part of the thigh was followed by the development of a tumour in the same spot, which, on examination, was found to consist of adipose matter, and was in every respect a common lipoma. Here again, we have an illustration of the principle which I have so long, and so often, insisted on ; namely, that irritation may be the exciting cause of every species of alteration both of nutrition and secretion ; but that, of itself, it is incapable of producing any one of them.*

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* Nothing is more common ·than to observe in the animal œconomy dissimilar effects produced by one and the same cause. For instance, how endless is the variety of symptoms presented by individuals who have received syphilitic infection from the same source. Again, how different are the general symptoms in persons who have contracted measles or small-pox from the same contagion. The following fact, related by Johnson (Influence of Tropical Climates on European Constitutions,) is particularly interesting. 28 soldiers were employed at work in the neighbourhood of an extensive marsh in America ; every one of the party fell sick, but not all of the same complaint. 3 died of cholera, 5 of dysentery, 4 of adynamic fever accompanied with yellow colour of the skin, and all the others were seized with intermittent fevers of a malignant character. Here then is a remarkable instance of different forms of disease resulting from the application of the same miasmata.

ARTICLE II.

Hypercrinia, with Discharge of the Fluid.

MANY diseases were classed by the nosologists of the last century under the generic appellation of *fluxes*, which were chiefly characterized by an external discharge of fluid. If, however, we suppose that every modification of secretion is necessarily connected with some alteration of the solid which secretes it, it follows, that the modification of secretion is only a symptom, and that the disease should be named, not after it, but after the lesion of the solid which causes it. Accordingly, such has been the system adopted in the greater number of cases. We now no longer maintain the old doctrine, that in all cases of increased discharge from the mucous membranes, these membranes only serve as a sort of filter through which certain deleterious humours are separated from the blood; neither do we believe that those diarrhœas which terminate certain chronic diseases, depend on a species of liquefaction of the nutritive substance, the constant expulsion of which produces marasmus. These doctrines are no longer received, because the existence of such a liquefaction is proved by no fact whatever, and because

we have learned from morbid anatomy, that the fluxes of mucous membranes are in general merely the effect of some local morbid action, to which these membranes are so particularly liable. It may, however, be fairly questioned, whether the adoption of these views resolves all difficulties, and whether by the total rejection of the class of fluxes, we have not neglected and overlooked several facts of importance. May not the flux constitute, in some cases, so predominant a symptom, that, of itself, and independently of the cause from which it proceeds, it is capable of producing the most serious consequences ? And, what is still more important to determine, is it not against this symptom that our treatment should principally be directed ? Does it not often happen, that the part from which the discharge proceeds, on dissection, exhibits no morbid alteration, or at least so slight a deviation from its healthy appearance, as by no means to correspond with the severity of the symptoms ? And, lastly, are there not several diseases in which the cause of the flux must be sought, not in the texture of the solid from which the discharge proceeds, but in some of the other solids ? Let us take the skin, for example, and in what other class than that of fluxes, shall we place those profuse sweats which exist during the course of various acute and chronic

diseases, and sometimes constitute so predomi-
nant a part of the affection, that an epidemic
disease has thence received its name (*la suette*,
morbus sudatorius.) I readily admit, that in
this case there exists at the same time some
lesion of one or more of the internal organs;
but it is also indisputable, that the profuse cuta-
neous exhalation does not depend exclusively on
these organic lesions, and that the only appreci-
able morbid phenomenon which the skin itself
presents, is an increased activity in its natural
function of perspiration. By what other name
than that of flux, can we designate those local
perspirations which are so abundant in the ax-
illæ, or at the soles of the feet, of some indivi-
duals; or those profuse general sweats, which
fatigue and exhaust certain persons whose health
is in other respects not affected? We frequently
observe such perspirations in convalescents;
they disappear as the strength is re-established,
and are often successfully treated by tonics and
astringents, applied directly to the cutaneous
surface, or administered internally. How else,
than as a species of flux, are we to consider
those cold sweats which sometimes cover the
bodies of the dying? a phenomenon which, not-
withstanding the frequency of its occurrence, has
never yet been satisfactorily accounted for. Nei-
ther can we better explain why acute rheuma-

tism of the joints is of all inflammatory affections
that in which perspirations are the most fre-
quent, and the most copious; or why, in persons
with pulmonary tubercles in a state of suppura-
tion, profuse sweats are such a constant symp-
tom, whilst, in those labouring under chronic
gastritis, there is in general such a remarkable
aridity of the skin. May we suppose, that, in the
phthisical patients, the cutaneous transpiration
serves as a substitute for the pulmonary transpira-
tion which is suspended? The cause of these
differences is of little importance for our subject;
the fact of their existence is sufficient to show
that, in a nosological arrangement, many cases
of perspiration deserve to be classed and de-
scribed by themselves, and that the only class
they can with propriety be arranged under is
that of *fluxes.*

Several diseases of mucous membranes in
like manner present as their principal, or even
as their only symptom, an abundant discharge
of fluid, which may be either blood, serum, or
mucus.

The bloody fluxes of the mucous membranes
must not be confounded with the inflammatory
affections of these membranes : an epistaxis is
not a coryza. It is true, that in both cases
there almost always exists in common the phe-
nomenon of sanguineous congestion, but then
there are other circumstances to be taken into

account. 1. In the hæmorrhage, the conditions of the hyperæmia are such, that the blood, instead of accumulating in the vessels of the mucous tissue, escapes from them as fast as it arrives; but how the vessels are in such cases modified, in order to allow the escape of the blood which traverses them, is a mystery which we are totally unable to divine. 2. The hyperæmia is not in this, as in inflammatory affections, necessarily of a sthenic or active character; it may also be either passive, or produced by a mechanical obstacle to the venous circulation; as I have already exemplified when treating of the different species of hyperæmia. 3. The existence of vascular congestion is not essential to the production of every species of hæmorrhage; it is sufficient that the qualities of the blood should be so modified, that its molecules lose their natural form of cohesion; in which case the blood escapes from its vessels with the greatest facility, and hæmorrhages occur simultaneously in different parts of the body, totally unconnected with the presence of any irritative or inflammatory action. We have examples of such hæmorrhages in scurvy, in typhoid diseases, and in all those diseases where, from our knowledge of the exciting causes, or the inspection of the blood, we have sufficient evidence of the quality and properties of that fluid having been altered.

To this species of hæmorrhage should, I con-
ceive, be referred a case of hæmaturia, which
I had an opportunity of observing in an old
woman labouring under a cancerous affection
of the stomach. About a fortnight before her
death, numerous purplish spots appeared on
the skin, and during the same time a quantity
of blood was passed each day with the urine.
Red spots likewise appeared on the conjunctiva
of both eyes, one of which presented exactly
the appearance of chemosis. On examining
the body, a number of ecchymosed spots, simi-
lar to those on the skin, were found in the cel-
lular tissue subjacent to the pleura and perito-
neum; on the internal surface of the cavities of
the heart; and in different portions of the ali-
mentary canal. The urinary passages contained
a bloody fluid, and, on pressure, a similar fluid
was made to exude from the mamillæ of the tu-
bular substance of the kidneys. Neither in the
heart, nor in any of the large vessels, could we
discover any thing except a violet coloured
fluid, without the slightest appearance of coa-
gulation. A case precisely similar has been
lately reported by M. Stoltz, in the *Archives de
Medicine*, vol. xv. In this case also, there was
an appearance of chemosis produced by the
same cause. The individual was a woman,

who at the time was pregnant; and what renders the circumstance peculiarly interesting is, that ecchymoses similar to those in the mother were likewise found in the lungs, pericardium, heart, and vessels of the fœtus.

The following fact has been related by Doctor Schreyer (*Bulletin des Sciences Medicales,* April 1828). Of a family consisting of five children, the eldest died of hæmorrhage from having accidentally bitten his tongue; the second and fourth are robust healthy children; but the third and fifth have a remarkable disposition to hæmorrhage : they are all five of the male sex.

The third, whose age is five years, and the fifth, fifteen months, both present, at variable intervals, on their legs and thighs, a number of blue spots which swell to the size of a pigeons egg, and then assume a yellowish green shade : they do not bleed, unless when opened artificially, but then the hæmorrhage continues until the patient falls into a swoon, and his body becomes pale as death. The blood which flows is at first red, but subsequently resembles water in which raw meat had been steeped, and at this period of the hæmorrhage the blue colour of the spots disappears. The further progress of the bleeding is arrested by the pressure of the

fingers on the orifice, which the parents state it is generally necessary to continue for the space of twenty-four hours. The orifice is never closed by a well formed coagulum. The children recover slowly, but then continue to all appearance healthy until the next renewal of the hæmorrhage. The eldest once had an attack of hæmorrhage from a carious tooth, by which he was excessively reduced: the youngest has not this disposition to so great a degree as his brother. Neither the father nor mother, nor their parents, have ever had any similar attack.

The perspiratory fluid which is constantly exhaled in the form of vapour, on the surface of mucous membranes, as it is on every other surface, whether serous, cellular, vascular, or cutaneous, is sometimes exhaled in much larger quantities than usual ; instead of vapour, it then assumes the fluid form, and in this way the mucous membrane *sweats* precisely like the skin. This exhalation or flux may be very considerable without being accompanied by any remarkable organic disease of the membrane. The enormous quantity of fluid which in this way escapes in a very short time from the system, may produce a series of morbid phenomena, analogous to those produced by other great evacuations ; of which the following are the principal. 1. The

blood becomes remarkable for its deep black colour, and for the predominance of its fibrinous part; both of which alterations result from the fact of the serous exhalation having deprived the blood of its albuminous portion. 2. The activity of the other secretions is diminished, or altogether suspended. 3. The cutaneous surface becomes suddenly cold, and its usual perspiration ceases. 4. The strength sinks rapidly. 5. Various functional derangements of the nervous system occur, similar to those which so frequently succeed to great losses of blood, and which should not, in all cases, be regarded as proceeding from a real exaltation of the forces of that system.

The production of this serous flux does not appear to be connected with any determinate degree of irritation; in fact, the slightest irritation is just as effectual in producing it, as the most intense. It is sometimes established after the sudden suppression of a profuse sweat; the impression of cold and moisture on the skin of individuals who had been previously exposed to a high temperature, is likewise not unfrequently followed by a copious serous flux from the intestines. Another case in which this flux sometimes occurs, is when a dropsy suddenly disappears, and a fluid similar in appearance to the dropsical effusion flows from the surface of some

mucous membrane. In this way I have seen the sudden absorption of a hydrothorax followed by an abundant serous discharge from the mucous membrane of the air passages ; and an ascites replaced by an intestinal flux, which seemed to consist of a prodigious quantity of watery fluid. In these different cases, I see no reason why we may not suppose that it is the same fluid which, being absorbed from one of the serous cavities, and carried into the torrent of the circulation, is subsequently separated from the mass of the blood on one of the great eliminating surfaces : it is thus that water, injected into the veins of a living animal, escapes by the mucous membrane of the bronchia ; and thus also, we constantly observe various fluids taken up by absorption into the mass of the blood, and separated from it with the urine.

There is a very extensive class of diseases, which the older nosologists designated by the term *catarrhal affections*, and which they carefully distinguished from inflammatory diseases. These affections generally occur in individuals of a soft lymphatic temperament, are most frequent in cold and wet countries, and are especially characterized by an excessive secretion from the different mucous membranes, with or without some febrile excitement attending. Their treatment used to consist in modifying the mu-

cous secretion by the use of aromatics, bitters, purgatives, or cutaneous revulsives; bleeding was seldom had recourse to, and emollient drinks were altogether proscribed. As it is the fashion of the present day to regard all mucous fluxes as simply the results of inflammatory action, they have consequently ceased to be classed and described as distinct from inflammations of the mucous membranes: in this instance again, I cannot help thinking that we have refined too much, and pushed our theories too far. We may surely suppose an accidental increase in the secretion of the mucous follicles, independently of any inflammatory action; just as we constantly see the secretion of urine increased by the agency of different causes, without the existence of nephritis. Is there always stomatitis in those cases in which, under the influence of a moral emotion, the mouth becomes parched, or the tongue suddenly loaded with an unusual quantity of mucus? But even supposing that every mucous flux must necessarily be preceded by irritation, (which yet in many cases is supposed rather than proved) it will be always necessary to admit some peculiarity in the mode of irritation; for, after death its existence is not manifested by any appreciable lesion. For example, I have frequently found on dissection, especially in infants, the mucous membrane of the intestines perfectly

white, and presenting its natural thickness and consistence, in cases both of acute and chronic mucous diarrhœa : neither have I found any more appreciable lesions in the bronchial mucous membranes of individuals affected with chronic pulmonary catarrh. Moreover, it cannot be denied that several of these mucous fluxes are most successfully treated by different substances all more or less stimulant. How many of the intestinal mucous fluxes, for instance, yield to the employment of astringents, or bitter purgatives ; in a word, to substances which appear to act by substituting a new modification of the mucous follicles in the place of the former ? I am acquainted with the case of a female, who was teazed with difficult digestion accompanied with constant copious vomiting of a glairy mucous fluid, and who was cured by the use of rhubarb and chalybeate waters. I may remark, by the way, that it would be a great error to suppose that the fever which accompanies certain acute mucous fluxes, is an infallible proof of their inflammatory nature ; for the simple fact of an organ's being deranged in its nutrition, secretion, or innervation, is sufficient to generate fever, no matter whether that derangement be attended with the augmentation, diminution, or perversion of the vital powers of the organ : the bare circumstance of a part of the living body

being in a state of suffering, whatever the nature
of that suffering be, is sufficient to light up the
various sympathies which constitute *fever*. The
existence of fever does not, therefore, necessarily
imply the idea of stimulus or of excessive action ;
and consequently the object of the practitioner
should not, in every case of fever, be to combat
this stimulus, but in some cases it should be to
relieve a derangement, either circumscribed and
purely local, or affecting generally the blood
itself, or the centres of the nervous system. In
many instances, the true indication of treatment
consists neither in debilitating nor stimulating,
in drawing blood nor administering tonics ; as
is exemplified in certain fevers which resist alike
the use of the lancet, and the administration of
cinchona, but yield to the employment of pur-
gatives.

The secretion of the different glandular or-
gans may, like that of the tegumentary mem-
branes, increase considerably in quantity, with-
out the secreting organ appearing in any degree
altered in its texture. Thus, for instance, I have
frequently found the liver and its appendages
free from any appreciable lesion, in individuals
whose alimentary canal, in some cases sound,
in others diseased, contained an unusual quan-
tity of bile ; or who during life had passed an
enormous quantity of that fluid by stool or by

vomiting. I have had an opportunity of examining the bodies of four persons who died of diabetes: in one only, the kidneys were remarkable for their size, and the congested state of their blood-vessels; in the other three, the kidneys presented no remarkable appearance whatever. In the case of a man too, who for a length of time previous to his death had an incessant ptyalism, for which he could assign no satisfactory cause, the salivary glands presented, on dissection, not the slightest vestige of any morbid appearance; and on the other hand, we do not observe that inflammation of the parotid glands is accompanied by any remarkable increase of the salivary discharge. Is not the flow of tears produced by a moral impression, another example of an action *sui generis,* and independent of any inflammatory action? From these facts, we are, I conceive, warranted in concluding, in the imperfect state of our knowledge respecting what passes in the interior of a gland when its secretion is augmented, that the cause of that augmentation, whatever it be, is at least independent of any other morbid action; and in appropriating the term *flux* to designate such an augmentation.

The facts I have now stated, and the considerations which they have suggested, induce me to admit, under the title *fluxes,* a certain class

of diseases, in which the external discharge of a fluid constitutes the principal phenomenon, that to which all the other symptoms are subservient, and against which the application of remedies should be especially directed. These characters are all applicable to the disease known by the name of *cholera morbus*. The principal feature which characterizes its existence, is an excessive evacuation of bile, mucus, or serum : all the other symptoms depend principally on the extreme abundance of these evacuations, and their suppression is the main object indicated. Hence, opium has been found so successful in the treatment of cholera ; and hence, on the contrary, the practice of blood-letting, when trusted to exclusively, has proved so dangerous, or at least so inefficacious a remedy.

Fluxes may, with respect to their *seat*, be divided into two classes ; those from membranes, and those from the glandular tissues.

With respect to their nature and composition, they may be distinguished into three species. 1. Bloody fluxes. 2. Serous fluxes. A fluid more or less analogous to the serum of the blood forms the principal, if not the only ingredient, in a great proportion of the fluxes from the cutaneous and mucous membranes, and likewise in some of those from parenchymatous organs. For instance, in diabetes insipidus, the

urine is almost wholly composed of a serous fluid. 3. Lastly, we must admit a third species of flux, produced by an excessive secretion of the different fluids furnished by the secretory organs, properly so called; such as mucous, salivary, bilious, and urinary fluxes, &c.

Fluxes, wherever they are seated, or of whatever materials they are composed, may be either acute or chronic; active or passive; continued or intermittent; sporadic or epidemic, or even endemic. The existence of all these varieties has been already sufficiently established by the facts adduced in the preceding part of this article.

The organ from whence the flux proceeds, may present any of the following appearances. 1. The same condition and appearances which, to the eye of every anatomist, constitute its natural state. 2. A remarkable colouring of its tissue. 3. A sanguineous congestion, either active, passive, or mechanical, unaccompanied with any other alteration. 4. Different alterations of texture. In general, however, the apparent slightness of the morbid alteration of the part, forms a striking contrast with the violence of the symptoms.

Besides the alterations in the organ from which the flux proceeds, we frequently find it resulting from other causes, which I shall now enumerate. 1. A state of irritation in the mem-

branes on which the secreting organ pours its se-
cretion. 2. Some modification of the nervous
influence : thus, there is not a secretion which
may not be suddenly increased by a strong
mental emotion. 3. The sudden or gradual
suspension of other secretions ; to this source
may perhaps be traced one of the causes of the
endemic cholera morbus of the East Indies.
4. The absorption of a fluid which had accumu-
lated in the areolæ of the cellular tissue, or in
the serous cavities. 5. The elimination from
the system, of various foreign substances which
had been taken up by absorption.

The influence of a flux on the constitution may
be either beneficial or injurious. The injurious
effects may result either from the exhaustion
it produces, or the morbid sympathies it excites.
It may prove beneficial, by carrying off delete-
rious substances which had been introduced
into the blood, or by consisting itself of a dele-
terious matter, or by causing a determination to-
wards the organ from which it proceeds, at-
tended with the cessation of a morbid action
which had been going forward in some other
part.

CHAPTER II.

Modifications in the Situation of the Secretions.

This class of the modifications of secretion, which may be designated by the term *Hetero-crinia*, has hitherto received but little attention from pathologists. The doctrines most gene-rally received in the modern schools naturally prevented their obtaining that share of atten-tion which their importance merited ; and the facts by which their existence was established, were either rejected in toto as irreconcilable with some favourite theory, or else admitted under the condition of being interpreted in its favour, and made to conform with the particu-lar views of the theorist. A more accurate, and what is of still greater importance, a more dis-interested observation, will, no doubt, add con-siderably to the number of those facts which we at present possess ; and those well acquainted with medical literature might find additional in-formation in the writings of our predecessors, many of whose theories were formed in conse-quence of their having observed several facts of this description ; and perhaps in some cases, the cause of the facts being observed might be

traced to their conformity with some favourite theory or preconceived idea of the observer. I do not mean to insinuate that our predecessors were deficient in the art of observing; but, being less precise in their manner of describing facts, and deducing their conclusions, they had fewer chances of discovering the truth; and, when they had found it, but too frequently perverted its import by their vicious methods of observing and reasoning. For this reason it was, that the humoral metastasis, which they admitted, came afterwards to be regarded as a mere chimera, although modern observations have since clearly proved that the doctrine of metastasis is by no means destitute of foundation. Let us then endeavour to ascertain how much of this doctrine is supported by *facts*, and, as indifferent to the theories of the past, as to those of the present day, let us not shrink from the conclusions to which these facts seem legimately to lead.

Several of the products of secretion have been found at a distance from the place in which they are naturally separated from the blood. Sometimes they are found containing all their usual ingredients; in other instances they contain only a certain number of those ingredients.

A fatty substance has sometimes been ob-

served in the blood, presenting the appearance of small oily drops, suspended in the general mass of fluid contained in the blood vessels. A case of this description has been related in the 15th volume of the *Archives Generales de Medicine.*

I do not rank in the list of heterocrinias, either accumulations, or discharges of serous fluid ; because, wherever they occur, the serum is in fact only increased in quantity ; instead of existing in the form of vapour, it assumes, in consequence of its increased quantity, the fluid form ; but this alteration is widely different from the definition we have given of heterocrinia.

Certain secretions of fat may, however, be considered as belonging to the class of heterocrinias. I have, for instance, on two occasions found in the submucous cellular tissue of the intestines, small fatty tumours perfectly analogous in their form, external appearance, and composition, as well as in the cellular envelope by which they were surrounded, to the fatty tumours which are often formed under the skin. I need scarcely remark, that, in the natural state, fat is never found in the dense compact cellular tissue which lines the mucous membranes.

I am not aware of any instance of mucus being found any where, except on the free surface of the mucous membranes.

Some cases have been recorded, in which one of the constituents of milk, caseum, was discovered in parts where it is not usually contained. M. Cabal ascertained the existence of a substance possessing all the properties of caseum in the urine of a widow who had never had children. It is also stated in the *Bulletin des Sciences Medicales* for the year 1826, that a substance perfectly analogous to caseum was found in the peritoneum of a woman who died of inflammation of that membrane.

M. Hervez de Chegoin has lately communicated to the Academy of Medicine a case in which caseum is likewise stated to have been detected in the urine. A woman, on the fourth day after her delivery of a dead child, was seized with a miliary eruption ; the breasts were not at all swollen, and presented no symptom of any secretion of milk : she died on the tenth day. The urine was analyzed by M. Petroz, principal chemist and apothecary to the hospital of *La Charité*, and by him was pronounced to contain caseum.

It appears that, in these cases, there was no milk secreted in the breasts ; and consequently we cannot suppose that the caseum was formed in the mammary glands, and thence removed by absorption to other parts of the system. A more important point, however, to determine, is

whether the caseum of the milk is perfectly identical with the morbid matter found in the urine and elsewhere, to which the same name has been applied. This identity is extremely difficult to establish, inasmuch as, according to Orfila, in the present state of the science, we possess no means of distinguishing caseum from several other organic principles. I must not omit to mention, that, in a course of lectures delivered this year (1828) at the *College de France*, by a highly talented and experienced chemist, M. Dumas, it was announced, that a substance in every respect similar to caseum formed one of the ingredients in the composition of pus; so that this principle can no longer be considered as exclusively the product of the mammary secretion.

It is exceedingly common to find a yellow colouring matter exactly similar to that of bile, mixed with the fluids, or combined with the different solids. It is this that characterizes jaundice. This peculiar colour generally co-exists with some disease of the liver or its appendages; in some cases, however, neither the symptoms which occur during life, nor the appearances found on dissection, afford any proof of such disease having existed.

Another principle, named cholesterine, which is generally considered as belonging more especially to the bile, has been found in various parts

both of the solids and fluids. Not only does it enter into the composition of certain biliary calculi, but it has likewise been detected in the brain of man and several animals; in a diseased lung—Gmelin ; in a liver which contained an abscess—*idem ;* in a human tongue injected and preserved—Wœhler ; in the fluid of a hydrocele ; and in some of those tumours which are called *scirrhous.* (It has likewise been discovered in musk, and in certain species of mushrooms.) Hence it would appear, that cholesterine is one of the most generally diffused principles in the human œconomy, and that almost every tissue is capable of forming it, or of separating it from the blood.

The ancients made frequent allusions to the possibility of urine being secreted in other ways than by the kidneys ; indeed there is scarcely a part of the body in which they do not state their having found collections of that fluid. The observations they have transmitted to us on this subject, do not, however, possess that character of precision, which would guarantee their accuracy, or render them available to the interests of science. In the present state of our knowledge, the following propositions embrace all that we can affirm on the subject.

1. Several of the immediate principles of the urine, generally considered as belonging to

it exclusively, may be found in other parts of the body besides the urinary apparatus.

2. These principles have been found out of the urinary passages, both in cases where the renal secretion had been for a longer or shorter period suspended, and where the secretion of urine went on as usual.

3. Uric acid has been detected by M. Vauquelin in the sweat of individuals whose kidneys were diseased.* Several chemists have likewise discovered this acid in the tophaceous concretions which are found situated in and about the joints of gouty persons.

4. Urea also has been detected out of the urine.

5. A fluid has been seen passing off by different outlets, which, in its physical properties, bore an exact resemblance to urine, and which, on being analyzed, was found to contain one or more of the immediate principles of that fluid. The following fact, related by Doctor Arnold,† appears to me particularly interesting, and, in the present state of the science, highly important.

Maria Burton, aged twenty-seven, of a strong constitution, enjoyed uniform good health until

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* *Clinique Chirurgicale de M. Pelletan*, tom. ii. p. 369.
† The New-England Journal of Medicine and Surgery. Boston, 1825.

the month of June 1820, at which period she
was seized with hæmoptysis, and suppression of
the catamenia. Under the use of copious vene-
sections and emetics, she was relieved from the
hæmoptysis, but had no return of the menstrual
discharge. For two years after this period it
was necessary to introduce the catheter once
every twenty-four hours, in order to draw off the
small quantity of urine which was secreted into
the bladder. Whenever the introduction of the
instrument was neglected, a fluid apparently
urinous was seen to exude in considerable quan-
tities through the integuments of the lumbar
region.

In September 1822, the introduction of the
catheter was omitted for seventy-two hours,
during which period a new phenomenon was
presented. A fluid in every respect resembling
urine issued from the right ear, at first in single
drops, and afterwards in larger quantities. This
discharge continued in variable quantities, and
at irregular intervals, every day for a consider-
able length of time: the average quantity dis-
charged during the twenty-four hours might be
estimated at about eight ounces. The discharge
was always preceded by a very distressing sen-
sation in the eye and ear of that side, which
generally continued until the discharge was
fully established; and if at any time the eva-

cuation from the ear was less abundant than
ordinary, or did not recur at the usual period,
the patient was seized with general anxiety, ex-
cruciating headach, and delirium. Sometimes
the delirium was not preceded by headach;
and on other occasions the suppression of the
discharge was succeeded by violent tetanic
spasms, after which she gradually swooned away,
and fell into a state of perfect insensibility,
which was occasionally interrupted by starts,
deep-drawn sighs, convulsive laughter, and teta-
nic immobility of the lower jaw. This state of in-
sensibility, accompanied with an almost perfect
cessation of arterial pulsation, and extreme
lentor of the respiratory movements, continued
on one occasion for twenty-four hours. The
right ear gradually became insensible to the
impression of sounds, and the sight of the right
eye was likewise lost. These different symptoms
continued during the latter part of the year
1822, and for the two succeeding years, 23 and
24; during which time the discharge took place
successively from the right ear, then from the
left, and afterwards from the left eye, in which
it produced a violent inflammation. On the
10th of March 1823, the patient began to vomit
a fluid perfectly similar to urine. On the 21st
of April, the right breast became swollen, hard,
and painful; shortly after which, a few drops of

fluid were observed to issue from the nipples. At the end of twenty-four hours these phenomena disappeared, and, in a week after, they returned : on their second appearance, the fluid which issued from the nipple presented the same colour as urine, and on analysis was found to contain urea. This discharge continued until the ensuing autumn ; occasionally, however, it changed to the left breast. On the 20th of November, the fluid assumed a whitish colour, and presented the same appearance as milk largely diluted with water. This new secretion continued until the 12th of December, on which day the fluid reassumed its former colour.

On the 10th of May, the umbilical and hypogastric regions became tense and painful ; and soon after, a fluid similar to that which had previously made its escape by so many different outlets, was observed trickling down from the umbilicus. This discharge continued for some time, and increased gradually in quantity. Lastly, on the 30th of July 1823, another discharge of the same nature as the preceding was established from the nose, and continued for several months, flowing occasionally in such considerable quantities as to constitute a copious flux.

All the fluids which issued from the several outlets just enumerated were analyzed and found to contain urea ; in addition to which they also

contained the following substances. 1. Some alkaline sulphates; as was ascertained by testing with muriate of barytes and acetic acid. 2. Some muriates; which were detected by the nitrates of silver and of mercury. 3. Some phosphates; which were recognized by employing potash, ammonia, and lime. The urea was procured by evaporating the fluid, dissolving the residuum in alcohol, and again evaporating the solution.

During the whole of this period, a small quantity of urine was constantly discharged by the bladder; and at different times the urinous fluid which issued from the other outlets was replaced by pure blood. The quantity of the irregular discharges was uniformly diminished by frequently introducing the catheter, and drawing off the urine as fast as it accumulated; but the discharges never ceased altogether. The quantity of urine furnished by these supplementary secretions was sometimes so considerable, that some imposition might have been suspected, if the precaution of standing constantly by the patient's bed side had not been taken.

All the violent nervous symptoms above described continued to increase in violence for six months, and then began to abate. At present (Autumn 1824) when the urinous fluids

flow copiously, the patient finds herself in a very tolerable state of health, and is able to get up and walk about. The discharges still continue from the right ear, the right breast, and from the umbilicus; but are neither so frequent nor so abundant as formerly. A considerable quantity of urine is every day voided by the bladder. It is now several months since any discharges have taken place by the stomach, nose, or eyes. The patient who forms the subject of this extraordinary case, was attended by Drs. Arnold, Fisher, Mitchell, and Hosack, of New York.

The general conclusions which the facts just recorded naturally suggest, are, that the blood contains, in variable proportions, the elements of all the secretions; that, in general, these elements are separated from the blood only in certain organs, the peculiar structure of which favours that separation; and that after their separation they are so united and combined in their respective organs as to form the different secretions; thus, bile is formed in the liver, urine in the kidneys, &c. But, under certain circumstances, those elements which are contained in the blood may be separated from it by other outlets than those through which they naturally pass; in such cases, however, they pass off from the blood single and uncom-

bined, so that it is not the secretions as they exist in the natural state which are found in other parts than in their respective secreting apparatus, but merely some of the elements of these secretions. Thus, for example, it is not the bile in its natural condition, which, in cases of jaundice, imparts the peculiar colour to the different solids, or enters into combination with the various fluids; but chiefly one of its elements, namely, the colouring matter: neither is it milk in its natural state, but simply caseum, which has been found elsewhere than in the mammary gland or its ducts, and which M. Dumas affirms he has constantly observed in pus. Thus, in like manner, it is uric acid, not urine, which is found in the articulations of persons affected with gout; and, in the case recorded by Doctor Arnold, urea, without uric acid, formed the basis of the fluid resembling urine which passed off by the ears and other extraordinary outlets.

Three hypotheses may be admitted in explanation of these unusual secretions. 1. We may suppose that there exists in the blood an exuberant formation of some of the ordinary elements of the secretions, and that, in order to relieve the blood from their presence, it is necessary that some supplementary outlets should be established. 2. We may suppose that these

elements are combined in the organ destined by nature to separate them from the blood, and are subsequently absorbed and taken into the circulating fluid, from which they are afterwards eliminated in some way or other, just like a foreign substance injected into a vein, or like pus absorbed from a purulent collection. 3. Lastly, we may suppose, that the natural secreting organ is in such a state, that its functions can no longer be performed; in consequence of which, the materials which it should separate from the blood being deprived of their natural outlet, have a tendency to pass off by other ways, but not in a state of combination, or at least never so perfectly combined as when separated by their natural secreting organ.

It is likewise by an aberration in the situation of the secretion, that those singular cases can be explained, in which cysts containing hair and teeth have been found in different parts of the body. These productions cannot be considered as the fragments of a fœtus, inasmuch as they have been found in men, and in other parts of the body besides the abdomen.

CHAPTER III.

Modifications in the Quality of the Secretions.

WE have laid it down at the commencement of this volume as an established fact, that, wherever a particle of living matter exists, a secretion of some kind is constantly carried on. Another fact equally well established, is, that wherever this secretion takes place, it is liable to have its qualities considerably modified; so that in place of the fluid which should constitute its natural product, another substance may be found, differing from it in a greater or less degree. This morbid production may occupy the place either of the peculiar fluids which are furnished by their respective secreting apparatus, or, of the perspiratory fluid which is formed in every part of the living body. Thus the bile, mucus, saliva, urine, &c., occasionally present, in their sensible qualities, numerous and important modifications, which are, in some cases, connected with certain alterations in the circulation or nutrition of the secreting organ, and in other instances are altogether dependant on some modifications of the blood itself, or of the nervous influence. I shall not at present enter into the consideration of the different altera-

tions of these secretions, because their history
cannot with propriety be separated from that of
the organs by which they are secreted; which,
according to the plan of this work, is reserved
for the second volume. For the present, there-
fore, I shall confine my observations to those
morbid productions which are formed in the place
of the perspiratory fluid. I must, however,
premise, that it is not always easy to determine,
whether the morbid production which we find
in an organ is the result of an alteration of se-
cretion of this perspiratory fluid, or of an altera-
tion of the nutrition of the part. Indeed, these
two species of alteration are frequently com-
bined; for instance, in scirrhus of the stomach,
there is an evident thickening of the submucous
cellular tissue accompanied with hypertrophy of
the muscular tunic, and at the same time it is
evident that a new substance is deposited be-
tween the molecules of these tissues, and that
this substance occupies the place of the natural
perspiratory fluid.

Since the perspiratory fluid exists in every
part of the body, so likewise the morbid secre-
tion which usurps its place may exist in every
part. The same force which every where pro-
duces a perspiratory fluid analogous to itself,
independently of any peculiar arrangement of
matter, or organization, may likewise produce
in every part of the system a morbid matter

equally analogous to itself ; thus it is, that tu-
bercle appears indifferently in parts the most dis-
tant, and most differently organized. This mor-
bid production, which presents such an infinite
variety of appearances, may be either solid, or
fluid, or may alternately assume those different
forms. When once separated from the blood,
it has a constant tendency to increase in volume ;
which is in some instances effected by the sim-
ple deposition of new particles, constituting
growth by juxtaposition, and in others, by a
spontaneous internal development, similar to
that which in the impregnated germ gradually
transforms a drop of fluid into an animated
being ; constituting growth by intus-susception.
The morbid productions whose growth is ac-
complished in this manner, may be considered
as endowed with a certain plastic force, by virtue
of which they represent, in the several stages of
their formation, the development of the embryo,
or of the different beings of the animal series,
and, like them, constantly continue to rise in
the scale of life and organization.

Whether these morbid productions remain
stationary, or continue to increase either by
juxtaposition, or intus-susception, they are liable
to undergo various alterations in their appear-
ance, texture, and physical properties, the cause
of which may reside either within themselves,
or in the surrounding parts. If they do not

present any trace of organization, or betray any symptom of vitality, it is evident, that the changes which they undergo cannot result from any action of their own, but must necessarily depend on some modification of the living parts in which the morbid production is developed. For example, if, after having been soft, this production becomes subsequently hard, the change is accomplished by the absorption of some of its constituent parts by the surrounding tissues. If, on the contrary, after having been hard, it becomes soft, the change will in general be found to depend on the irritation caused by its presence in the living tissues, which leads them to secrete a new matter, pus, that constantly tends to separate the particles of the morbid production, for the purpose of thus accomplishing the law by virtue of which every foreign body lodged in any part of the living system should be eliminated from it. (See, farther on, the article on *tubercles*.) If, however, the morbid production presents any traces of organization or vitality, the cause of its subsequent alterations must be sought for both within itself, and also, as in the preceding case, in the tissues by which it is surrounded. Such a production, like every other being endowed with life, has an independent nutrition and secretion of its own : hence arise two series of phenomena ; one of which constitutes its phy-

siological state, *e. g.* the formation of vessels, exhalation of serum, development of different tissues, &c.; and the other, its pathological, *e. g.* various derangements of circulation, nutrition, and secretion, analogous to those occurring in the different beings endowed with life.

The tissues in which these morbid productions are developed, present some one of the following conditions.

1. The natural healthy state. In this case, the tissues may either have retained their healthy condition from the commencement, or, having been engaged to a greater or less extent at the period of the first formation of the morbid product, may have subsequently returned to their physiological condition. But even though the surrounding tissue retains its natural structure and healthy state, it may, notwithstanding, suffer such a degree of compression from the contained morbid production, as to have its appearance considerably altered, and its functions in some degree affected.

2. A state of active hyperæmia. In this case, more or less appearance of vascularity is found in the vicinity of the morbid production ; and, as these productions, when growing by juxtaposition, occasionally surround, and, as it were, imprison some portions of the tissue in which they are developed, it follows that the same appearance of vascularity which is found about

the entire mass, may likewise be discovered in its interior. In cases of this description, the vessels which are seen traversing the morbid mass have erroneously been supposed to belong to the production itself; whereas they in reality appertain to the debris of the tissues which were imprisoned within the accidental production: the truth of this assertion may readily be ascertained by the dissection, or maceration of the part. The hyperæmia may present all those varieties of colour which we have already enumerated when treating of that subject: for instance, we may observe, in the interior of these products of morbid secretion, or in their immediate vicinity, either a red, grey, or a brown tint, or even a more or less deep shade of black: when with this latter colour there likewise exists a certain degree of induration, the disease is said to be complicated with melanosis. The hyperæmia which attends on these productions is not necessarily continued; it may cease at intervals, and return at stated periods. Many of the products of morbid secretion betray no symptom of their existence, unless at those periods when a determination of blood is thus produced in their vicinity. The influence of the morbid growth in producing increased determination of blood, may be compared to the irritation caused by a foreign body; and when once

the hyperæmia is established, it reacts on the cause by which it was produced, and in its turn causes an increased activity in the process of secretion; the product of which is sometimes analogous to the original morbid production, and in other cases presents quite a different aspect, being, for example, either blood or pus.

3. Some modification of the *consistence* of the molecules of the surrounding tissue. From these alterations of the parts adjacent to the morbid production, arise the several degrees of induration and softening which we sometimes observe in its vicinity.

4. Some modification of the *number* of the molecules of the surrounding tissue. Hence arises in some cases a considerable degree of hypertrophy, and in others, such a remarkable degree of atrophy, that the entire substance of the tissue or organ gradually disappears, as the morbid secretion increases in size. It would appear in these cases, that when the force of secretion predominates in the cellulo-vascular structure of the organ, there is at the same time a diminution of that other force by which the particles destined to constitute the proper tissue of the organ are separated from the blood. This state of the affected organ is in some sort analogous to what passes in the system at large, when the entire body becomes emaciated in

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consequence of the extraordinary activity of the secretions. The state of atrophy which thus accompanies the increased activity of a secretion, certainly indicates a modification of the organic actions, but we have no proof whatever that it results from irritation.

5. A secretion of pus. This secretion takes place either around the whole mass of the accidental production, or between its different parts, when they are divided by portions of the tissue of the organ, which remain imprisoned within it. The period of softening of accidental productions appears to me nothing more than the result of a secretion of pus, which takes place in the manner I have already attempted to describe, either around these productions, or in their interior : in the first case, the softening commences at the circumference, and passes to the centre ; in the second, it passes from the centre to the circumference. The molecules of the morbid production are separated, and in a manner diluted by the newly secreted pus, by which means they are more easily removed from the system, like foreign bodies, by outlets accidentally formed for their evacuation. In the place which had been occupied by the morbid secretion, there generally remains a solution of continuity, a sort of ulcer, which in some cases cicatrizes, in others con-

tinues for an indefinite period to secrete either pus, or else a substance more or less similar to that of which the original morbid production was composed. Thus we observe in this group of morbid phenomena, as well as in the several healthy functions, a series of organic actions, constantly succeeding each other in the same determinate order, and with the same ultimate object.

If we endeavour to ascertain the symptoms attendant on the development and progress of these morbid productions, we shall find that in some cases they are developed, and continue their progress, without giving rise to any symptom either local or general, by which their existence could be revealed. In other cases, again, although there is no local disturbance in the part where the morbid secretion is produced, yet a variety of disorders are observed in all the different functions, for which no appreciable or satisfactory reason can be discovered. Sometimes the functions of the nervous system are those most disordered; and the patient feels a general sense of lassitude and uneasiness, which is frequently considered as the result of some nervous affection, or of hypochondriasis, until the local symptoms declare themselves, and remove all doubt as to the source of the disease. Sometimes the general symptoms consist of

slight febrile paroxysms, without any regularity either in their form, or in the periods at which they recur; and, lastly, we now and then observe an alteration in the general function of nutrition, producing a progressive emaciation that sometimes actually amounts to marasmus before the lesion which causes it can be detected. Can there possibly exist a more striking example than this, of the wonderful dependance and mutual connexion which subsists between the different organic actions, by virtue of which the disturbance of any one, sooner or later induces the disturbance of the whole?

The local symptoms which proceed from the development of an accidental production in an organ, consist either in the disturbance of its functions, or in the production of pain. This latter symptom does not constantly attend on any one of these morbid secretions; neither does it afford a character by which any of them may, with any degree of certainty, be recognized; in many cases it is wanting altogether. It is in all cases necessary to distinguish between the symptoms which arise from the morbid secretion itself, and those which proceed from different lesions of the tissue in which the production is developed. For instance, the symptoms local as well as general which accompany the formation of a morbid secretion, when the surrounding

parts retain their healthy structure, are widely different from the symptoms which arise, when those parts are in a state of softening, sanguineous congestion, or purulent secretion.

Many attempts have been made to investigate the causes which influence the formation of these morbid productions ; and, in order to explain their origin, three principal hypotheses have been formed. The partisans of one theory consider them all as the result of atony ; others, again, refer them to an increased degree of vitality, or in other words to a state of stimulus or irritation ; whilst a third party neither admit debility nor irritation as the essential elements of these productions, but attribute their formation simply to a modification, a kind of perversion of the natural actions of nutrition and secretion. The partisans of these three opinions each maintain that their doctrine is founded on the observation of facts, and appeal to experience in its confirmation. Thus, those who look upon such productions as the result of atony or debility, insist particularly on the fact, that they are generally developed in persons of delicate constitutions, whose pale skin, and flaccid muscles, coupled with the circumstance of their blood containing a deficient proportion of fibrine, announce a want of activity in all their vital functions ; they have likewise been forcibly

struck with the fact of some of these accidental productions occurring especially under circumstances which tend to enervate the individuals submitted to their influence, and to impede their perfect development. Thus it has been observed, that at the same time that, under the combined influence of a damp atmosphere, want of insolation, and insufficient or bad diet, the blood circulates in less quantity, or less highly coloured, in the capillary vessels of the cutaneous surface, and that the secretions of mucus and serum acquire an increased degree of activity, at the same period likewise tubercles are formed, and entozoary animals are developed in different parts of the body.

No doubt can be entertained that in all this succession of morbid phenomena, there exists a diminution of the apparent strength of the individual, and a tendency to retrograde towards the organization of the inferior animals ; but in theory it may be objected, that this diminution of the powers of life exists only in certain organs, or in certain functions, and that in those parts where the tubercles or worms are developed, there exists a positive increase of the vital powers, or in other words, a degree of irritation. To this objection it may be replied, that we cannot create these accidental productions artificially, even though we have recourse to every

possible variety and degree of irritation, whilst,
on the contrary, they spring up and multiply with
almost incredible facility, wherever the debilitat-
ing effects of air and diet above alluded to come
to exert their influence on the œconomy.   I
shall not pretend to determine whether the
parts in which the accidental productions are
thus developed, suffer a real diminution of their
vital powers, such as we know from observation
the parts engaged in the process of hæmatosis
undergo ; but it is an indisputable fact, that the
blood which they receive under such circum-
stances is considerably modified in its qualities,
and that in consequence of this modification,
their nutrition and secretion must be also modi-
fied.   Thus far we are supported by facts.   To
maintain that in such cases the organic actions
of nutrition and secretion are perverted, is a
simple proposition stating what we know from
observation to take place ; but to maintain that
these actions are either exalted or diminished, is
a mere assumption.   It is, however, not to be
denied, that the development of a morbid pro-
duction is frequently preceded by the most un-
equivocal symptoms of irritation, or in other
words, of the exaltation of the vital powers
of the parts affected ; but are we to suppose
that this irritation is sufficient of itself to
explain the formation even of the simplest

of these productions ?　In order to establish
such a supposition, it would first of all be neces-
sary to demonstrate, that the formation of every
accidental production corresponds with some
determinate degree in the intensity or in the
duration of the sanguineous congestion by
which the existence of irritation is rendered sen-
sible to us.　Now it is notorious, that it is im-
possible to observe any such mutual correspon-
dence, and that whether the congestion be
intense or feeble, of long or of short duration, it
is followed indifferently by the formation of vari-
ous morbid productions, or else not succeeded
by any one of them.　Hence it is evident, that
though this congestion may be one of the
conditions of the existence of these produc-
tions, it does not necessarily determine their
formation ; and that in no case whatever
can the peculiar nature of these produc-
tions be explained by this congestion alone.
Besides, in a great number of cases, there is
no proof whatever of any such congestion
having ever existed ; and if, in the absence of
any appreciable congestion, it be assumed
that an irritation of secretion or nutrition exists,
though in a latent form, I would ask, is not
such a supposition the most gratuitous of all
hypotheses ?　If it be urged that we are author-

ized by analogy to admit the existence of such an irritation, I would reply, that analogical reasoning is only admissible when supported by a rigorous induction, as for instance, when it is proved that the existence of two facts cannot occur without the existence of a third; in such a case, it is sufficient to perceive the two first, in order to affirm the presence of the other. How should the boasted improvements of modern science have ever been achieved, if from the frequent co-existence of two phenomena, their necessary and indissoluble connexion were inferred? and yet it is on a similar error of reasoning, that the doctrine is founded, which maintains that every morbid production is caused by an increase of vitality, or irritation, although its existence is in many cases disproved, both by theory and observation.

Whatever tends to modify the natural process of interstitial secretion, tends likewise to create an accidental production; it is only in this way that irritation operates as an exciting cause; not because it *increases the activity of the nutrition or secretion*, but because it *deranges* these organic functions. Any other cause which changes the natural mode of the nutrition or secretion of a part, is equally capable of generating these morbid productions. Whether it acts by exciting, or by debilitating, may be, and, no

doubt, often is, an important consideration in determining the proper treatment to pursue, but has no influence whatever on the formation of the accidental product; and if in some cases these productions are formed in parts whose vital powers had previously assumed an unusual degree of activity, they are likewise to be found occurring where the activity of these powers is considerably diminished. Thus, melanosis, which is frequently formed in lungs that have long suffered from chronic irritation, is also found in the healthy lungs of old persons, which, we know from observation, have their anatomical elements reduced to a state of comparative atrophy, and in reality possess a less degree of vitality than the lungs of children or of adults.

There are, in every individual, certain peculiarities of constitution, which lay the foundation of the different temperaments, and which, by imparting a peculiar character to the innervation, hæmatosis, and all the different functions of nutrition and secretion, are the real and essential cause of these morbid productions. These peculiarities may be independent of the primitive organization of the individual, and may have been acquired from the influence of external agents. Thus, for instance, the circumstance of living in a cold damp, atmosphere, from which the sun's rays are excluded, pro-

duces such a modification in the general state of the system, that a disposition to the secretion of tubercles is formed in every organ; thus, likewise, the same atmosphere causes an abundant development of entozoary animals in the alimentary canal and in other parts of the body. A watery and not sufficiently nutritive diet, produces in sheep the worm known by the name of the Fluke (*fasciola hepatica ;*) and in man the use of food containing an excessive proportion of azote, produces a superabundant secretion of uric acid, either in the kidneys, or in parts of the body where it is not usually formed. Independently of the influence of these external agents, there are other causes which reside in the individual himself. Thus, as each period of life produces some new modification in the œconomy, different morbid secretions successively predominate : in childhood, for instance, tubercle is the most frequent of these secretions ; whereas in old age, melanosis is the most common.

The products of morbid secretion are numerous and of great variety; various attempts have accordingly been made to classify and distinguish them by names, but all that has as yet been effected towards the completion of this object, can only be considered as provisional. Thus, it could only have been until some more

accurate knowledge was attained on the subject, that pathologists agreed to distinguish certain morbid productions from each other, by naming them, in some instances, after their form (tubercle,) in others, after their colour (melanosis,) and in others, after the resemblance they were supposed to bear to certain substances, such as glue (colloid matter,) the substance of the brain (encephaloid matter,) &c. It is evident that all these denominations belong to a science as yet in its infancy ; it is, however, necessary for the present to retain them, for if we attempt to substitute others in their stead, we shall experience considerable difficulty in the task, from the paucity of scientific data for the purpose. If, for instance, we endeavour to denominate them according to their chemical characters, we shall soon find how vain is the attempt ; for the most dissimilar of these productions present on analysis identically the same principles, albumen, fibrine, or some other animal substances which do not exactly answer to any of the immediate principles with which we are well acquainted.

Morbid secretions, whatever be their chemical or physical characters, may be divided into two principal classes, according as they do or do not present traces of organization and vitality. I think this division is a useful one to

establish, inasmuch as it fixes our attention on one of the most important phenomena of these productions. The following is the order in which they may be classified and described.

In the first class, may be ranged all the products of morbid secretion in which no trace of organization or of vitality has as yet been discovered.

These productions present every possible variety of consistence ; they may be either solid or fluid, or may even assume both these forms alternately : thus, the morbid product may at the time of its formation be fluid, and subsequently become solid, or may be at first solid, and afterwards fluid. The chemical analysis of these productions shews that they are principally composed of albumen and gelatine ; they likewise contain certain salts. If we proceed to investigate their anatomical structure, we find that they present no trace of fibres, laminæ, areolæ, or canals; in short, that they have none of those appearances which usually characterize organized bodies. The phenomena of vitality are never observed in these substances, but only in the tissues amidst which they are formed, whether those tissues traverse their structure or merely invest their surface. It is in these tissues likewise that we are to look for the cause of those alterations which morbid productions

frequently undergo, as I have already endea-
voured to prove, and as I shall again have occa-
sion to explain when I come to treat of the
softening of tubercles.

The following are the products of morbid
secretion which may be ranged under this first
class :

1. Pus.
2. Tubercle.
3. Colloid matter.
4. Fatty matter.
5. Colouring matter.
6. Saline substances.

These several productions may either exist
singly, or in various states of combination.

The second class of morbid secretions differs
from the preceding in presenting traces of orga-
nization, and exhibiting a certain number of
vital actions. The substances comprized in this
class appear principally composed of fibrine ;
in several cases, however, the precise nature of
the animal matter which forms their principal
ingredient, is far from being well understood.

The most simple of all these productions,
and that which appears to be the original
source whence many others are formed, is a
fragment of pure fibrine, either coagulated in
the blood-vessels, or extravasated into the sur-
rounding tissues. This fibrinous deposit usually

presents the appearance of a whitish or reddish mass, of variable consistence, and endowed with a certain tendency to become organized, though at first it possesses neither organization nor vitality.

This mass of fibrine may, like the impregnated ovum, become the seat of various organic actions, which it reveals to us by the following phenomena. 1. By the constantly increasing tendency it has to assume the form of some one of the simple or compound textures which are found in the animal kingdom. 2. By its performing different secretions. 3. By its exhibiting the same morbid phenomena when irritated, as the natural tissues do under similar circumstances. Hence it appears, that this fibrinous mass, like any other being endowed with life, possess the faculties of absorbing, secreting, and nourishing itself, and is likewise susceptible of disease.

These phenomena, which, wherever they are found, uniformly indicate the existence of vitality, may take place in a morsel of fibrine, without its containing any organ properly so called, or even presenting any distinct or determinate texture. Its vitality in such cases may be compared to the imperfect life of those zoophytes that are composed merely of an amorphous gelatinous mass, and, like the morsel of fibrine,

perform the functions of nutrition, secretion, and absorption, although destitute of the slightest vestige of a circulatory apparatus. We are thus enabled to understand how a serous fluid may be exhaled in the centre of a mass of coagulated fibrine, or be deposited in cells of various dimensions formed for its reception; and how pus, or any other species of morbid secretion may be developed in its interior. I have repeatedly found small collections of pus in the centre of those fibrinous coagula which are formed in the cavities of the heart, even in cases where there was no process of suppuration going forward in any part of the body, and where there consequently could have been no absorption of that fluid. I recollect once finding in one of these coagula, which was remarkable for its firmness, and adhered closely to the parietes of one of the auricles, a whitish substance resembling a mixture of plaster and water, such as is frequently found in the lungs. In the individual in whom this semi-calcareous concretion was found, (which appeared to me to result from a morbid secretion accomplished in the interior of the coagulum) neither the lungs, nor indeed any of the other solids, contained any similar deposit.

Several tumours, the origin of which has hitherto been mistaken, may, I conceive, be fairly traced to the coagulation and solidification

of fibrine in the blood-vessels of the part. The following examples will serve to illustrate my ideas on this subject. On dissecting the body of a middle aged man, I found one of the lungs full of masses of a whitish substance, like those which constitute the so called *cancerous tumours* of that organ. The pulmonary artery had its middle-sized ramifications filled with a substance which in some points was solid, and of a dirty white or reddish colour, and in others was fluid, and in appearance similar to a thick greyish soup.

This substance, when closely examined, appeared to me nothing else than coagulated blood reduced to its fibrinous element, and retaining in some points its colouring matter, with the fibrine here and there in a state of fluidity. On pursuing my dissection, I ascertained the existence of a similar substance in the more minute vessels, as far as I could follow them with the scalpel ; and in this way I fully satisfied myself that the whitish masses with which the lungs were studded, were neither a degeneration of the tissue of that organ, nor an accidental production developed in its substance, but simply an assemblage of minute vessels filled with solid fibrine almost wholly deprived of its colouring matter. Neither was this the only case of the description which I have observed : I recollect

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finding a similar appearance in the liver ; and I am convinced that several of the tumours of that organ usually termed *cancerous*, are in fact composed of solid fibrine accumulated in the minute ramifications of the vena portæ. I have likewise observed the same morbid appearance in the kidney : a fibrinous concretion of a dirty white colour, filled the emulgent vein, and adhered strongly to its parietes ; the coagulum was prolonged into the subdivisions of the vein, and might be traced in its minutest ramifications even into those points where, before the dissection, nothing could be distinguished but masses of a dirty white or pale red colour, which Laennec would have pronounced to be *encephaloid tissue in the state of crudity*. If then this appearance may be produced by coagulated fibrine while contained in its vessels, we may *a fortiori* suppose that the same appearance may be produced by this same fibrine when escaped from its vessels, and collected into masses in the substance of an organ. In this manner, I conceive, are formed several of those morbid productions denominated by Laennec, *encephaloid tumours*.

We have already seen, that certain manifestly vital actions may take place in the fibrinous coagulum, even before it presents any appreciable traces of organization, at least in the sense usually applied to that term. We are

now about to view it presenting other pheno-
mena, which, in their successive development,
bear a striking analogy to the several metamor-
phoses of the embryo, from the first moment of
its impregnation, to the time when it becomes
a perfect animal, capable of enjoying an inde-
pendent existence. The first symptom of an
approach towards organization which we can
detect in the morbid production, is the forma-
tion of red points, such as are observed in the vi-
tellary membrane of the chicken ; from which it
would appear that the chemical elements of this
morbid production have the same tendency as
those of the impregnated ovum, to form such
combinations as shall produce a colouring mat-
ter similar to that of the blood. In some cases,
a few red points like small collections of blood,
scattered on the surface or in the interior of a
whitish mass, constitute the whole appearance
of organization. In others, again, we observe
reddish lines or furrows, of various lengths, and
running in various directions: these rudiments
of vessels are sometimes isolated from each
other, and sometimes anastomose, forming by
their mutual intersections a sort of net-work
with meshes of various sizes. Lastly, in other
instances, we are able to detect the existence of
regular blood vessels, and may even detach
them from the substance of the mass in which

they are formed, which could not be done in the preceding case : they are in general exceedingly delicate. As their development proceeds, some of the branches of this independent circulatory system, which at its commencement was as perfectly unconnected and isolated as that of the membrane of the yolk in the egg, gradually elongate themselves so as to anastamose and communicate with the vessels of the adjacent tissues.

It sometimes happens, that instead of finding in these products of morbid secretion a system of vessels more or less perfectly developed, we can discover no trace of vascularity whatever; but in the centre of the mass a collection of fluid blood is found, just like those collections of pus and serum, which we have already noticed as not unfrequently met with in the centre of fibrinous coagula. Indeed these effusions of blood are by no means uncommon; thus presenting the curious phenomenon of blood without blood vessels. We must carefully distinguish from the above description, those cases in which a real hæmorrhage occurs; that is to say, in which the blood escapes from vessels that are visible on inspection of the part. The extreme delicacy of their parietes of course renders these vessels peculiarly liable to rupture.

When once vessels are formed in a morbid production, or even when currents of blood are established, though no distinct vessels are as yet formed,* the substance which had previously

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* The researches recently made by Dr. Dollinger in Germany, fully confirm the results previously obtained by other anatomists. It appears to me now fully demonstrated, that currents of blood may be established in animal substances when about to undergo the process of organization; even though there exist no distinct tubes or vessels for the passage of the fluid. In several of the inferior animals, the blood or other fluid which serves as a substitute, is not contained in any regular vessels, but traces out a passage for itself through the solids ; and even in the higher order of animals, there exist currents of blood which traverse the substance of the different organs, independently of any apparatus of vessels. It is exceedingly curious to observe, in the intimate structure of the different tissues, globules of blood detaching themselves either from the solid substance of the part, or from other globules in motion, and, after moving about in different directions, losing themselves in other currents with which they come in contact, or else attaching themselves to the solid substance of the tissue ; so that in fact the state of motion or of repose constitutes the only difference that exists between this solid substance and the blood. A tissue is animal matter in the state of repose ; the blood is the same animal matter in a state of motion. As to the force which produces this motion, we in fact know nothing ; for it surely cannot be considered a satisfactory explanation to attribute it to vitality. As well might we say, that the heavenly bodies are endowed with vitality, because they move. If I were to hazard an hypothesis on the subject, I should feel disposed to admit the agency of electricity in producing this passage of animal matter from a state of rest into a state of motion. In fact, in the living body there are several causes constantly operating, which must tend to generate electricity, such as the continual friction which takes place, and the universal presence of heterogeneous substances, &c.

These facts might serve to prove the possibility of currents of blood traversing certain morbid productions, even though their existence was not established by direct observation.

been an amorphous mass, tends to lose its homogeneous nature, and to assume a particular texture. Its anatomical elements arrange themselves either in fibres, laminæ, cells, or networks ; and in this way the morbid secretion may assume the structure and appearance of any of the natural tissues, with the exception of the nervous and the muscular.

The morbid productions capable of becoming organized and of being endowed with vitality, may be formed in every part of the body where there is blood, being nothing but modifications of the fibrinous element of that fluid. They have even been found in the vessels themselves, from the largest to the smallest ; indeed it is in them that we can most accurately trace the several stages of the various transformations the fibrine undergoes, from its simple coagulation, until it arrives at that state in which it generates its own vessels, and produces in its interior various morbid secretions. The blood that escapes from a wounded vessel has frequently been observed coagulating in the surrounding cellular tissue, and there assuming unequivocal appearances of organization : Hunter succeeded in injecting the vessels which were formed in a clot of blood, and the same experiment has since been successfully repeated by Sir Everard Home.

It is not, however, only in those cases where a vessel has suffered a solution of continuity, that the fibrine may thus make its escape into the surrounding cellular tissue, and there be- come organized ; for, it not unfrequently hap- pens, that, under the influence of certain causes more or less appreciable, the fibrine, either alone or accompanied with a variable propor- tion of the colouring matter, abandons the other elements of the blood, and, escaping from the vessels by some morbid process, finds its way into the adjacent tissues. This separation of the fibrine independently of any rupture of the vessels, may be proved to demonstration in the cavities lined with serous membranes ; for we shall presently see that the organizable matter which is exhaled on the free surface of those mem- branes in cases of peritonitis, pleuritis, &c., has been ascertained by chemical analysis to consist exclusively of fibrine. The plastic substance, known by the name of coagulable lymph, which is formed wherever there has been a solution of continuity, is likewise composed of pure fibrine. Arguing then from analogy, I am disposed to think, that this principle likewise constitutes the basis of all those morbid productions that pre- sent traces of organization, whether developed in parenchymatous or in membranous tissues. In the present state of our chemical knowledge,

it is in some cases exceedingly difficult, if not altogether impossible, to distinguish fibrine from albumen; it has even been said that albumen, when solidified, gradually assumes the characters of fibrine; and that the albumen of the chyle approaches nearer the appearance of fibrine, as it is examined nearer to the thoracic duct. Our anatomical knowledge on this subject must, therefore, remain uncertain, as the chemical data on which it is founded are themselves involved in considerable uncertainty.

All the morbid productions we have as yet considered participate in the life of the rest of the body, and adhere to and communicate with it either by vessels, or by some other medium of connexion. But there are other productions that have no connexion whatever with the surrounding tissues. To this class may be referred, in the first place, certain fibrinous concretions, which, though floating loose in the fluid of a serous cavity, present evident marks of incipient organization. Beclard used to exhibit specimens of this description at his lectures, and I have myself seen several instances of it. Instead of these floculent masses, which present traces of organization before assuming any determinate form, we sometimes find transparent cysts, containing in their interior a serous fluid similar to that in which they float. The most

remarkable case of this description I have seen,
was in a monkey, which I examined with
M. Magendie in 1818. On opening the body,
I found one of the pleuræ filled with a large
quantity of serous effusion, in which there
floated nearly 40 spherical bodies, each about
the size of a hazel nut. These little cysts pos-
sessed a considerable degree of elasticity; their
parietes were colourless and transparent, and
were composed of a homogeneous tissue, like
serous tissue, smooth on both surfaces, and
presenting no appearance of granulations.
The fluid which they contained was perfectly
limpid. Cysts of this description are much more
frequently met with in accidental serous cavi-
ties, in which situation they often exist in consi-
derable numbers, and are contained one within
the other. The texture of their parietes does
not always possess the density or firmness of the
natural serous membranes; and in some cases
they seem composed merely of a sort of gela-
tinous substance, which is easily broken down
under the finger like size, or else bears a strik-
ing resemblance to the tissue of the transparent
cornea, when softened by prolonged maceration.
This substance is not always found in the
rounded form of a cyst; it sometimes presents
the appearance of filaments, or of an irregular
web suspended in a serous or other fluid : hence

it appears, that at the first period of its development in the medium in which it is suspended, it possesses no determinate shape ; and that it subsequently assumes the form of a cyst, just in the same manner as the coagulum of fibrine, which is originally an amorphous mass, afterwards becomes vascular and organized. But there is yet another class of these morbid productions, which present a still higher degree of organization : in the place of simple cysts, floating in different fluids, whether natural or accidental, we sometimes find bodies possessing a more complicated structure, which, in addition to a vesicle filled with an aqueous fluid, are furnished with other parts, that from their form and situation give to these vesicular bodies the appearance of animals. Thus, an appendage similar to a head is not unfrequently attached to these vesicles, from which it can be protruded and retracted. This head may be either single or compound ; and occasionally presents several orifices, which seem in some instances to serve as suckers, and in others as organs of progression. The vesicular, next passes gradually into the cylindrical or flattened form, and the characters of animal life become much better marked, by the manifestation of unequivocal movements, and by the appearance of different organs as distinct and as well formed as those of

the vertebrated animals. In this way we pass by regular and almost insensible gradations from the simple clot of fibrine deposited in a serous cavity, to the *strongylus* or the *ascaris lumbricoides;* just as during the formation of the embryo, we observe it gradually advancing from the state in which it exists as a homogeneous mass, devoid of form or texture, until it acquires all the organs of a perfect animal ; and as, in the series of animated nature, we can trace the development and progress of life and organization, from the green matter of vegetables up to man. It appears to me perfectly futile to attempt fixing the point in this series of transformations where what is called animal life commences. If we give the name of animal to the cyst which floats loose in a serous cavity (the acephalocyst of Laennec,) why should we refuse it to the clot of fibrine, which, like the cyst, floats loose in a serous cavity, and is moreover provided with vessels ? and if we consent to admit the animal existence of this clot of fibrine, where are we to stop, or where draw the line of demarcation ? If we admit to the rank of animal every aggregate of matter which, being developed in the interior of a being endowed with life, is capable of supporting itself, and of increasing in size without having any connexion with that being, the

serous cysts already described must then be considered as animals, and accordingly they have been described as such by Laennec. But if we only recognise as animals those bodies which present some trace of sensibility or motility,* these cysts then forfeit all claims to that title. So that, in fact, this much agitated question turns out to be a mere dispute of words, which can never be finally adjusted until the contending parties shall agree in their definition of what it is which essentially constitutes an animal.

I have now enumerated the principal varieties of form, texture, and situation, which organizable morbid productions are capable of assuming. When developed on the free surface of the different membranes, they constitute the *false membranes*, and when formed in the cellular tissue, either where it exists free and uncombined with other tissues, or where it enters

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* Some authors have gone so far as to represent the globules of the blood as so many animalculi, simply because during their circulation they execute some remarkable movements. It yet, however, remains to be proved, that these movements are spontaneous ; and I confess I think it much more probable that they are merely the result of some external force of the nature of electricity. If this force, whatever it be, could be rendered inherent in the globule itself, it would then become an animal ; but so long as its movements are dependant on an external force, it is evident that it can have no claims to that rank ; the power of spontaneous motion, and not any particular form or structure, seeming to be the true requisite for that purpose.

into the structure of the parenchymatous organs, they constitute a class of morbid productions which differ much less from the false membranes in their nature and properties, than in the form they are compelled to assume in consequence of the situation in which they are developed. Like the false membranes, they present considerable varieties of appearance, depending especially on their consistence, colour, and different degrees of vascularity ; to each of which if we attach a particular name, we may multiply *ad infinitum* the number of species and varieties of these productions. But in thus describing each variety of appearance which these bodies are capable of assuming, and erecting each into a distinct species (as Laennec did with that particular variety which he denominated *encephaloid matter*) there is, in my opinion, nothing philosophical, or calculated to advance the interests of science. For, after all, of what consequence are these distinctions? In a practical point of view, all that is really important is to know that, notwithstanding the varieties of appearance which they assume, they are all identically of the same nature ; that they have all a constant tendency to the development of organization ; that, in all of them, the essential phenomena of life, namely, nutrition, secretion, and absorption, may take place ; and finally,

that in such as contain blood, hyperæmias may be formed, and that in those which are capable of secreting, the various morbid secretions, such as pus, tubercle, &c. may be developed.

All the varieties of morbid productions susceptible of life and organization may, I conceive, be reduced to two classes.

The first class comprehends such of these products as participate in a common life with the rest of the body, on which they have the same dependance as the natural organs, and with which they are, like those organs, continuous, having, in short, the same physical relations to it as any individual organ. They may either be deposited on a surface, or else developed in the substance of a tissue or organ.

The second class comprehends all the entozoa, that is to say, the different morbid productions developed in the living body which have an individual existence, like that of an animal. Indeed, most of these productions are as perfect animals as many which have a determinate place assigned them in the zoological scale.

The following classification of the products of morbid secretion, founded on these principles, appears to me the most philosophical, and best adapted to the present state of the science. We must still, however, bear in mind that, like the rest, it is merely provisional.

First Class.

Morbid secretions not capable of becoming organized.

First Genus.

Substances of an albuminous appearance. Pus. Tubercle.

Second Genus.

Substances of a gelatinous appearance. Type: the colloid substance of Laennec.

Third Genus.

Fatty substances.

Fourth Genus.

Saline substances.

Fifth Genus.

Colouring substances.

Second Class.

Morbid secretions capable of becoming organized.

First Genus.

Organizable matter deposited on the surface of organs.

Ascertained chemical element : *fibrine.*

Generic term : *false membranes.*

Second Genus.

Organizable matter deposited in the substance of organs.

Probable chemical element : *fibrine.*

Different appellations by which it has been designated. . . . . .

$\left\{\begin{array}{l}\text{Scirrhus.}\\\text{Simple Sarcoma.}\\\text{Fleshy Sarcoma.}\\\text{Vascular Sarcoma.}\\\text{Medullary Sarcoma.}\\\text{Encephaloid.}\\\text{Fungus Hæmatodes.}\end{array}\right.$

Third Class.

Organized products possessing an independent vitality.

Chemical elements : like those of all animals, *complex.*

Generic term : *entozoa.*

In this order I shall now proceed to describe the different morbid secretions. Some of them, however, I shall notice but slightly, either in consequence of their small importance, or because we as yet know but little about them ; more accurate researches on the subject being still amongst the desiderata in the science.

FIRST CLASS.

MORBID SECRETIONS NOT SUSCEPTIBLE OF ORGANIZATION.

FIRST GENUS.

SUBSTANCES OF AN ALBUMINOUS APPEARANCE.

FIRST SPECIES.

PUS.

THE generic term, pus, has long been applied to a morbid secretion, which occasionally presents considerable varieties in its physical properties. A homogeneous creamy fluid, of a yellow white colour, sweetish taste, and faint smell, constitutes what, by way of preeminence, has been called *laudable pus*. In several instances, however, its appearance varies considerably from this description; as it sometimes resembles a turbid serum or sanies, and sometimes assumes a grumous appearance, or even evinces a disposition to become solid, and to assume the appearance of the accidental production known by the name of *tubercle*. Nay, the pus which is secreted from the *same surface*, may, in a short space of time, so completely alter its physical properties, as to resemble alternately a thick cream, a mixture of curds and whey, and the

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dregs of wine ; its colour too may change alter-
nately from white to yellow, green, or red; and
its smell may be at one time inodorous, and at
another more or less fœtid.

Several varieties of pus have been estab-
lished, founded on these alterations of its physi-
cal properties.   Pearson has enumerated no
fewer than four, to which a fifth has been added
by other authors.

1st. Variety.—Creamy homogeneous pus.

2nd. Variety.—Curdy pus.

3d. Variety.—Serous pus.

4th. Variety.—Glairy muciform pus.

The third of these varieties is likewise known
by the name of *sero-purulent fluid*, and the
fourth, by the term *puriform mucus*.

The fifth variety is distinguished by the
name of concrete or lardaceous pus.

These fluids, though presenting such re-
markable differences in their physical proper-
ties, appear perfectly identical when examined
with a microscope ; as they then all seem com-
posed of globules floating in a fluid, which re-
sembles the serum of the blood in being coagu-
lable by heat and acids, but differs from it in
being likewise coagulable by muriate of ammo-
nia.   The globules of pus have been considered
by many authors as precisely similar to the glo-
bules of the blood, when deprived of their en-

velope of colouring matter. According to M. Gendrin,* these globules only differ from those of the blood in being somewhat larger, and of an opaque yellow colour; and these differences, he conceives, depend on the transformations which the globules of the blood undergo during its conversion into pus. According to this ingenious author, the whole process of the transformation of the one fluid into the other may be observed with a microscope, in that species of pus known by authors under the name of bloody pus. In the first stage of the process, the globules of the blood are seen divesting themselves of their colouring envelope, which appears in striæ in the intervals between them. They are then much paler than natural, of a greyish red colour, and still transparent: they next become opaque, and of a greyish yellow colour; in this state the globules may be considered as *semipurulent*: lastly, these globules become larger than those of the blood or of its coagulable matter, and assume a wrinkled appearance after remaining a few moments on the object glass of the microscope; which marks the completion of their transformation into globules of pus. According to this statement, the only difference between pus and blood would

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* Histoire Anatomique des Inflammations, tom. ii. page 489.

appear to be, that the globules of the latter, during its conversion into the former, undergo certain modifications in their *size and colour*. On the other hand, Doctors Hodgkin and Lyster, who have recently bestowed considerable attention on this subject, are of opinion that the globules of pus have not the slightest resemblance whatever to those of the blood, and are extremely irregular in their form and size. I shall not at present attempt to reconcile these discrepancies of opinion, or to decide which is the most probably correct. I am, however, of opinion, that the different varieties of appearance which pus presents, depend on certain modifications both of the globules, and of the fluid in which they are suspended. These modifications may either affect their quantity or their quality. When the globules exist in great abundance, the pus is thick and opaque; on the contrary, it becomes more and more serous as the proportion of globules diminishes. The grumous concrete state of the pus may either proceed from an alteration in its fluid part, which becomes spontaneously coagulable, or from an excessive proportion of globules. It is evident that, if we suppose these globules to be identical with the globules of the blood, we must admit that beside the modifications which they undergo in their form, size, and colour, they

have likewise lost their faculty of *plasticity* or *organization.*

Pus has repeatedly been submitted to chemical analysis. Schwilgué found it composed of albumen *in a particular state,* extractive matter, fatty matter, soda, muriate of soda, phosphate of lime, and other salts. According to this analysis, the only difference between the serum of the blood and pus consists in the presence in the latter fluid of extractive matter, and in the particular state of the albumen. The nature of the extractive matter has not as yet been satisfactorily determined: by some chemists it has been regarded as a peculiar animal substance, to which nothing analogous can be detected in the healthy state; by others as a combination of albumen and fibrine ; whilst a third set consider it as a peculiar modification of fibrine, rendered incapable of coagulating spontaneously or of being organized. Pearson denominates this matter an animal oxide, and assigns as its physical characters, that it is white, opaque, and sparingly soluble. Lastly, some authors are of opinion that this peculiar substance presents a considerable analogy to the caseum of milk. If this latter opinion should turn out to be correct, it may afford some explanation of the peculiar tendency to suppuration which females manifest after child-

birth. According to M. Gendrin, the pus furnished by scrofulous ulcers contains a larger proportion of soda and muriate of soda; to which cause he attributes its remarkable fluidity. Cruikshank analyzed the fœtid ichorous pus which is discharged from hospital gangrene, and found it composed of precisely the same elements as those already enumerated.

When pus is poured into water, it subsides, and forms a precipitate at the bottom of the vessel; but if the mixture be shaken, the water assumes a uniform white colour. When litmus paper is introduced into pus, it is in some cases turned red, in others restored to blue, and in others its colour is in no ways affected, especially if the pus has been recently taken from an acute phlegmonous abscess in a state of healthy suppuration. The pus which is formed in scrofulous individuals appears to be in general alkaline; and lastly, this fluid becomes acid whenever it has been exposed for any time to the action of the atmosphere. According to some chemists, a solution of caustic potash, poured on pus, does not dissolve it, but converts it into a viscid, ropy, semi-transparent substance, which remains suspended in water without mixing with it. Thompson* has remarked that pus,

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* Traité de l'Inflammation traduit par Bouisseau et Jourdan.

when thus altered by the action of alkalies, presents a striking resemblance to the mucus which is secreted in diseases of the bladder. Other authors, however, amongst whom is M. Gendrin, maintain that pus is dissolved by a solution of caustic potash, and may be precipitated from the solution by the addition of water. These opposite results in all probability proceed from the same kind of fluid not having been employed by the different experimenters. Ammonia, when applied to pus in a concentrated form, converts it into a transparent colourless jelly, possessing a remarkable degree of tenacity. It has been stated, that when pus is treated with sulphuric acid, it forms a reddish solution, from which it may be precipitated by the addition of water. The following are the results of my experiments on this subject. I mixed with the sulphuric acid of commerce, 1. softened tubercular matter ; 2. creamy pus collected from cavities in the lungs of individuals who had died of phthisis ; 3. pus furnished by a pleuritic effusion ; 4. the sputa of persons in the last stage of consumption ; 5. the sputa of patients labouring under chronic pulmonary catarrh ; 6. mucus collected from the pharynx and from the nasal fossæ. All these different fluids were alike dissolved by the acid, which, in every instance, turned at first red, and afterwards black, this

latter change being accompanied with a considerable elevation of temperature. When a small quantity of water was poured into these solutions, they assumed a greyish white colour, and if a little more were added, a grumous, curdy deposit was observed gradually forming in large quantities; and when, after some hours, it had completely subsided, the rest of the fluid became transparent and colourless. I could not, in any of these experiments, verify the remark of Darwin, that pus forms a greyish sediment at the bottom of the vessel, and that mucus, on the contrary, remains suspended in the form of minute flocculi. Darwin also announced, that nitric acid dissolves both pus and mucus; and that if water be added to the solutions, the pus is precipitated, and the fluid in which it had been dissolved remains transparent; whereas the mucus is not precipitated, but the solution becomes turbid and dirty. These observations do not at all coincide with the results obtained in my experiments; for I constantly found, that, on the addition of the nitric acid of commerce to the fluids above enumerated, so far were they from being dissolved, that they invariably acquired a greater degree of consistence, and remained suspended, in the form of yellow grumous masses, without depriving the medium of its transparency. The results obtained by Beau-

mes,* are exactly the same as those I have stated
as observed by myself. I shall not dwell longer
on this subject, for no useful object that I am
aware of has as yet been attained by the attempts
made to ascertain the effects of the various
reagents on pus; neither have chemists been
more successful in the distinctions they endea-
voured to establish between pus and mucus. No
doubt, in certain cases, a well marked difference
must exist between them ; the fluid which is fur-
nished by a healthy mucous membrane is, doubt-
less, widely different, and may be readily distin-
guished by its chemical characters from pus
furnished by an acute phlegmonous abscess :
but is that the case with the mucus secreted by
a diseased membrane, which presents as many
varieties in its composition as there are different
degrees or modes of irritation in the membrane
that furnishes it ? The fact is, that in this case
pus and mucus alternately run into each other,
so that no precise line of demarcation can be
drawn between them. The importance attached
to this distinction must have been much greater
at a period when it was universally believed
that pus could only be formed by a tissue in a
state of ulceration ; for then, to detect the pre-
sence of pus in the sputa, would have been con-

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* *Traité de la Phthisie Pulmonaire,* tom. i.

sidered tantamount to proving the existence of an abscess in the lungs. But what practical advantage can we of the present day expect to derive from the discovery of such means as should enable us to distinguish with certainty between these fluids, when we know that the mucous membrane of the bronchia, in a state of chronic irritation, may furnish all the varieties of secretion which are formed in a pulmonary excavation.

Not only does pus present considerable varieties in its physical and chemical properties, but two portions of this fluid which, in their external appearance, present not the slightest difference, and in their chemical characters are perfectly identical, may nevertheless differ so widely from each other, that one of them, applied to a mucous membrane, or introduced under the epidermis, shall determine only a local irritation of various characters and degrees of intensity, whilst the other shall produce either syphilis or small pox.

It is interesting to observe the different circumstances which contribute to modify the physical properties of pus, and cause it to assume, either temporarily or permanently, one or other of the appearances we have already enumerated. In many cases, for instance, an alteration, so slight as to be scarcely perceptible, in the process of irritation of a suppurating sore, is suffici-

ent to convert its thick white pus into a reddish
sanies, or to re-convert the ichorous discharge
into what is termed laudable pus. In order to
obtain these results, it is in some cases necessary
to diminish the irritation, and in others to in-
crease its activity. We are not, however, to
suppose that the qualities of the purulent secre-
tion are affected by these local conditions only;
they are likewise modified by every alteration,
whether physiological or pathological, which
takes place in any other organ, no matter how
far removed from the seat of suppuration, even
though it has with it no particular connexion
either of function or tissue. Thus, we have all
seen instances of the pus secreted by the surface
of a sore becoming suddenly altered, both in
quantity and quality, under the influence of a
simple moral emotion, of the process of diges-
tion, of the diminution or increase (whether
spontaneous or artificial) of any of the secretions;
or, in short, of any supervening disease. Nay
further, there are certain constitutions, certain
idiosyncrasies, which modify the qualities of pus,
and in which it constantly assumes a peculiar
and determinate character. There are some
persons, for example, whose organs when irri-
tated, never furnish any other secretion than a
thin serous fluid; in others it is always blood
more or less pure which is secreted; whilst, in

a third class of persons, the place of pus is sup-
plied by a grumous fluid presenting the appear-
ance of fragments of cheesy matter floating in
an albuminous fluid. This peculiar modifica-
tion of the purulent secretion is chiefly observed
in scorbutic and scrofulous individuals, in whom
all attempts to modify the qualities of the suppu-
ration by local treatment are utterly ineffectual ;
for it is the system at large, and not merely the
suppurating surface, which is deranged in its
nutrition and secretion. If, then, we wish to
alter the qualities of the pus formed in scro-
fulous or scorbutic persons, we must commence
by endeavouring to modify their whole process
of nutrition, innervation, and hæmatosis.

Various hypotheses have been formed in
order to explain the origin and formation of pus.
It is the more unnecessary to repeat them here,
as this fluid is now almost universally regarded
as the product of a morbid secretion which takes
place in the solids, when irritated in a certain
manner and within certain limits. (I shall pre-
sently discuss the point, whether the formation
of pus is in all cases necessarily preceded by ir-
ritation.) In the valuable work lately published
by Doctor Gendrin, the author endeavours to
prove that pus is nothing more than blood in a
peculiar state of alteration, and that the globules of
the blood escape from the capillaries in the state

of pus, in consequence of some modification they are subjected to, during the stagnation which the blood undergoes in certain degrees of active hyperæmia. The following are the facts which he adduces in support of his opinion.

1. If we examine with a microscope a portion of cellular tissue in which we can perceive with the naked eye a mixture of bloody serum and pus, we observe at the point most remote from that where the pus exists, a transparent fluid destitute of globules; a little nearer the seat of suppuration we begin to observe in the same fluid globules exactly similar to those of the blood; as we approach the suppurating point, the globules change their appearance, they gradually lose this transparence, and in the seat of suppuration become perfectly opaque. In this experiment then, we can trace the first appearance of fibrinous globules in a serous fluid, and their subsequent transformation into purulent globules.

2. If a seton be passed through a portion of artery previously obliterated by coagulated fibrine, the fibrine is thereby thrown into a state of *suppuration ;* it becomes soft, and is *gradually converted into pus.* The same conversion may be observed around grains of lead or mercury which have been introduced into a portion of artery previously emptied of its blood. A coa-

gulable substance ere long obliterates the vessel, and subsequently becomes soft and is converted into pus round the foreign body.

3. If a solution of nitrate of silver, or of caustic potash, be injected into an artery or vein, the circulation having been previously suspended; and if, after the injection, the blood is allowed to flow into the vessel, and there retained by a double ligature, we observe it first coagulating, and then losing its red colour, and passing progressively into pus.

4. If we irritate the foot or mesentery of a frog, and observe with a microscope the modifications which the circulation in these parts undergoes, we perceive the blood, (as has been more fully explained at the commencement of this volume) circulating more quickly in some points; but in others its course becomes progressively slower, and in these parts the eye can follow the various alterations which the globules of the blood undergo during their conversion into pus : they are first seen corrugating themselves, for the purpose of getting rid of their colouring envelope; they then gradually lose their transparency, and arrive at the edge of the solution of continuity, where the irritation is strongest, transformed into purulent globules.

These experiments require to be repeated; for it is possible that their ingenious author may

have been deceived by the resemblance of co-
lour, and may have mistaken for the globules of
pus what in reality were only the globules of
the blood deprived of colour. I do not, however,
by any means wish to reject, without farther
examination, the idea of pus being simply the
fibrine of the blood which has undergone cer-
tain modifications caused by derangements in
the circulation. Such an idea I conceive to be
too important, and fraught with too serious con-
sequences to be hastily rejected; but for the
same reason also I should be slow in adopting
it as an established fact, until its accuracy is
fully demonstrated by additional facts and ex-
periments.

Pus has been found in every tissue in the
body, and even in the blood itself, of which I
have already related some examples. Collec-
tions of pus are particularly frequent in certain
portions of the cellular tissue, especially in the
subcutaneous and intermuscular tissue. They
are seldom met with in the submucous cellular
tissue; I have, however, occasionally found
small abscesses in that portion which lines the
mucous membrane of the alimentary canal, and
in one case I recollect finding an extensive
layer of pus interposed between the mucous
and muscular coats of the stomach, throughout
the whole extent of that viscus. Of all the dif-
ferent portions of the subserous cellular tissue,

that in which pus is most frequently found, is the part which, under the name of pia mater, is in contact with the adherent surface of the arachnoid: sometimes the purulent infiltration of the pia mater is limited to certain points; in other cases it is general, as when it forms a vast envelope round the entire surface of the brain and spinal cord, of which some examples are on record.

In all the other serous membranes, it is much more common to find pus effused into their cavities, than deposited on their external surface. Why is it, that the arachnoid differs from all the other serous membranes in this respect?

It is now generally admitted, that mucous membranes are capable of secreting genuine pus, the mucus which in the natural state lubricates their surface passing into it by insensible degrees.

Pus has repeatedly been found in the vascular system; its presence has been ascertained particularly in the following places:

1. In the veins which returned the blood from parts where there was a collection of that fluid. In several cases of metritis, for example, terminating in suppuration, the uterine, hypogastric and iliac veins, and the inferior vena cava, have been found full of pus.

2. In veins that had been irritated by a puncture or otherwise, independently of the existence of any abscess or collection of pus. In such cases the pus is evidently formed in the interior of the vein.

3. In the coagula of blood which are formed in the heart and large vessels, whether there had existed at the same time a purulent collection in some other part of the body, or an old discharge of pus had ceased a short time previous to death, or even though no trace of suppuration could be detected during life, or after death.

4. In the lymphatic vessels. In some cases these vessels set out from a part in a state of suppuration; but in others there was no pus to be found except in the lymphatic vessel itself. I have sometimes found the lymphatics leading from an intestinal ulcer, laden with pus, either fluid, or in a semi-concreted state, and in this latter form bearing a strong resemblance to the matter of tubercle.

A great deal has been said of the peculiarities of the pus furnished by the osseous tissue. I am inclined to think, however, that in the greater number of cases this pus is not furnished by the bone itself, but by the surrounding soft parts. The peculiar smell and colour, as well as the different physical qualities on

which so much stress has been laid, appear to me to depend principally on the condition of these parts, on the exposure of the purulent collection to the atmosphere, either directly or through the medium of a fistulous passage, and also on the nature of the applications used for dressings, &c.

The pus of the muscular tissue is, in reality, furnished by the cellular tissue interposed between its fibres.

It is a question which yet remains to be decided, whether, when the nervous tissue is in a state of suppuration, the pus is furnished by the nervous tissue itself, or by the cellular tissue which enters into its composition. This much, however, is certain, that in some cases of abscess of the brain, we find in the seat of suppuration nothing else than a congeries of cellular tissue, which in all probability is the only source from whence the pus is derived, inasmuch as the nervous tissue has completely disappeared from the part. Certain white softenings of the brain have been regarded by some authors as the effect of a purulent infiltration of the nervous tissue. This opinion is, in my mind, a mere gratuitous hypothesis; there is no proof whatever of the presence of pus in these cases of softening; all that the most minute examination can detect, is a diminution in the

consistence of the nervous tissue, which in those cases appears to manifest a disposition to return to its original state.

There is not one of the parenchymatous tissues in which pus has not been found; in these, as in all other parts, it is sometimes found in the state of infiltration, and sometimes in the state of abscess. Infiltration is most common in the lungs, and the form of abscess in the liver.

The tissues in which pus is found, whether in the state of infiltration or of abscess, do not present any peculiar lesion which can be regarded as the cause of the purulent secretion. It is now no longer believed that pus can only be formed where there is ulceration. In a great majority of cases, the presence of pus is accompanied with anatomical signs of irritation. Thus we find, in the immediate vicinity of the suppuration, 1. various shades of hyperæmia; 2. different varieties of softening; 3. solutions of continuity, which appear in some cases to have preceded, and in others to have followed the suppuration; 4. the disappearance of the proper tissue of the organ where the pus is collected, and its place occupied by cellular texture, in the areolæ of which the pus is infiltrated. When the suppuration is limited, constituting what in medical language is termed an abscess, the pus

is contained in a cavity, the parietes of which are sometimes formed by the naked tissue of the organ where the abscess is formed, sometimes again they are lined by an inorganic layer apparently composed of the more concrete part of the pus, and, lastly, they are in some cases lined by an organized membranous layer, which in its appearance bears a more or less perfect resemblance to the natural mucous membranes. (See the article on *mucous transformation.*)

There are, however, other cases in which no symptoms announce during life the formation of pus in those parts where it is found after death; and in which anatomy can detect no trace of irritation having existed then, or at any antecedent period, in the seat or neighbourhood of the suppuration. Every thing appears in its natural state; neither the colour, consistence, nor thickness of the part, are in any respect altered; molecules of pus are found lodged between the molecules of the solid, and this constitutes the only morbid alteration that can be appreciated. It frequently happens that this accumulation of pus unaccompanied by any appreciable disease of the surrounding solids, is not confined to a single point, but exists at the same time in different parts of the system; as, for instance, in several parts of the intermuscular cellular tissue, in the liver, spleen,

lungs, and brain. Each of these organs may contain either a single collection of pus, or may be so studded with them, as to render it almost impossible to count them. I have myself on one occasion reckoned more than thirty in one lung. When the vessels are examined in these cases, we sometimes find pus mixed with the blood contained in the heart, arteries and veins; it is likewise sometimes found in the lymphatics; but in other cases not the slightest vestige of pus can be detected in any of these vessels. I may also remark with respect to these cases, that, in some instances, no appearance of suppuration is to be observed except in the vessels, and in the points where these purulent collections exist; but that in other instances, and they are by far the most general, these purulent collections thus disseminated through the system, make their appearance in those cases where some capital operation, such as an amputation, has been performed; especially when the effect of the operation is to remove a part from which a purulent discharge had been kept up for some time previously. Lastly, it is by no means uncommon to meet these numerous depositions of pus in women who, shortly after their confinement, are carried off by inflammation of the uterus and peritoneum. In such cases the pus, instead of forming distinct collections, may infiltrate

the surrounding tissues in such a way, as that no appearance of any fluid can be observed, and that the only perceptible alteration consists in the unusual colour which these tissues present in the infiltrated parts. In this way are formed these grey or yellow masses which are frequently found, after serious operations, for example, in the different parenchymatous organs. At first they are hard, and bear a strong resemblance to portions of lung in a state of grey hepatization, or to that appearance which has been denominated *tubercular infiltration ;* but, after remaining in this situation for a variable time, they gradually become soft and fluid, in consequence of the purulent matter, at first combined molecule to molecule with the organized tissue, subsequently separating and detaching itself, in order to form a distinct collection.

I think no doubt can reasonably be entertained that these purulent depositions are the result of absorption, in those cases, at least, where they are found in persons who had had a suppuration more or less extensive going forward in some part of the system, at a short period before their death : the pus, when taken into the torrent of the circulation, is separated from the circulating fluid on the surface, or in the interior of the different organs ; just as mercury, when injected into a vein, is found to

deposit its globules in different parts of the body, but more especially in the lungs and liver. As to those comparatively rare cases in which similar collections of pus have been observed without any evidence of an antecedent suppuration having existed, (as in the case I have already alluded to, where we found a collection of pus in the centre of a coagulum of blood, without being able to discover a particle of it in any other part of the system,) we cannot, in the present state of the science, form any rational conjecture as to their origin or cause. We must for the present be content to deduce from them the conclusion, that pus may be formed in a solid, or in a solidified fluid, such as coagulated blood, even in those cases where no trace of irritation, of congestion, or of alteration of texture, can be discovered either by the examination of symptoms during life, or of the different organs on dissection. It is certain that there are some individuals in whom pus is much more readily formed than in others ; so that a purulent diathesis may be admitted with as much reason as a tubercular diathesis : in the latter, most pathologists are agreed in renouncing the supposition of an antecedent congestion or irritation being necessary to the development of tubercles, when they are found in almost every part of the

system. Why, then, may not the same be the case with respect to pus?

M. Marechal,* one of the most distinguished pupils of Professor Roux, has recorded, in his *Inaugural Dissertation*, several facts of this description, collected in the surgical wards of La Charite. I have already stated, that it was by no means uncommon to find collections of pus deposited in several of the internal organs, in those cases where amputation of the extremities had been performed : in addition to a numerous list of cases of this description, M. Marechal relates two instances of similar collections having been found after the removal of cancerous breasts. In one of these, besides the collections in the lungs, there were an innumerable quantity of small ones in the substance of the brain. Our author states that he has also frequently found them in the following cases. 1. After operations for the stone, where the operation was followed by suppurative inflammation of the cellular tissue of the pelvis. 2. After extensive urinary abscesses, which had quickly proved fatal. 3. After the tapping of a hydrocele. 4. After the ligature of the femoral artery round

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* *Recherches sur certaines Alterations qui se developpent au sein des principaux Visceres, à la suit des blessures ou des Operations*, par M. Marechal, 4to. 1828.

which an abscess formed, accompanied with extensive phlebitis : in this case, and in the preceding, the collections of pus were exclusively confined to the lungs. 5. After four operations for fistula in ano ; in three of these cases the lungs were the only organ in which pus was found ; in the fourth, it was found also in the liver. M. Hervez de Chegoin* has recorded a remarkable case he saw at *La Charité*, of an individual with an abscess in the pelvis, who died almost suddenly at the very time when he was supposed convalescent. On opening the body, pus was found in the ventricles and in the substance of the brain.

SECOND SPECIES.

TUBERCLE.

THIS term was employed in medical language at a very early period, since it occurs in the works of Galen. For a length of time, it was applied to a variety of morbid alterations possessing no character in common except their form, which, as the etymology of the word indicates (it being a diminutive of *tuber*) was that of a small tumour developed in the interior, or on the sur-

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* A case reported to the *Academie Royale de Medecine (section de medecine)* at the sitting of the 29th January, 1828.

face of an organ. In this acceptation, the name of *tubercle* was given as readily to an enlarged cutaneous follicle, as to that accidental production in the lungs to which it is at present still applied. Its signification, however, became subsequently more restricted; and, instead of being used as a synonyme for *tumour*, the term has for some time been employed exclusively to designate a morbid production distinguishable by certain physical characters; a body, namely, of a yellowish white colour, in form most commonly round, extremely variable in size, at first hard but friable, afterwards softening and becoming transformed into a heterogeneous matter, composed of whitish curdy masses suspended in a sero-purulent fluid. When once the tubercle has undergone this change, it acquires a tendency to quit the situation where it was originally formed, leaving behind it an ulcerous cavity, which sometimes extends more or less rapidly in every direction, sometimes remains stationary for an indefinite period, and, lastly, sometimes becomes cicatrized.

From this description it appears, that tubercle does not present the same uniform appearance in the different stages of its existence; indeed, according to many authors, the transformations it undergoes are still more numerous than those I have just described. Thus, according

to Dr. Baron,* tubercle is at first a transparent vesicle, a hydatid. Professor Dupuy, † of the veterinary college at Alfort, has likewise adopted this opinion. I have endeavoured to ascertain its truth, by examining both the human subject and different animals, particularly the horse ; and the following are the results of my observations. It is quite certain that, in some few cases, small, round, transparent vesicles, filled with a serous fluid, are found along with un- doubtedly genuine tubercles of various sizes. In the lungs of phthisical horses, for instance, I have more than once found cysts of this descrip- tion ; but I have never been able to find them in the human subject, except in one solitary case, in which the lungs contained also nume- rous tubercles, some hard, others soft, and others, again, transformed into irregular cavities. In the horse, I have sometimes seen the fluid con- tained in these vesicles lose its transparency, and become turbid ; and the entire vesicle thus assume the aspect of the opake white tubercles around it. From this, which is all I have been able to observe, I think we may draw the fol- lowing conclusions.

* *Traité des Maladies Tuberculeuses*, by Baron, translated from the English by Madame Boivin, 1 vol. 8vo.

† *Traité de l'Affection tuberculeuse, &c.* by Dupuy, in 8vo. 1817.

1. The transparent vesicles, which, in some rare cases, are found among tubercles, are only accidental productions with which these latter are complicated.

2. They cannot be considered as the origin of the tubercles, or as their primary form; for, in that case, they would be met with much more frequently. It is surely impossible that, where we have constant opportunities of examining pulmonary tubercles in man, in all their shapes and stages, they should have been but once found in that particular one.

3. It may so happen that these vesicles secrete, in place of the serosity which they usually contain, a substance whose physical characters approach more or less to those of tubercle; but is this a sufficient reason for establishing that the formation of the latter is always preceded by the development of a serous sac, to serve as its secreting organ? As well might we assert that a mucous follicle is the constant secreting organ of tubercle, because matter of a tuberculous appearance has been sometimes found in such a follicle; or again, that tubercles are invariably seated in the lymphatics, because a matter more or less analogous to it has been occasionally found in these vessels.

The co-existence of serous cysts and tubercles, which is so exceedingly rare in man, and

very rare even in the horse, becomes much less so in other species. In the hog, for instance, these productions exist almost always together ; and in the disease called *measles*, to which that animal is subject, the cysts are even more numerous than the tubercles. This co-existence has, probably, misled those who viewed such cysts as the first stage of tubercle. We must also be on our guard not to take for a transformation of cyst into tubercle, certain cases in which, as I once saw in a rabbit's liver (*Clinique Medicale*, vol. iii.) tubercular matter is deposited around hydatids, just as a layer of pus is often found about a foreign body.

In my opinion, therefore, the original form of tubercle is not a serous vesicle ; neither is it a greyish, semi-transparent granule, as Laennec maintained. According to his idea, the white opake corpuscle constituting tubercle, is not what is observed in the first instance ; but is preceded by a greyish, semi-transparent granule, in whose centre is subsequently developed a white point, which by degrees extends to its surface, and involves its whole substance ; so that this granule is really the first stage of tubercle. To this opinion may be offered the following objections.

If tubercle commenced necessarily by being a greyish semi-transparent granule, this latter

should have been observed in every part of the system where tubercles have been found. Now, I would ask, have such granules been observed in the lymphatic ganglions, where tubercle can be followed in all the phases of its development? Have they been found in the brain, in the liver, in the spleen, in the submucous, subserous, or intermuscular cellular tissue? M. Chomel has, certainly, related a very singular case of an individual whose brain contained thirty or forty small globular bodies, resembling in size, colour and consistence, the human crystalline lens; similar productions were also found in the lungs, on the surface and in the parenchyma of the liver, spleen, and kidneys, and in the phrenic portion of the peritoneum.* But, to judge from M. Chomel's description, these bodies thus formed simultaneously in almost all the organs, did not at all resemble the granules usually found in the lungs, and regarded by Laennec as the first stage of tubercle. Neither is there the least resemblance between the common pulmonary granules and those small, greyish, irregularly rounded bodies, which are at times found studding the free surface of serous membranes, and which seem to me to be nothing but rudi-

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* *Dictionnaire de Medicine,* by Adelon, Andral, Beclard, &c. art. *Granulation.*

ments of false membrane. As to those greyish granules which are observed sometimes on the surface of mucous membranes, I have never considered them to be any thing but follicles in a state of hypertrophy. Here, then, we have several morbid alterations resembling each other in form, but essentially different both in their origin and nature. In all these bodies, called by the generic name of *granulation*, tuberculous matter may undoubtedly be formed, just as pus may; but I deny that they are invariably the primary origin of tubercle. Thus we very often find in the lungs whitish points, which are genuine tubercles, appearing in the very midst of granulations; but there is nothing extraordinary in that, inasmuch as these granulations are, in most instances, merely the effects of partial pneumonias,* and tubercle has an especial tendency to develop itself wherever there exists a chronic process of irritation.

Another opinion has recently been advanced by M. Cruveilhier, namely, that before the occurrence of tubercle as a hard body, and at an earlier period of existence, it may be detected in a fluid puriform state. While conducting some experiments on the artificial pro-

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* Vid. *Clinique Medicale, Maladies de Poitrine,* and vol. ii. of the present work.

duction of tubercles in animals, and examining their bodies as soon as possible after the development of those tubercles had commenced, he observed among some hard white bodies, others which differed from them only in their inferior degree of consistence, being in a fluid state. In human lungs, filled with tubercles, I have occasionally found, scattered through their substance, white points composed of a fluid substance like a drop of pus. In the lungs of horses, too, M. M. Trousseau and Leblanc have seen, among well formed tubercles, clusters of points, in some of which was a purulent infiltration, in others were small abscesses. These different facts seem to afford some confirmation to the opinion of M. Cruveilhier, but we must always take care to distinguish between what is constant, and what is only accidental. Now, I think it probable enough that tubercle is in the fluid state at the moment of its deposition ; but the fact does not appear to have been as yet sufficiently demonstrated ; and it is quite certain, that, be the tubercle ever so small, it is most frequently found in the solid state.*

We shall, therefore, take it for granted, that

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* We must not imagine that every product of secretion appears at first in the fluid state ; for there are some, the cuticle for instance, which never appear but in the solid state.

tubercle is in its first stage, when it appears under the form of an opake, friable, rounded body, of a yellowish white colour, and without trace of organization or texture. After having continued in this state for a period of which the duration may vary from only a few weeks to many years, it is susceptible of two species of transformations, namely, the purulent, and the cretaceous.

The only appreciable modification tubercle undergoes previously to the commencement of either of these transformations is an increase of bulk ; and the first question for us to examine is, how this takes place ; how a body whose size does not at first exceed that of a small pin's head, can acquire in time the bulk of an ordinary orange.

To account for this enlargement, an hypothesis has long been current, by which tubercle is supposed to have the power of growing by intus-susception, like organized living beings. Now, it is not because I consider tubercle as a product of secretion, that I oppose this opinion ; for it might, notwithstanding, when once secreted from the blood, become susceptible of organization and life, like the fibrine which is effused on the surface of a serous membrane when irritated. In the fibrine, however, it is easy to demonstrate the existence of vital actions;

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but none such have ever been detected in the matter constituting tubercle. If, then, this matter is not endowed with life, it cannot grow, like living bodies, by intus-susception ; it can only increase in bulk, as inorganic bodies do, by juxtaposition. Wherever the secretion of tubercle has once commenced, that process continues : each particle of living matter, instead of the perspiratory fluid which it usually separates from the blood, takes from it a particle of tuberculous matter, which, added to those already secreted, tends to increase their mass. All tuberculous matter, then, is in this manner infiltrated among the tissues of the part. In some instances, traces of those tissues can still be recognized in the midst of the tubercular mass, and to them belong the vessels sometimes found traversing it. In others, the tissues being confined, and constantly more and more compressed, cease to be distinguishable, and nothing is to be found but a homogeneous mass of tuberculous matter. In some cases this mass has a tendency to isolate itself by degrees from the surrounding living parts, and a cyst becomes organized around it, just as it would be around a collection of pus, or any foreign body. Here, then, we see tubercle acting like pus : it first infiltrates the tissues in which it is formed, and then proceeds to isolate itself from them.

The purulent transformation of tubercle is what has been termed its period of softening. The cause of the change of consistence which the tubercle then undergoes, no more exists in itself, than the cause of its increase of bulk.* Each particle of tuberculous matter, acting like a foreign body on the tissues with which it is in contact, produces in each corresponding point of these tissues a secretion of pus which mechanically effects the division of the tubercle into clots, and which occurs here in the same manner as it does in all cases where a foreign body has been lodged for any time in some part of the living system. In the place where such a body is deposited, there is first formed a process of irritation, then a secretion of pus, and eventually, in most cases, a solution of continuity, by which a way is opened for its escape. In the case of tubercle the process is similar. Its softening, then, is merely the result of the disuniting and separating of its particles by pus; and the end of this process is, as in the case of the foreign body, the expulsion of the tubercle. But, after this has been accomplished, the process of suppuration may continue, and, more-

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* M. Lombard of Geneva appears to me to be the first who has given a good theory of the softening of tubercle, in an excellent work on that subject, to which I am indebted for many of the facts brought forward in this article.

over, the same cause which had produced the tubercle before, may produce it again ; the same process which eliminated it may contribute to the renewal of its formation : so that, far different in this respect from a foreign body introduced from without, the tubercle may be indefinitely re-created simultaneously with the pus destined to produce its elimination. It has been asserted, that the softening of tubercles commences always at their centre ; it certainly does in a great many cases, but they may also begin to soften in other parts, and especially towards their surface.

We sometimes find that tubercle, in place of softening, acquires an unusual hardness, and becomes transformed into a gritty mass, in which chemical analysis shows a notable quantity of phosphate and carbonate of lime. These salts are also found, but in much less quantity, in ordinary tubercles; so that their cretaceous transformation is merely a withdrawing, a re-absorption of the animal matter which is their chief constituent, and an augmentation of secretion of the calcareous matter. Thus, in some pulmonary tubercles in the unsoftened state, which were lately analyzed in the laboratory of M. Thenard, at the *College de France*, there were found in 100 parts,

Animal matter - - - - 98.15
Muriate of soda ⎫
Phosphate of lime ⎬ - - 1.85
Carbonate of lime ⎭
Oxide of iron - - - - a trace

Other tubercles which had undergone the cretaceous transformation, presented inverse proportions of those substances ; that is, in 100 parts,

Animal matter - - - - 3
Saline matter - - - - 96

The cretaceous transformation appears to occur more particularly in those cases where the tubercles have long ceased to exert any hurtful influence on the constitution ; and is in this res-pect the reverse of the purulent transformation.

We sometimes meet with it in situations in which, long before death, more or less decisive symptoms had announced the existence of tu-bercles, which afterwards ceased to afford any indication of their presence. Often, too, there is found about the cretaceous tubercle a tissue that appears shrunk, and occupies less space than in the natural state ; and we have reason to believe, in some cases, that this tissue has actually been in part destroyed, and absorbed along with a tubercular mass of greater or less extent, whose remains appear as a chalky con-cretion. This conjecture receives additional support from the fact, that tubercles in the soft-

ened state are sometimes found containing, among the curdy masses floating in the purulent fluid, some hard, gritty particles, formed of phosphate of lime. If we submit such tubercles to the action of an elevated temperature, or expose them for some time to the air, the liquid part evaporates, and we then, in place of a semifluid heterogeneous mass, find only a homogeneous concretion.

As tubercle is produced by the perspiratory secretion, of which it appears to be a morbid alteration, it may be developed in every part of the body : the situation, however, in which it is most usually secreted, seems to me to be the cellular tissue, whether free or combined. The submucous, subserous, and intermuscular tubercles, are evidently developed in this tissue ; it would be difficult to prove that the same holds good of tubercles of the spleen ; and we can admit it only by analogy in those of the brain, liver, kidneys, testicles, and lymphatic ganglions. As to the lungs, by examining dried sections of a tuberculous lung with a magnifier, or even with the naked eye, we may detect tubercles in the substance of the cellulo-vascular tissue which forms the parietes of the air vesicles and the infinitely small bronchial tubes opening into them. An apparently tuberculous matter has been found in the interior of cavities lined with

mucous membranes, without the presence of ulceration : this fact, of which there are as yet very few instances, shews the possibility of tubercles being secreted in other tissues than the cellular. It is not very uncommon to find the mucous follicles filled with a substance which has exactly the aspect of tuberculous matter ; and I have more than once found the same substance in the lymphatic vessels, which then appeared under the form of whitish knotted cords : some of them proceeded from organs containing tubercles, others from parts which were free from that affection, but were in a state of acute or chronic irritation, or else presented no appearance whatever of disease. For instance, I have often seen lymphatics full of a whitish matter like that of tubercle, proceeding from intestinal ulcerations, and losing themselves in the mesentery, while no where else in the intestine were traces of this matter to be found. A woman died at *La Charité* of a cancer of the uterus, in August, 1824. On opening the body, it was found that the mesenteric ganglions and those of the hollow of the pelvis formed hard white masses of great size in front of the vertebral column. The inguinal and bronchial ganglions presented the same alteration ; and from several of the former proceeded vessels distended with a limpid colourless serosity, which

presented, at intervals, white points capable of being displaced by a slight pressure. It appeared, then, that the matter which formed these white points was contained in the calibre, not in the parietes of the vessels; and in fact, on making a slight incision, it escaped freely by the sole action of their elasticity. It was of a dull white colour, and of a moderate consistence, readily breaking down under the finger; it was, in short, genuine tuberculous matter. Some of the lymphatics thus distended by it at intervals, could be easily followed under the crural arch, and into the pelvis, to the middle of the mass of diseased ganglions in front of the spine. The thoracic duct disengaged itself from this mass, opposite the last dorsal vertebra; and was, in three or four places, greatly distended, and in a manner obstructed, by the same whitish substance already described, which here formed masses, one of which was as large as a nut, and which were also evidently contained in the calibre of the tube, without having any connexion with its tissue. The external surface of both lungs was traversed by a great number of white striæ, exactly similar in their disposition to lymphatic vessels injected with mercury. These striæ were really lymphatics distended with a matter analogous to that contained in the others and in the duct. It was easy to follow

some of them into the bronchial ganglions, which were themselves transformed into hard white masses. The interior of the lungs, especially the left, likewise contained several of these vessels, appearing like white thread, and distended at intervals. In some spots, they were isolated; in others, more or less crowded, forming a kind of plexus. Nothing resembling tubercle was to be found in any part of the lungs. Neither the parietes of the different vessels in which the whitish substance occurred, nor those of the thoracic duct, presented any appreciable alteration. I shall not attempt to decide, whether this tuberculous looking matter was formed in the vessels in which it was found, or introduced by absorption. I shall only remark, that, if the blood has the power of coagulating in its vessels, and of assuming therein the most different appearances, even to the extent of becoming transformed into the substance called *encephaloid*, or into *pus*, it is not surprising the serous fluid of the lymphatics should also possess the power of spontaneously becoming solid within them, and, having once passed into this state, of undergoing those same alterations, of which observation has ascertained the possibility in the case of the blood.

Whatever be the tissue in which the tubercular matter originates, it does not appear with

equal frequency in every organ. In the adult, the parts that most frequently become tubercular, are, first the lungs, and next, the small intestine. In three hundred and fifty subjects, M. Louis found (not counting the lungs) tubercles

In a third of the subjects . in the small intestine.
In a ninth . . . . in the great intestine.
In a fourth . . . . in the mesenteric glands.
In a tenth . . . . in the cervical glands.
In a twelfth . . . in the lumbar glands.
In a thirteenth . . in the prostate.
In a fourteenth . . in the spleen.
In a twentieth . . . in the ovaries.
In a fortieth . . . in the kidneys.
In one . . . . . in the uterus.
Ditto . . . . . . in the cerebrum.
Ditto . . . . . . in the cerebellum.
Ditto . . . . . . in the ureter.

If these observations had been made in surgical practice, we should have had a different result. There would have been mentioned, for instance, tubercles of the testicle, which, though common enough, are not taken into account in the table of M. Louis.* Tubercles of the bones would also have been introduced.

In the three hundred and fifty subjects he

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* *Recherches sur la Phthisie Pulmonaire.*

examined, M. Louis found but one in which tubercles occurred in different other organs without there being any in the lungs.

In one hundred adult subjects, Dr. Lombard found, not counting the lungs, tubercles

In the intestines, in . . . . . . 26 cases.
In the mesenteric ganglions . . 19
In the bronchial ganglions . . 9
In the cervical ganglions . . . 7
In the spleen 6
In the lumbar ganglions . . . 4
In the subperitoneal cellular tissue 4
In the axillary ganglions . . . 3
In the ganglions of the anterior
    mediastinum 3
In the subarachnoid cellular tissue 2
In the spinal cord 2
In the false membranes of the pleura 2
In those of the peritoneum . . 2
In the intercostal muscles . . 2
Ovaries 2
Pariétes of the gall bladder . . 1
Liver 1
Cavity of the pleura 1
Posterior mediastinum . . . 1
Vertebræ 1
Ribs 1
Omentum 1
Uterus 1

Prostate . . . . 1 case.
Submucous tissue of the bladder . 1
Cerebrum and cerebellum . . 1
Medulla oblongata . . . , . 1
Kidneys . . . . , . . . 1
Vesiculæ seminales 1

From my own observations, I have arrived at the conclusion, that the relative frequency of tubercles in the different organs, observes nearly the same order as that indicated in the preceding tables ; except that I have in more cases than M. Louis, found tubercles in other organs without there being any in the lungs, and I have discovered them in the false membranes of the pleura and peritoneum, in a greater proportion of cases than M. Lombard. Besides the testicle, in which the tuberculous matter, when it occurs, constitutes a variety of sarcocele, both authors have also omitted to mention the intervertebral cartilages, in which I once found a mass of tubercles.

In children, tubercles, with respect to their situation, differ from those of the adult in the following circumstances.

1. Tubercles occur in other organs without there being any in the lungs, more frequently in children than in adults.

2. They have also a tendency to affect a greater number of organs at once.

3. The organs which are the most frequently affected in adults, are not those which are so in children. This may be seen on comparing the following table* with the two preceding.

In a hundred young subjects, M. Lombard found tubercles

In the lungs, in 73 cases, in 30 of which but one lung was affected, viz. the left in 13, and the right in 17 cases.

In the bronchial ganglions, in . . 87 cases.

In the mesenteric ganglions . . 31

In the spleen 25

In the kidneys 11

In the intestines 9

In the nervous centres 9

In the cervical ganglions . . . 7

In the membranes of the brain . . 6

In the pancreas 5

In the gastro-hepatic ganglions . . 5

In the subperitoneal cellular tissue 5

In the spleen 4

In the inguinal ganglions . . . 3

In the cellular tissue under the pleura 2

In the lumbar ganglions 1

In the submucous tissue of the bladder 1

In the omentum 1

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* *Lombard,* op. cit.

In the parietes of the gall bladder 1 case.

In the false membranes of the pleura 1

It is remarkable that in these hundred young subjects, tubercle was not found in the liver in one single instance. On comparing this table with the preceding, we see, that in two hundred subjects young and adult, tubercles were found but once in that organ, while they were found thirty-one times in the spleen, but not with equal frequency in both classes; as they occurred in the one-fifth of the cases in the young, and only in the one-sixteenth in the adult. In the latter, the intestines are more frequently tubercular than the mesenteric ganglions; the reverse is the case in children. It would result too, from the preceding tables, that intestinal tubercles occur more rarely in children than in adults. I confess that my own experience would have led me to the opposite result; so that I think this fact requires to be verified on a greater scale. We find also, from these tables, that the proportion of tubercles in the bronchial ganglions is much greater in children than in adults; a fact which I have long considered as certain; indeed it appears from the same source, that they are more frequently found in those ganglions, in children, than in the lungs. I have also observed in the adult, but far more rarely, tubercles in the bronchial ganglions without there being any

in the lungs. (*Clinique Medicale*, diseases of the chest.) On the contrary, it is very common to observe, after puberty, tubercles in the lungs without there being any in the ganglions; this is even the most general case. As to the cervical ganglions, we see how small is the number of cases in both classes, where they have been found tubercular, in comparison with the cases where tubercles were found in the lungs.

Lastly, these tables also confirm a fact generally known, the greater frequency of tubercles in the nervous centres in children than in adults.

The examination of the relative frequency of tubercles at the different ages, without considering in what organs they occur, will lead us to the following results.

1. Tubercles are but very rarely developed in the foetus.

2. During the first month after birth, they are likewise very rare.

3. From after that period till towards the age of four years, they occur rather more frequently, but still few in number.

According to the researches made by M. Lombard at the *Hopital des Enfans Malades* at Paris, tubercles are found in only one-eighth of the children who die between the ages of one and two; in two-sevenths of those between two

and three; and in four-sevenths of those who die between three and four years of age.

4. Between the ages of four and five, in consequence as it were of a sudden development, tubercles appear in much greater quantities, and in a greater number of organs at once. It results from the researches of M. Lombard, already cited, that, at this age, three-fourths of the children who die are victims of some tubercular affection; or, at all events, on being opened present a greater or less number of tubercles in different parts. At this age, then, every irritation or congestion is far more to be dreaded than in the preceding years, inasmuch as it may be more easily followed by the production of tubercles. It often happens that children, while still very young, towards the period of weaning for instance, are attacked by an intestinal or pulmonary irritation, which disappears after having lasted for an uncertain period. They then recover their health, but many of them continue habitually pallid, their muscular system remains imperfectly developed, and their limbs are slight; they are in fact what is called delicate : some are affected occasionally with either cough or diarrhœa; others do not present even these symptoms. At last, towards the age of four or five, the cough returns, but in a much severer and more obstinate form; the digestive

functions become deranged, emaciation suc-
ceeds, a fatal termination ensues, and, on opening
the body, tubercles are found in every part of it.

5. In the succeeding ages, up to the period of
puberty, the tubercles are more numerous than
they were before the age of four years, but are
much less so than between the fourth and fifth
year.

6. From the period of birth up to the fif-
teenth year, from one to two is, according to
M. Lombard, the age at which fewest tubercles
are found ; on the contrary, between four and
five, is that at which they are most common.

7. After puberty, tubercles again become
more frequent, and that, no longer in all the
organs indifferently, but only in the lungs, in the
intestines, and in some parts of the lymphatic
system. Between eighteen and forty they are
very common, but are, however, a less cause of
mortality than in childhood between four and
five. In this interval, some ages have been
marked as appearing to favour the development
of tubercles, but we have not yet attained to any
great certainty on this head. It appears to me,
however, to result from the researches of this
kind hitherto published, as well as from those
which I have been able to make myself, that
males, after puberty, are particularly subject to
tubercles between the ages of twenty-one and

twenty-eight ; while females seem to be more ex-
posed to them before twenty. As, however, after
the period of puberty, tuberculous affection be-
comes almost synonymous with *pulmonary con-
sumption*, the second volume of this work, as
including the diseases of the respiratory appa-
ratus, will be the proper place to return to this
question, now but slightly touched upon. For
this reason, I think it best to defer the detailed
account of what has been done with a view of
determining the relative frequency of phthisis
pulmonalis at different ages.

The development of tubercles is not peculiar
to man ; they have been likewise ascertained to
exist in many beasts. In the first place they
often occur in the apes that die in our menage-
ries; and that, in several organs at once. Thus
I had an opportunity, lately, of examining the
body of a male of the species *Simia Æthiops*, that
had died at the *Jardin du Roi*, and found in
it tubercles existing simultaneously in the lungs,
(which were quite stuffed with them) in the
liver, spleen, axillary and mesenteric ganglions,
and under the mucous membrane of the intes-
tines. A tuberculous mass, developed in the
neighbourhood of the anterior mediastinum, had
perforated the pericardium, and appeared to be
the cause of a pericarditis which had existed in
the animal, and had probably hastened its death.

Cases of pleurisy and peritonitis, produced by the irruption of tuberculous matter into the peritoneal or pleural cavity, have been more than once observed in man; but I know not whether a pericarditis produced by a similar cause, has as yet been observed in the human subject. M. Hippolite Royer Collard informed me, that last year, at the menagerie, he opened the body of a lion, in which the lungs contained a number of tubercles with hepatized pulmonary tissue between them.

I have likewise ascertained the frequent existence of tubercles in the following animals.

1. In horses. I have examined the bodies of these animals at the slaughter houses at Montfaucon, where this affection was so common in the spring and summer of the year 1824, that of six horses, the average number slaughtered at each of my visits, I almost constantly found tubercles in one, and often in three. In the horse, the parts where I have most frequently observed tubercles, are, the pituitary membrane, or rather the cellulo-fibrous tissue which separates it from the osseous and cartilaginous parietes of the nasal fossæ, and, next to it, the lungs. Of the lymphatic ganglions, the sublingual and bronchial appeared to me most frequently to manifest the process of tubercular secretion. It results from an estimate made by Professor

Dupuy,* that almost every time tubercles are observed in the nasal fossæ, they are also to be found in the sublingual ganglions. In fact, of sixty-six cases of tubercles of the pituitary membrane, he found sixty with tubercles in the sublingual ganglions. From the researches of this author, the development of tubercles in the bronchial ganglions does not appear to succeed with equal constancy their development in the pulmonary parenchyma. Thus, of forty-two horses with tubercles in the lungs, he found but twenty-seven that had them also in these ganglions. Among seventy-two glandered horses, he observed thirteen cases of tubercles in the inguinal ganglions, and but six of that affection in the testicle. I have never been able to meet with tubercles in the alimentary canal, or mesenteric ganglions, in this animal; for we must not apply that term to tumours sometimes developed in the internal surface of the intestines, which are nothing but follicles in a state of hypertrophy. This negative result proves at least the rare occurrence of intestinal and mesenteric tubercles in the horse; a fact confirmed by the observations of Dupuy: in seventy-two glandered horses, he found tubercles of the in-

* De l'Affection Tuberculeuse, vulgairement appellée morve, &c. by M. Dupuy, 8vo. 1827.

testines in two only, and of the mesenteric gang-
lions in four. The liver also, and spleen, some-
times contain tubercles ; they appear to me more
frequent in the latter than in the former : I have
never been able to discover them in the nervous
centres, neither does M. Dupuy make mention
of such an occurrence.

2. In the hog. In the body of one of these
animals, which I examined along with M. Du-
puy, I found tubercles at the same time in the
lungs, in the heart, and in several groupes of
muscles.   In the heart and muscles they were
mixed with transparent vesicles surmounted by
a head-shaped prolongation, which appeared to
be of that species of hydatid termed *cysticercus*.

3. In the ox. In several dried specimens
of cows' lungs, presented by M. Dupuy to the
Academie Royale de Medecine, were numerous
tubercles, which were remarkable for the cir-
cumstance of their being much harder, than
usual, the calcareous salts appearing to predo-
minate in their composition : it might, however,
have been an effect of the drying. M. Larry
lately sent me a rib of beef, in which was a
round cavity containing a tubercular mass of the
size of a large cherry.

4. In the rodentia. It is not very uncommon
to find tubercles in rabbits. In these animals,
the liver is the organ in which I have most fre-

quently observed them. Dr. Lombard told me he has found some in their intestines and mesenteric glands. M. Dupuy has seen tubercles in the liver and mesentery of a hare.

Lastly, several authors inform us they have pretty frequently met with tubercles in the sheep. We are assured also, that amongst birds, the parrots in menageries almost always fall victims to a tuberculous affection. There is in the museum at Alfort the liver of a turkey which is full of tubercles.

From the preceding facts it follows, that several animals have, in common with man, this melancholy tendency to tuberculous affections. They shew us, that, amongst the mammalia, animals using the most different kinds of food are equally subject to it; the carnivorous as well as the herbivorous. Amongst the carnivorous, however, there is one species, in which, though we frequently examine their bodies, genuine tubercles have never, to my knowledge, been discovered: I mean the canine species. Is this because the dog lives in freedom in a climate that agrees with him, and where he can enjoy exercise proportioned to his strength? And is it because the lion happens to be in opposite circumstances that he dies affected with tubercle? Observe, that most of the animals in which we have just now proved the existence of

this affection, are either transported from a hot to a cold climate, where they are deprived of liberty and exercise (as is the case with monkeys and parrots), or confined in damp places, without sun, and almost without air, (cows, pigs, house rabbits), or exposed either to continual alternations of cold and heat, or to constrained and violent exercise, as the horse.

The predisposing causes of tubercle are still far from being well known. Observation has proved that it has an especial tendency to grow in those individuals whose skin is very fair, and as it were, blanched, and without any trace of colouring matter in its capillaries, and in whom the prominences of the cheek exhibit a red tint, as if it were laid on with a brush, which forms a remarkable contrast with the dead white of the rest of the cheek. The colouring matter thus deficient in their skin is likewise so in their eyes, which retain the blue tint of infancy, and in their hair, which is light-coloured, and also small in quantity. Their muscles are soft and slender, and shew little contractile power ; their blood is serous, and deficient in fibrine and colouring matter ; and among their secretions the mucous predominate. In these individuals, lastly, sanguineous congestions are formed with remarkable facility in different parts of the skin and mucous membranes; and when once formed,

never terminate, but continue in the chronic state, and are frequently succeeded by ulcerations and various disorganizations, which do not heal without the greatest difficulty, and that, often by the employment of measures the reverse of those termed antiphlogistic. It seems that such persons preserve in adult age several of the characters belonging to the age of childhood, considered in its healthy or morbid state : their organization is in a manner arrested in its development. Such a constitution as this may have been formed without any external cause appearing to contribute to it. In other cases, it appears to be acquired. The living in an impure or insufficiently ventilated atmosphere, the crowding together of a great number of persons, want of due exposure to the sun, habitual humidity of the atmosphere, the use of food which does not sufficiently repair the forces of the system, various excesses which exhaust these forces, and waste the nervous influence to the detriment of the nutritive powers ; such are the causes, which, while they produce in the blood an impoverishment indicated externally by the state of the skin and muscles, and impress on every hyperæmia a chronic or languid character, tend also to produce in every organ the secretion of tubercle.

Thus, then, there are certain habits of body,

certain constitutions, innate or acquired, that predispose to the development of tubercle ; that is to say, it most frequently appears in those constitutions ; and it is a remarkable fact that it is in such cases especially we observe this morbid production developing itself in several organs at once, both in old and young.

I do not mean, however, to assert that tubercles are found only in individuals like those just described ; on the contrary, they occur also in others of a totally different constitution. It is not uncommon, for instance, to observe amongst the victims to consumption, some with a brown skin, very black hair, and strongly developed muscular system. Still, I think, I am borne out by facts in the two following positions : 1st, that the tubercular diathesis is in direct proportion to the development of the constitution above described ; and 2nd, that in proportion as this constitution becomes less strongly marked, the tubercles also become less frequent, and, especially, occur in fewer organs at once.

Thus, with respect to their predisposing causes, tubercles should, I think, be divided into constitutional and accidental. The first are distinguished by the two following characters : 1st, their simultaneous existence in several organs ; and, 2nd, the very frequent absence of any appreciable symptoms of antecedent excite-

ment or congestion in the part where they ori-
ginated. To explain the presence of tubercles
in several organs at once, it has been said that
they were at first formed in some one of them,
the lungs for instance, and were afterwards
absorbed, introduced into the circulation, and
deposited with the blood in the parenchyma of
the other organs. According to this opinion,
the case would be with the tuberculous matter
as with pus, which, as we have already seen,
is capable of being thus absorbed, and deposited
afterwards on the surface, or in the substance
of the different tissues. It is possible that the
tuberculous matter also may possess this pro-
perty; but as yet there is no fact to prove it,
and without having recourse to such an hypo-
thesis, its simultaneous existence in several
organs can be very naturally accounted for by
the single fact of an identity of modification in
the whole of the perspiratory secretion.

But, in order that this modification may
take place, is it necessary that there should pre-
viously exist an exaltation of the vital powers
of the part, augmentation of its organic action,
stimulation, irritation, and, consequently, active
hyperæmia? This question is answered by ex-
perience, that in many cases there have been
symptoms indicative of sanguineous congestion
in those parts in which the tuberculous secre-

tion was afterwards established ; but that in other cases there has been no proof that this sanguineous congestion, produced by irritation, had ever existed ; so that it can be admitted only by analogy. We then have to go back to reasoning, and, according to the meaning which is given to the word irritation, according as we attribute to it such or such a series of functional derangements, it will become free to every one to admit or deny the presence of irritation in those cases in which, after death, tubercles are found in most of the organs at once, without there having been any sign of its existence during life. All that can be established in this respect, are the three following propositions.

1. In many cases, neither the study of the symptoms, nor the examination of the morbid changes in the dead body, discovers the past or present existence of a process of iritation in the part where the tuberculous matter is found. This holds good not only of those organs whose sensibility is feeble, and whose sympathies are of little activity, such as the lymphatic ganglions, liver, and spleen, but also of the brain.

2. In the formation of tubercles, as well as in that of every other morbid production, theory shews that irritation is an energetic and very frequent, but not a necessary cause.

3. Irritation, without the concurrence of

other causes, can no more account for the formation of tubercles, than for the particular nature of each of the innumerable alterations of nutrition and secretion it so often precedes, and which are developed not by it but through it.

Thus, the mere presence of irritation, be its intensity and duration what they may, does not necessarily determine the formation of tubercles; on the contrary, they may occur without any *appreciable* irritation.

To sum up all, it appears to me that, in the present state of the science, tubercle must be considered as the result of a modification or perversion of secretion, which is often attended or preceded by an active sanguineous congestion. This is all we know for certain; beyond this, every thing is mere conjecture.

SECOND GENUS.

SUBSTANCES OF A GELATINOUS APPEARANCE.

It is not uncommon to find in different organs a substance which, in its physical properties, may well be compared to a strong animal jelly, or to a solution of starch. In consequence of this resemblance to jelly or glue, it has received from Laennec the name of *colloid substance.* Sometimes it is colourless, and sometimes it presents various tints from a bright

yellow to a pale rose colour. It is without any trace of organization, and appears to be separated from the blood, and deposited in the different organic textures. Sometimes it is infiltrated into them, producing more or less alteration in their appearance ; and sometimes it is collected into one or more isolated masses, which seem, when depositing, to have thrust back the surrounding parts : in both cases it is similar in its effects to pus or tubercle. When it exists in the state of infiltration, it often happens that the cellular tissue, whose areolæ it fills, becomes indurated around the molecules of the effused matter. In such cases, whether the induration depends on a true hypertrophy of the cellular fibre, or is merely the result of a mechanical condensation, the jelly-like substance is always traversed, and divided into compartments by numerous white, hard, resisting plates, which seem to have the office of secreting it. In some cases these plates tend to pass into the fibrous or cartilaginous state ; and red vessels have been observed ramifying on their surface, but never have, to my knowledge, been traced into the colloid matter itself.

The colloid substance does not exist in this isolated state only ; it is also found at times in tumours composed of a medley of different morbid products. It is not uncommon to find de-

posits of it in the midst of tumours formed of cellular tissue in a state of hypertrophy or induration ; and it is often contained in cysts of various kinds, which appear to be its secreting organs. The tumour described by authors under the name of *meliceris,* which consists of a cyst containing a fluid like honey, is, in my opinion, merely a variety of the morbid production at present under consideration.

If I may draw a conclusion from a single instance, I am authorized in admitting that this same morbid secretion whose numerous varieties resemble animal or vegetable jelly, glue, or honey, respectively, may be formed not only in the different organic tissues, with or without a cyst, as we have just seen, but also in the interior of the great serous cavities. I allude to a case in which I found one of the pleuræ full of a slightly greyish substance, exactly resembling honey ; so much so indeed, that I find it designated in my notes by the name of *meliceris interne.*

I refer the reader to the article *Transformation,* for the description of some cases of development of the colloid substance ; which will serve to complete its history as far as can be done in the present state of the science.

THIRD GENUS.

FATTY SUBSTANCES.

The fatty substances developed in different parts of the system may be divided into two species, according as they are perfectly identical in their physical and chemical properties with natural fat, or as they are more or less removed from it.

The first species is, most commonly, not a new production, but is merely the natural fat secreted in greater quantity than usual. It has been already spoken of in the first chapter of this section.

The second species does not resemble the natural fat in appearance, although it does in its principal component parts, without which it would not be fat. Thus, there are sometimes found, in different parts of the body, cysts of various sizes, filled with a substance exactly similar to suet, which sometimes constitutes of itself the entire bulk of the tumour, and sometimes is mixed with different other morbid secretions, or alterations of nutrition. It is not very uncommon to find in the ovaries, tumours formed wholly or partly of a fatty matter like suet. I have elsewhere (*Clinique Medicale*) mentioned a case of a cyst with

cartilaginous parietes, of the size of the head of a full-grown fœtus, developed between the folds of the mesentery, and full of a suety matter. Hair has not unfrequently been found in such tumours.

We sometimes observe the proper tissue of the different parenchymatous organs reduced to a state of atrophy, and its place occupied by a fatty matter, easily recognizable by its physical properties. It is then said that these textures are transformed into fat. I shall follow in detail the effects of this alteration on the different organs, when I come to treat specially of the morbid anatomy of each.

FOURTH GENUS.

SALINE SUBSTANCES.

Chemical analysis has detected in all the animal fluids the presence of a certain number of salts analogous to those forming a great part of the inorganic kingdom. It often happens that, under the influence of causes which are still far from being well known, these salts are formed or deposited in superabundant quantities in different parts of the body. There is not a single part of the system where such saline concretions have not been discovered. They may consist either of the same salts as are usually

found in the blood and other fluids of the body, or of others not usually contained in them. Sometimes they are found in the fluids, in the excretory ducts by which they are to escape from the system, and they are then formed at the expense of those fluids; hence proceed the salivary, biliary, and urinary calculi, whose history will come before us in the second volume along with that of the organs in which they are formed. Sometimes, again, these deposits are formed in the solids, whether in the cellular tissue or in the various parenchymata. They may be found either alone, or combined with other morbid productions. Lastly, they sometimes succeed other morbid secretions: thus we have already seen that tubercle is in some instances replaced by a calcareous concretion.

FIFTH GENUS.

COLOURING MATTERS.

The formation of colouring matter in the tissues is one of the most general phenomena presented in the organic kingdom, vegetable or animal. The white variety of the human race is that in which the colouring matter least abounds, while it becomes more abundant and more varied in the inferior classes of animals. Even in the white man, however, there are some

traces of colouring matter or pigmentum to be
found, 1. in the pilous system ; 2. in the choroid;
3. in the iris ; 4. in some parts of the brain,
where black, brown, or yellow spots appear in
the natural condition.

These are the only places in which deposits
of colouring matter appear naturally in man.
Perhaps I might add to the list, the lungs of
old people.   The black colour which, in them,
tinges the parietes of the pulmonary vesicles,
or the intervening cellular tissue, is so common,
and seems so independent of any morbid altera-
tion, as to warrant the opinion of its being a
physiological condition.   It may be asked whe-
ther this secretion of colouring matter in the
lungs of old people is to supply the place of the
secretion of the pilous system which then usu-
ally ceases to exist ; whether it depends in any
manner on some modification in the structure
of the lungs ; or on an increase in the varying
quantity of carbon separated from the blood at
different periods of life. I must refer for the
discussion of these questions to my second
volume, under the head of *Diseases of the Re-
spiratory Apparatus.*

The different varieties of colouring matter
have been seen accidentally produced in all the
tissues, either combined with them, or deposited
on their surface, sometimes in the liquid, and

sometimes in the solid state. They may be un-
accompanied by any other morbid alteration, or
may co-exist with different lesions of nutrition
or secretion. For instance, indurated tissues
often acquire a brown, black, or yellow tinge ;
old cicatrices of the mucous membranes also are
pretty frequently tinged with a more or less deep
shade of black. Different secretions, likewise,
may present some accidental colouring matter ;
as sometimes happens with tubercle.

The deposition of colouring matter is very
often preceded by an evident process of irrita-
tion. The skin affords us many instances of
this. Thus we sometimes observe a grey,
brown, or yellow tinge, in the place where a
herpetic affection or an ulcer had existed, long
after that affection has completely disappeared.
But, deposits of colouring matter may also be
formed in the skin without any antecedent irri-
tation, and they have been seen spreading and
multiplying on it without any other appreciable
phenomenon than the mere change of colour.
Cases have been seen in which the skin of in-
dividuals of the white species suddenly became
partly or wholly black ; and others, in which
blacks became partly white. Now, in these de-
positions and abstractions of colouring matter,
irritation plays at least no appreciable part ; so

that we have here another case in which it favours the production of a morbid secretion, but is not its necessary cause.

Two kinds of colouring matter, one black and the other yellow, have received particular names, and require a particular description. The black, or nearly black colouring matter has been called *melanosis :* the yellow has been lately described under the name of *cirronosis.*

FIRST SPECIES.

MELANOSIS.

The name of *melanosis* has been given to an accidental production, whose distinguishing character is a black colour of greater or less intensity.

Melanosis has received its name from M. Laennec, and was first described by him in the *Bulletins de la Societé de l'Ecole de Medecine,* (1806, No. 2.) Since that, several physicians in France and elsewhere have contributed observations of cases of this affection in different organs. In 1821, Dr. Breschet published some new remarks on its nature, chemical composition, and the different dispositions it affects in the different parts of the body in man and in beasts. Lastly, MM. Trousseau and Leblanc have by their late researches added a new in-

terest to the history of melanosis. (*Archives de Medecine*, June, 1828.)

Melanosis may exist in four forms. 1. It pretty frequently constitutes masses encysted or otherwise. 2. The matter which composes it may, like the tubercular matter, be infiltrated into the different tissues. 3. It may be spread like a layer of greater or less thickness on the free surface of the membranous organs. 4. Lastly, it may exist in the fluid state, either pure or mixed with other fluids. Laennec has admitted the three first species, but says nothing of the fourth, nor indeed could he, since calling melanosis, as he did, a tissue, he could not consider a fluid as such. But to those who view it in another light, and consider it merely as an unorganized deposit of colouring matter, it is as easy to conceive its being in the fluid as in the solid state. Be it as it may, I shall now proceed to describe these four principal forms, in which, in my opinion, melanosis may indifferently appear.

A. *Melanosis in masses.* This first form has also been denominated *melanic mass,* or *concretion.* These masses have been classed by Laennec among the accidental productions which have nothing analogous to them in the healthy state; and, according to him, present two periods or stages of existence: 1, a state of crudity, and, 2, a state of softening.

In their crude state they present the follow-
ing anatomical characters. Their colour is not
always exactly the same: some are of a yellow-
ish brown, so as not to answer well the name
of *melanosis*; others, like bistre; others again,
like soot; lastly, others are of a fine deep black,
and when rubbed on linen or white paper, stain
it like Indian ink. Their form is sometimes
spherical, and sometimes irregular, so as not
to be like any geometrical figure. Some melanic
masses are studded with asperities, or with small
knobs, or have an embossed appearance; others
have a pretty strong resemblance to black cur-
rants, or mulberries; lastly, others, instead of
presenting a uniform appearance, and consisting
of one piece, are divided into lobules separated
by cellular tissue, or else seem formed by an
assemblage of plates or leaves lying over one
another, or side by side.

The consistence of these masses may, in
many cases, be compared to that of suet; and
in others to that of the lymphatic ganglions.

Their bulk varies in general from the size
of a grain of millet, or of a pea, to that of two
hen eggs taken together. They have sometimes,
however, been seen much larger; for instance,
they have been found in the abdomen in horses
constituting enormous tumours that weighed
so much as six-and-thirty pounds. But such

masses as these are generally composed of seve-
ral smaller masses, which, after having been
formed separately, have subsequently grown
together and become more or less perfectly con-
founded.

According to Laennec, a period at last ar-
rives when these masses lose their consistence,
and begin to soften from their centre to their
surface. When the softening is but a short way
advanced, the masses still preserve their form;
but, on incision or pressure, there oozes from
them a reddish, brown, or black fluid, in which
are suspended a greater or less number of black
clots. At a more advanced period, they lose
their consistence, and are transformed, at first
partly, and then wholly, into a kind of blackish
pulp. Around this, is then set up a process of
inflammation, for the purpose of eliminating it
from the system; for softened melanosis, like
foreign bodies, has a tendency to make its way
out of the body; and, according to the situation
it occupies, this is accomplished with more or
less facility and speed. In its place there then
exists an ulcerous cavity, which, according to
its situation, the organ in which it is, and the
constitution of the individual, may extend, re-
main stationary, or proceed to cicatrization.

Such is the description which is generally
given of the stage of softening of melanosis.

But, in the first place, we must observe, that this softening is of very rare occurrence. Laennec says (*Traité de l'Auscultation Mediate*, vol. 1. p. 293,) that he has never himself found in the lungs cavities formed by softened melanosis; but cites, as instances of it, the cases xx and xxi in Bayle's work on phthisis pulmonalis. In both these cases, the pulmonary parenchyma, which was hard and black, contained a number of small cavities whose parietes were lined with a layer of pus. I do not think there is any proof that these cavities were produced, as Laennec imagines, by the softening of a melanosis; since there was no trace of that accidental production in their interior: they might just as well have been considered as caused by the softening of small isolated tubercles, or by partial dilatations of the bronchia. In fact, I have often met with such cavities as those described by Bayle, situated, like them, in a hard black pulmonary tissue; and have been as often convinced, by dissection, that they were merely dilated bronchia. I am strongly inclined to think, that what has been called the softening of melanosis, depends, in certain cases, simply on the softening of the natural or accidental tissues with which it was united or combined.

There are cases in which the different lobules that often compose the melanic mass are not all

of equal consistence. Some of them do not even preserve the solid form, but resemble a thick soup of a more or less deep shade of black; while, in other parts of the tumour, there is nothing to be seen but a black liquid contained in a sac with cellular parietes. M. Trousseau adduces some facts of this nature for the purpose of demonstrating the softening of melanosis; but the question seems very difficult to decide: we may just as well imagine these fluids to have been secreted in that state, without ever having been harder. Such an opinion would be the more admissible, as, from some cases to be cited farther on, there is little room to doubt that melanosis is often secreted in the liquid form in the structure, or on the surface of the tissues, and continues there as such.

The masses of melanosis may either be contained in a cyst, or not. The first case is infinitely rarer than the second. Up to 1819, Laennec had found encysted melanosis only in the liver and the lungs; and that but once in the latter situation. M. Breschet asserts that he has discovered encysted melanic masses in different parts of the cellular tissue. Every time that I had an opportunity of examining masses of melanosis, I have invariably found them without a cyst: sometimes they adhered very closely to the surrounding tissues, and sometimes they were less strongly united to them, and could

easily be detached altogether from them without being torn. Authors who assert that they have found these masses contained in a cyst, describe it to be of a cellular texture, and have never seen it of a fibrous, cartilaginous, or osseous nature. By its external face, it adheres loosely to the tissues with which it happens to be in contact; from its internal, it often seems to send very delicate processes into the substance of the melanic concretion.

All attempts to seek for any trace of organization in melanic masses would be useless. They present merely a homogeneous mass, sometimes divided into lobules or plates by some cellular tissue, which traverses its substance without belonging to it. Neither cavities, nor areolæ, nor fibres, are to be found in them ; nor are any vessels or nerves distributed to them : in short, they are real inorganic productions, and seem tohave no claim whatever to the name of *tissue*. I am of opinion, therefore, that authors have not been correct in calling melanosis an *accidental tissue ;* it is no more such than tubercle, and, as in the case of the latter, if vital phenomena sometimes appear in the midst of a melanic mass, it is quite certain that they take place in the living parts involved and confined in that mass.

B. *Infiltrated melanosis.* Writers have de-

scribed under this name the black induration
of certain organs, especially of the lungs and
lymphatic ganglions. This induration, say they,
results from the presence in the lungs, or other
organs, of a new tissue, which is united or com-
bined, molecule to molecule, with the tissue of
the organ itself. We can conceive this to be
the case in some instances ; and that the colour-
ing matter constituting melanosis may be depo-
sited and become solid in each of the cells or
areolæ of the parenchyma, thus producing an
appearance of induration of this latter, just as
we have before seen it forming a solid deposit
in a circumscribed point, and constituting a
melanic mass or concretion. I think, however,
it would be easy to prove that, in most cases, the
induration of an organ which becomes black at
the same time, has no connexion with this black
colour, but is the simple result of a chronic
phlegmasia. Such is the case, for instance, with
the black induration of the lungs, which con-
stitutes the *phthisis with melanosis* of Bayle.

In fact, the same induration of the pulmo-
nary parenchyma may be found accompanied
with all possible colours, red, bright grey, deep
grey, or slate colour. In some cases, we can ob-
serve in the same lung the transition, by almost
insensible gradations, from the grey tint to the
deepest black ; and the lung is equally hard

where it is not black. We must, therefore, conclude, that the state of induration of the lungs accompanied with a black tint, does not differ essentially from that accompanied with a whitish or greyish tint. In the latter case, we at once refer the pulmonary induration to a simple chronic inflammation : why, then, should we not regard the black induration as depending on the same cause? A simple shade of colour is certainly not sufficient to warrant us in considering as different two states which exactly resemble each other in every other respect, both in their anatomical characters, in the symptoms that announced them during life, and in the causes which produced them. Thus, then, we must either regard the phthisis with melanosis of Bayle simply as a variety of chronic pneumonia, or we must enlarge the number of phthisical affections, and refer to them as so many distinct species, the white, grey, and yellow induration of the pulmonary parenchyma. In some cases we find, scattered through a generally sound lung, some hard black masses, which at first sight appear not to belong to the pulmonary tissue ; but if, without cutting or tearing, we isolate from the rest a lobule containing one of those masses, we perceive that it is partially or wholly indurated, and of different colours ; grey in many points, brownish in others, and

quite black in that point where a superficial ob-
servation would have led us to imagine the ex-
istence of a melanic mass, which now appears
to be what it really is, namely, a portion of the
pulmonary tissue itself, in a state of chronic in-
flammation, indurated, and stained black, just
as the neighbouring portions, which are also
indurated, are stained red, grey, or brown.

If these considerations induce us to admit
that the black induration of the lungs is only
a chronic pneumonia, with the addition of a
colouring matter, we may conceive cases in
which this latter may occur without the tissue
in which it is formed having been previously
indurated ; a fact which could not be admitted
by those writers who regard the black induration
as owing to the presence of melanosis. Laen-
nec also has taken great care to make a distinc-
tion between it and the simple black colour
often observed in the lungs in the form of lines
or patches, without any change in the natural
consistence of that organ. But if it is demon-
strated that the induration of the lungs is not
produced by melanosis, but merely co-exists with
it, there are no grounds for establishing a dis-
tinction between the black colouring which ac-
companies certain pulmonary indurations, and
that which exists without induration, and which

Laennec has classed separately under the name of *black pulmonary matter.*

C. Melanosis deposited in the form of solid layers on the surface of membranes. This form of melanosis has particularly been observed on the free surface of the serous membranes. Thus, in persons who die of a chronic peritonitis, the peritoneum is not unfrequently found lined partially or wholly with a solid layer of a deep black, of several lines in thickness. But, if we raise this layer from the surface of the peritoneum, we find it to have all the characters of the false membranes of the serous cavities, and that it differs from them only in its black colour : from these facts we must, I think, conclude, that many melanic productions ranged in this third class ought to be placed in the second; since, after all, they are merely false membranes stained black, or infiltrated with melanosis. It is remarkable that this black colour of the false membranes appears almost exclusively in the peritoneum. I have never found it in the false membranes of the other cavities, the pleura especially.

Melanosis also occurs sometimes in the form of a solid layer on the adherent surface of the serous membranes. I have seen an instance of it in a horse : the external surface of a coil of intestine was covered, for an extent of five or

six inches in length, and three in breadth, with a layer of black matter, about half an inch thick, and of great consistence. It was situated in the cellular tissue which unites the peritoneum to the muscular tunic.

D. *Melanosis in the fluid state.* M. Breschet has designated by this title certain fluids remarkable for their more or less deep black colour, which seem to result from a morbid secretion in several organs. Thus, in certain cases of acute, and still more so in some of chronic inflammation, the mucous membrane of the stomach secretes a fluid whose colour has been compared to that of soot or chocolate; there is often a striking resemblance between this fluid thus secreted by the inflamed stomach, and the black blood, more or less modified in its composition, that is sometimes found in the cells of the spleen.

In some cases of chronic peritonitis, I have found the serous cavity of the abdomen filled with a very black fluid; but this case is much rarer than that in which the peritoneum contains a reddish liquid, which is evidently blood in a greater or less state of purity.

In a case related by M. Proust, the urine appeared of a deep black colour, which he attributes to the presence of new acid, denominated by him melanic acid.

MM. Trousseau and Leblanc found on a horse's kidney a fibrous cyst of the bulk of a fist, which contained about eight ounces of a black fluid.

It follows from these facts, that the black colouring matter under consideration may be secreted in the liquid state both in accidental cavities or cysts, and in the different natural cavities; and that, in the latter case, it is sometimes mixed with the fluid usually contained in these cavities, and sometimes takes its place.

Chemical composition of melanosis. Melanosis has been studied not only with respect to its different physical properties, but also as to its chemical composition; and this latter description of researches has, in no small degree, contributed to our knowledge of the real nature of this accidental production. M. Thenard was one of the first who employed themselves with the analysis of melanosis; he found it essentially composed of carbon. M. Clarion has described it as consisting of albumen and of a particular kind of black colouring matter. M. Lassaigne found in melanic masses taken from the horse: 1, fibrine; 2, a blackish colouring matter, soluble in diluted sulphuric acid, and in a solution of subcarbonate of soda, which then assumes a red tinge; 3, a little albumen; 4, different inorganic substances, such as chloride

of sodium, subcarbonate of soda, phosphate of lime, and oxide of iron. According to M. Barruel, melanosis is chiefly composed of a deposit of the colouring matter of the blood, combined with some fibrine, *both in a particular state.* There are also found in it three distinct fatty substances; the first, soluble in alcohol at a moderate heat, and crystallizable; the second, soluble only in boiling alcohol, and not crystallizable; the third, liquid at the ordinary temperature. M. Barruel has besides discovered in it a good deal of phosphate of lime, and of iron. The details of his analysis are to be found in the valuable memoir on melanosis by M. Breschet. Lastly, still more recently, M. Foy has found a portion of a melanic mass from a horse, composed as follows. (*Archives de Medecine,* June, 1828.)

Albumen	15.00
Fibrine	6.25
A highly carbonized principle, probably altered crassamentum	31.40
Water	18.75
Oxide of iron	1.75
Subphosphate of lime	8.75
Muriate of potash	5.00
of soda	3.75
Carbonate of soda	2.50
of lime	3.75
of magnesia	1.75
Tartrate of soda	1.75
	100.00

These different analyses all agree in one important point; which is the reason I have thought it of use to compare their results. They all shew that the accidental production, termed *melanosis*, is formed of the different elements of the blood, especially of a colouring matter which has a greater or less resemblance to that of the blood, without, however, being exactly similar to it. It is the presence of this colouring matter, then, in which (from the analysis of M. Foy) carbon appears to predominate, that seems essentially to constitute melanosis. As to the different fatty matters described by Barruel, it becomes a question whether they belonged properly to the melanic mass itself, or to the tissue in which it was developed, which was unavoidably included in the analysis. I cannot find that this important distinction has been attended to in any of the analyses.

Melanosis considered in the different tissues. There is scarcely a tissue in which this accidental production has not been observed in some one of the forms already described. It does not, however, occur with equal frequency in all the tissues, nor in all the parts of the same tissue.

Melanic concretions have been sometimes observed in many parts of the cellular tissue. Thus, they have been observed in the subcuta-

neous cellular tissue in the form of rounded masses of various sizes, raising up the skin, and sooner or later producing inflammation and perforative ulceration. They have likewise been seen in the submucous cellular tissue; for instance, anatomists have often found, on the internal surface of the intestinal canal, black tumours, situated under the mucous membrane, which was thrust up by them. The tumours of this description I have had an opportunity of examining myself, were, on an average, about as large as a filbert; I have observed them more frequently in the great intestine than in the rest of the alimentary canal, and they were all hard, and without any apparent tendency to softening. M. Cruveilhier has seen similar tumours in the stomach. I have already mentioned a case of melanosis developed in the subserous cellular tissue, between the muscular coat of the intestine, and the peritoneum. Small melanic masses are frequently seen deposited between the pleura pulmonalis and the substance of the lung, which itself continues perfectly unaffected. I once saw a patch of a deep black colour, about as large as a two-franc piece, and seven or eight lines thick, on the external surface of the heart. On dissection, I discovered that it was situated between the fleshy substance of that viscus, and the peri-

cardium ; consequently, it was in the subserous cellular tissue. In an English Periodical, (*London Medical Repository*, 1823,) there is an account of a case in which black, round, tumours, of a pulpy consistence, were observed projecting underneath the serous fold of the pericardium which immediately lines the heart ; in the same individual, several similar tumours were observed on the external surface of the pleura costalis. Several authors have recorded cases of melanic masses developed in the cellular tissue interposed between the muscles, or fasciculi of the same muscle. Lastly, M. Chomel has given us an interesting account of a case in which a mass of melanosis involved the fat cellular tissue at the bottom of the orbit.

Perhaps we ought to refer to a cutaneous melanosis, the black spots which sometimes occur in the skin of whites, without any change in the thickness or consistence of that membrane ; and also the black, hard, tumours, of various shapes and sizes, that have been observed in some cases projecting from the surface of the cutaneous envelope, and that have been described by Alibert under the name of *cancer melané*, and by Jurine of Geneva, under that of *cancer anthracine*. In the very curious case described and drawn by Professor Alibert, in his *Nosologie Naturelle*, the whole skin was stud-

ded with numerous spherical tumours, several of which, in size, colour, and even in gloss, resembled black currants or juniper berries. They were also black in their interior, which was very like that of a truffle. M. Breschet assures us that he has found in several subjects, a great number of small black tumours, resembling black currants, seated in the skin, and appearing to spring from the corpus mucosum of Malpighi. In the cases related by M. Jurine, we first see a very black spot appearing in some one point of the skin. This soon becomes a granulated tumour, not very unlike a mulberry. At a certain period of its existence, it changes colour, acquires a bistre or olive tint, and at last softens and ulcerates ; and the solution of continuity which then takes place presents the same characters as an ordinary cancerous ulcer, with respect to its appearance, progress, the symptoms to which it gives rise, and the tendency of the tumour to spring up anew after having been removed. I do not think that such a morbid production as that, can be considered as a simple melanosis ; it rather belongs to the class of compound accidental productions, to be considered farther on.

The mucous membranes present, much more frequently than the skin, this black colour, which, though not natural in man, is

so in many animals. The intestinal mucous
membrane especially presents frequent exam-
ples of this accidental black stain, which appears
in it in the form of points, spots, or patches of
greater or less extent. In a man who had been
affected with chronic diarrhœa, I found the in-
ternal surface of the great intestine as black as
Indian ink, from the cæcum to the rectum. The
colour was seated in the mucous membrane,
which presented no other alteration except a
remarkable development of its follicles. In this
case, the mucous membrane was not only inti-
mately combined with a black colouring matter,
as appeared from its colour not being restored
by maceration in water ; but the colour was
also deposited on the free surface of the mem-
brane, which blackened linen when rubbed on
it. This condition exactly resembled the natural
condition of the choroid. Some nearly similar
cases have been brought forward by M. Billard.

In the case just mentioned, we see combined
the two circumstances of a black infiltration of
the mucous membrane, and of a secretion of the
same nature on its surface. These two may also
occur separately. Thus, we sometimes find a
black matter contained in the alimentary canal
and evidently resulting from a morbid secretion
of its internal membrane, which itself merely
presents a red, grey, or slate-coloured tint. Still

more frequently, we observe the membrane stained black without any transudation on its surface. If we examine it attentively, we find that it results from a real black injection of the villi, so that it is in those the secretion of the black colouring matter or melanosis appears principally to take place. I have observed this particularly evident in the horse.

We must not class among the melanic affections certain brown or even black tumours which are occasionally found projecting from the internal surface of the intestines, sometimes with, and sometimes without, a pedicle. These resemble melanic masses only in their colour, their texture being totally different ; as they present indubitable traces of organization. On dissection, we find them composed of a tissue formed of filaments intersecting each other in various directions, and leaving between them spaces or areolæ into which blood appears effused. These tissues seem composed of a true accidental erectile tissue : they are by no means common, and when they do occur, there are but one or two found in the whole extent of the intestinal canal. In one single instance, I saw eight or ten of them on the mucous membrane of the cæcum packed close together. These tumours evidently differ from those that really belong to the class of *melanosis*, in there being

no sign of the production of a new tissue in the latter, but merely an infiltration, a simple deposition of colouring matter, in the interior or on the surface of a natural tissue.

The melanoses which have been considered as seated in the serous membranes exist much more frequently in the subjacent cellular tissue, or else in the membranous concretions which, in cases of inflammation, line the free surface of those membranes. I have already mentioned some cases of this description, and also some in which the serous membranes were observed to exhale a black fluid, which had not the appearance of resulting merely from the exhalation of the natural elements of the blood. In some instances, however, it has appeared to me that the black tinge of the serous membranes was seated in their own tissue: thus, in two cases, I saw the intestinal portion of the peritoneum strown over with numbers of small black spots, nearly circular, which could be removed with the membrane, the cellular tissue remaining untouched beneath: there was no trace of peritonitis. In a horse affected with hydrocele, the portion of serous membrane that covered the tunica albuginea of one of the testicles, presented a round spot as black as ebony, of about the size of a five-franc piece. Not far from this large spot were three or four smaller ones, of a less regular form,

and rather slate-coloured than perfectly black. I convinced myself by accurate dissection that this tinge was seated solely in the serous membrane itself.

The different tissues composing the parietes of the arteries have hitherto presented melanosis under two principal forms. 1. In more or less bulky masses, deposited between the middle and internal coats of the vessel, like the concretions of phosphate of lime. 2. We more frequently observe a deep black tinge around and at the bottom of certain ulcers of the internal tunic of the artery. This is even one of the cases in which we can most easily follow in all its stages the change from the red tint of the phlegmasiæ to a deep black, like ebony or Indian ink, through the successive tints of grey, slate-colour, brown, and blackish. As to the black concretions situated under the internal tunic, they present no more traces of organization than any of the rest of the melanic masses that have been examined. There is nothing to be seen but a black, homogeneous mass, which sometimes breaks down readily enough under the finger, and sometimes offers a much greater resistance. I once saw one of these concretions which resembled a small calculus in hardness, and differed from it only in its colour, being black. I greatly regret it was not analyzed, since it

might have been found to consist of a combination of melanic colouring matter and phosphate of lime.

I do not know any instance of melanosis having been found in the parietes of the veins. There is, however, a very remarkable fact which has been already noticed by Breschet and Cruveilhier, and which I think I have ascertained myself; namely, the occasional presence of a black matter, or, in other words, of a more or less fluid melanic matter, in the cavity of the small arterial and venous vessels. It is not merely the parietes of the vessels that are tinged black; for sometimes, according to the account of the two able observers above mentioned, there can be seen in the interior of the vessel perfectly distinct black globules, capable of being displaced by pressure. Lastly, in the case observed by Dr. Halliday already cited, in which there was melanosis in several organs at once, we are informed that minute drops of a black matter were observed in the course of the vessels of the base of the brain, and of the choroid plexus, as if they had been deposited there by exhalation. In the lungs, especially when affected with melanosis, I have often seen on the surface of the pulmonary lobules, or in the interlobular cellular tissue, black lines, quite distinct from the surrounding tissue, and exactly

resembling small blood-vessels, except in colour. In these different cases, is the colouring matter constituting melanosis conveyed in vascular canals to be deposited on the surface or in the parenchyma of the organs?

The osseous tissue has been seldom found affected with melanosis. One of the most remarkable instances of melanic colouring of the bones that has been published, is that recorded by Mr. Halliday, in the English periodical already cited. The individual who is the subject of the case was affected with melanosis in several organs; but, besides that, the whole sternum, the anterior part of the ribs, and the greater portion of the parietal and occipital bones were uniformly tinged black. These bones had also become more brittle than in the natural state : their periosteum presented no appreciable alteration.

We have not as yet had any detailed account of an instance of melanosis being seated in the fibrous or cartilaginous tissues. M. Breschet merely says, in his memoir on this accidental production, that the fibrous system also may be affected with melanosis; and he adds that this occurs especially in that portion of it connected with the muscles. The English author already cited, Mr. Halliday, mentions, in a very vague manner, his having found small black tu-

mours on the dura mater. Lastly, Professor
Dupuy told me that he has frequently observed,
in oxen, a black tinge in part of the dura mater
that envelopes the spinal cord.

Several authors have spoken of melanic
masses being found in the muscles; but these
masses had not involved the muscular fibres
themselves, but only the cellular tissue uniting
them.

A remarkable case of melanosis infiltrated
into the proper tissue of the muscles has been
related by MM. Trousseau and Leblanc. In a
white horse which had a melanic tumour on the
perineum, some of the muscular masses at the
posterior part of the thigh were found to be
much paler than in the natural state : inferiorly,
they became insensibly confounded with the rest
of the muscles proceeding from the ischion to
the tibia ; on the contrary, advancing upwards,
they grew paler and paler, the cellular tissue
uniting their fibres became of a greyish colour,
and, at last, the muscular fibres themselves,
which had become harder and more coherent,
and capable of grating under the knife, assumed
a tinge of the deepest black, and in this state
proceeded to their attachment at the ischion ;
still, however, preserving their fibrous appear-
ance. Their tissue was dry, and exceedingly
difficult to break down ; the tendons and apo-

neuroses had alone escaped the melanic infiltra-
tion ; and the ischion itself was tinged black to
a great depth, and was remarkably friable.

Of the muscles of organic life, the heart
alone has been found in a state of melanosis.
M. Breschet once found several melanic masses
in the substance of its parietes. I am not
aware of there being another instance of the
kind on record.

The different parenchymatous tissues are
not all affected with melanosis with equal fre-
quency. Thus, it is often found in the lungs,
but has never been observed in the brain,
although the latter, in its healthy state, presents
in certain parts a black colour, which might be
denominated *natural melanosis*.

I have already spoken of melanosis of the
lungs, in which this affection certainly appears
much more frequently than in any other organ.
It may occur either without any change in the
ordinary consistence of the lungs, or along with
an increase of that consistence. In the first
case, Laennec has classed it apart from melano-
sis strictly so called, and given it the name of
black pulmonary matter. I have mentioned be-
fore my reasons for not admitting this distinc-
tion.

The black tinge of the lungs, *without* increase
of their consistence, may occur while they con-

tinue perfectly healthy in every other respect. Sometimes it exists only in the interlobular cellular tissue, and in such cases we often observe the most of the pulmonary lobules exactly circumscribed by black lines which mark their limits; sometimes, again, the melanic tinge attacks the lobules themselves, and appears there in form of points or spots of greater or less extent. Properly speaking, it cannot be considered as constituting a morbid state.

The black tinge of the lungs, *with* increase of their consistence, is, in most cases, as I have already attempted to prove, merely the same as that described in the preceding paragraph, accompanied by a morbid induration which is completely independent of it. In other words, the lungs, when in a state of chronic irritation, become tinged with black, just as happens with the intestine, which, under the same circumstances, passes gradually from the red to a brown or even blackish tinge, which often pass into each other by such insensible gradations that it is impossible to tell where the one ends and the other begins. Is it not, then, equally impossible to assign at what shade the accidental tissue termed melanosis begins?

It is easy to enumerate the cases of melanosis in the liver that have been hitherto observed. It has been seen there as yet only in

the form of masses of greater or less size. A
case of this description, which we owe to La-
ennec, has been cited by M. Ferrus. (*Diction-
naire de Medecine*, vol. ix. p. 213.) Another
very interesting case of melanosis of the liver
has been published by M. Chomel, in the third
volume of the *Nouveau Journal de Medecine*.
I shall here give a sketch of its principal fea-
tures. The subject was a dancing master, aged
fifty-two, who died in the last stage of marasmus.
The liver filled the greatest part of the abdomi-
nal cavity; above, it thrust up the diaphragm
to the fifth true rib, and it extended below to the
right iliac region; it weighed fourteen pounds
seven ounces, French measure. Through its
substance were scattered certain whitish tumours
capable of being extracted from their bed by
pressure (" *enucléables*") and presenting all the
characters of schirrhus. There were besides,
in many parts of it, other tumours, which were
as it were embossed, and hard and expressible
like the first mentioned: some of them were
of a fine black colour, others only of a deep
grey. The largest of these tumours was of the
size of a hen egg; the rest were mostly of the
size of a filbert. Through the liver were also
scattered small black points, which, mixed
through its own dull red, gave it a mottled

appearance. The bladder and biliary ducts were filled with bile.

Melanic masses have also been found in the breasts, where they seemed to occupy the cellular or adipose tissue situated between the granules composing the gland, rather than the gland itself; in the thyroid body, and in the uterus; and, lastly, very frequently in the ovaries. The small black tumours observed in these last mentioned organs deserve our particular attention, because their habits and the different appearances they present may serve to throw some light on the nature of melanosis. We often find in one or more points of an ovary one or more small cavities containing a little effused blood, which is in the fluid state, and is sometimes red and sometimes brown. The parietes of these cavities are lined with a blackish layer, which is evidently nothing but coagulated blood, which has assumed a deeper tint merely in virtue of its coagulation.

But, in other ovaries, the blood contained in similar cavities is found to have lost its fluidity and to be completely coagulated; in many cases, it has become merely a little bit of whitish fibrine, and one would be inclined to say at first that the colouring matter had been absorbed; but it is found deposited on the parietes of the cavity in form of a pulpy layer, of a red, brown or

black colour. In other cases this kind of separation of the elements of the blood does not seem to have taken place; and the whole cavity is occupied by a blackish clot, which in some parts assumes a greater degree of consistence, and is gradually transformed into a very hard, black concretion. We not unfrequently observe beside or around such a concretion a fine yellow colour similar to that which is found on the parietes of certain collections of extravasated blood in the brain.

We can clearly follow, in these different cases, the remarkable modifications the blood may undergo, when, after having escaped from its natural channels, it remains for a longer or shorter time effused in the midst of the living tissues. A period arrives when it becomes so very unlike itself, that it may well be asked if the new appearance it presents is not the result of a real creation of new elements which did not exist in the blood at the moment of its extravasation. Be that as it may, in the case before us there very evidently results, from some such modification, a production of a black colour, and greater or less degree of hardness, exactly similar to those which, in other organs, constitute melanosis.

The lymphatic ganglions of the different parts of the body are pretty frequently tinged black; the frequent occurrence of this in the

bronchial ganglions in particular, and the hypotheses by which it has been attempted to account for it, are well known. Melanosis of the lymphatic ganglions is usually accompanied by a more or less notable augmentation of their volume. Writers have spoken of enormous melanic masses found in the pelvis and in front of the vertebral column, and have described them as formed by an agglomeration of strings of black hard bodies : I have sometimes seen these masses, and am convinced that they proceeded from the obstruction and black induration of the numerous lymphatic ganglions situated in the course of the principal vessels proceeding to the receptaculum chyli. In fact there were some of these bodies which, being not yet black, exactly resembled lymphatic glands ; in others the black tinge appeared only in points or isolated spots. In like manner, an accurate dissection leads to the conclusion that a great many encephaloid or tuberculous masses in the mesentery are also seated in the lymphatic ganglions.

Melanosis may either exist alone in an organ, or be combined with other accidental productions. We often, for instance, observe it in combination with the scirrhous or encephaloid tissues, in the liver, stomach, breasts, and testicles. Dr. Rouzet has recorded a case of an ulcerated cancer of the breast, from which there

used to flow a fluid as black as ink ; and per-
haps the melanic masses already described as
found by M. Chomel in a scirrhous liver, were
merely scirrhous tumours tinged with melanosis.
It is also combined sometimes with tubercle, but
it does not give it a uniform tinge, and generally
appears in isolated points, spots, or irregular striæ.
I once found in a person who had died of phthisis,
several pulmonary calculi speckled with a mul-
titude of small black points.

Melanosis, like tubercle and cancer, may at-
tack a greater or less number of organs at the
same time in the same individual. In Dr. Halli-
day's case, already mentioned, it existed simul-
taneously in a great extent of the subcutaneous
and intermuscular cellular tissue, in the perito-
neum, pericardium and pleura, ovaries, sternum,
and in the bones of the cranium. M. Alibert
saw a case in which it affected the skin, the
cellular tissue of the different parts of the body,
the mediastinum, the mesentery, the omentum,
a great number of lymphatic glands, the thy-
roid body, and the lungs, all at the same time.
(*Nosologie Naturelle*, vol. i.) Lastly, in the in-
dividual whose case was published by Chomel,
(*loc. cit.*) the liver, the lungs, and the cellular
tissue at the bottom of the orbit, were affected
with melanosis.

Melanosis has been observed at all ages. I

found a very marked black induration of the whole superior lobe of the left lung, in a girl of nine years of age, that died at the *Hôpital des Enfans,* under the care of M. Jadelot. At *La Charité,* I have frequently observed this same black pulmonary induration in persons who had not reached their thirtieth year. However I may safely assert that it is in old men that chronic pneumonia is most frequently accompanied with this black tinge; as if the disposition to the formation of tubercles, so marked in youth, was subsequently replaced by a disposition to the secretion of melanic matter.

Melanosis is not an affection peculiar to man : it has, like the other accidental productions, been found also in several animals, in which it attacks the same organs as in man. It has been most frequently observed in the horse; probably, not because it is most common in that animal, but because it has been studied with more attention there. The lymphatic ganglions are the parts that seem most subject to the affection. In a glandered horse, I once found the submaxillary lymphatic glands greatly indurated, increased in size, and of a fine black colour. Now, we know that these glands are almost always in a state of chronic irritation in cases of glanders; so that there was here probably nothing but an ordinary ganglionitis, ac-

companied with an accidental deposition of co-
louring matter. In another horse, I found some
groups of lymphatic ganglions in front of the
bodies of the vertebræ, in a state of obstruction,
and as black as charcoal. M. Gohier, Professor
at the veterinary school at Lyons, has found in
the horse melanic masses in the substance of the
parietes of the heart, in the lungs, the spleen,
and even in the interior of the spinal canal.
M. Rodet, a veterinary surgeon, has seen in a
horse six years old a black induration of more
than one half of one of the parotid glands. The
same horse had a considerable melanic tumour
around the margin of the anus, and the bron-
chial ganglions were also black. He likewise
found in a glandered mare another, very re-
markable, kind of melanosis, seated in one of
the eyes : the space usually occupied by the vi-
treous humour was filled with a fluid as black
as Indian ink, in which floated equally black
clots. The crystalline lens, which adhered
strongly to the posterior surface of the iris, was
of a deep yellow colour, and in some parts, even
brown.*

It is a very remarkable circumstance in the
history of melanosis as affecting the horse, that
it is particularly in white or dapple grey horses

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* *Journal de Medicine Veterinaire,* by M. Dupuy, vol. ii. page 273.

that this accidental production has been ob-
served ; as if the colouring matter, not being
secreted in the integuments, was formed in a
more or less modified state in the internal or-
gans. But perhaps we have been too hasty in
generalizing this fact : at least it is certain that
it is not without exceptions. M. Rodet has
published (*loc. cit.*) some very interesting cases
of melanosis in horses of all colours ; and I have
myself found it in bay horses.

The other animals in which melanosis has
been observed, are, according to M. Breschet,
the dog, the cat, the rabbit, the mouse, and the
rat.

The symptoms to which this affection gives
rise, have nothing peculiar about them. They
appear to depend, 1. on the chronic irritation
which so often accompanies it, whether as cause
or effect ; 2. on the simultaneous existence of
other accidental productions ; 3. on the uneasi-
ness mechanically produced by its presence in
more or less voluminous masses, from its com-
pressing, like any foreign body, the parenchyma
of the organ in which it is developed. When
none of these three circumstances occurs, mela-
nosis may arise and become developed in a tis-
sue, without its existence being revealed by any
symptom, any morbid phenomenon local or ge-
neral.

SECOND SPECIES.

CIRRONOSIS.

IT has long been remarked that yellow spots sometimes appear either on the skin, or in other membranous or parenchymatous tissues ; and the learned Professor Lobstein, of Strasburg, has lately observed in several embryos a very marked golden yellow tinge in different parts. He has given to this singular affection the name of cirronosis, (from κιρρος, *yellow.*)

The serous membranes of the cranium, of the thorax, and of the abdomen, the spinal cord, and the two cords of the great sympathetic, are the principal parts in which M. Lobstein has found this affection. None of the fœtuses in which he found it were fully grown : one of them was but three months old ; and several others had reached the fifth month of their intra-uterine existence. (*Repertoire d' Anatomie Pathologique,* vol. i.)

It appears to me that cirronosis differs only in situation from the disease long known by the name of *icterus infantum* or *neonatorum,* in which it is any thing but proved that the yellow tinge of the skin is owing to the bile.

SECOND CLASS.

MORBID SECRETIONS SUSCEPTIBLE OF ORGANIZA-
TION.

I have already pointed out the nature and character of the substance denominated fibrine, and shown how it proceeds from the blood, one of whose constituents it is, and how it is capable of becoming organized and of preserving its vitality wherever deposited. We have seen how a small portion of it may become vascular and be transformed, sometimes into a tissue resembling one of the natural ones, and sometimes into a production equally endowed with life, and possessing a regular structure, but yet without any thing analogous to it in the natural state. We have now to study this organizable substance more in detail, and consider it in all its different situations, whether on the surface or in the texture of the various parts of the body.

FIRST ORDER.

ORGANIZABLE PRODUCTIONS DEPOSITED ON SURFACES.

These may occur either on the different natural surfaces, or on the accidental surfaces,

such as those formed in every organ that has undergone a solution of continuity with or without loss of substance.

FIRST GENUS.

ORGANIZABLE PRODUCTIONS DEPOSITED ON THE NATURAL SURFACES.

These are to be considered as occurring, 1. on the serous membranes ; 2. on the tegumentary membranes ; 3. on the internal membrane of the vessels.

FIRST SPECIES.

ORGANIZABLE MATTER OF THE SEROUS SURFACES.

The numerous varieties of form which this substance presents, have been long known by the name of *false membranes*. In fact they often bear a very great resemblance to the natural membrane which they line ; and, in all cases, they are the seat of a process set up for the purpose of bringing them, by a series of transformations, to a state in which they shall resemble either a serous membrane or its subjacent cellular tissue.

The substance constituting the false membranes of the serous cavities has long been considered as essentially albuminous in its nature.

Albumen, however, is not, like it, capable of coagulating spontaneously; which alone was sufficient to warrant a suspicion that the opinion was erroneous. It has since been actually demonstrated that every false membrane of the serous cavities is composed of two parts: one, concrescible and plastic, formed of fibrine; the other, fluid, and contained in the cells of the former, formed of albumen. M. Lassaigne has thus described the concrescible part: " This substance was not soluble in cold water, which merely deprived it of a small portion of albumen; boiling water caused it to shrink; boiling alcohol also made it shrivel up, and dissolved a little fatty matter, and some chloride of sodium; when immersed in acetic acid diluted with thrice its weight of water, it swells, becomes transparent, and is converted by a gentle heat into a mass soluble in water."

The organizable matter of the serous cavities at first appears as a soft substance, without form, organization, or structure. It is sometimes deposited in a shapeless layer on the serous membrane, and sometimes it floats in the more or less limpid fluid that has been secreted along with it. In other cases, it appears in several points at once, in the form of small globules studding the serous membrane, and giving it a wrinkled appearance. Before it has been yet

organized, we see it adhering to the opposite surfaces of the serous membranes, and, in order to keep its hold, following them as they glide over each other, and drawing out like a soft paste into filaments, lamellæ, or cords. It sometimes disposes itself regularly enough, and forms on the serous membrane numerous papillæ symmetrically arranged, or else assumes a reticulated appearance. It is a remarkable circumstance that the false membranes often display great regularity in the arrangement of their particles, even before they have assumed any manifest characters of organization. In general they present an assemblage of areolæ or cells whose parietes are formed by filaments intersecting in every direction, and which contain a fluid that may be expressed by a slight pressure.

The false membrane, whatever be its form, gradually becomes denser and more resisting, and at the same time the quantity of serum contained gradually decreases ; it adheres more and more closely to the serous membrane, and, at last, exhibits a phenomenon which has long attracted particular attention ; namely, its becoming injected with blood. Now the question is, how that fluid comes there : whether it is absolutely formed in the false membrane, or brought there by the vessels of the serous membrane, which shoot into it. Those who maintain the

first opinion compare these false membranes to the membrane of the yolk, in which both blood and vessels are likewise created. They also bring forward cases in which there are found in false membranes greater or less numbers of small red points, isolated from each other, which appear like so many small drops of blood deposited in the substsnce of those membranes. These points are not as yet lodged in vessels; by little and little they shoot out into lines or streaks, around which vascular parietes become developed, and at last, these newly formed vessels open into, and become continuous with, those of the serous membrane. On the other hand, those who maintain that the vessels of the serous membrane shoot into the false membrane, consider the scattered red points found in it as coloured globules swimming in a colourless fluid contained in a vessel; and assert that they have absolutely followed this prolongation of the vessels from the serous to the false membrane. M. Gendrin has lately adduced some facts in support of this opinion. He says,* that " at the points where the natural and the newly formed membranes adhere most intimately, the serous surface is red and rugose; the redness and rugæ are arranged in a dotted manner; the serous surface, when examined with a magnifier, is found to be

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* *Histoire Anatomique des Inflammations,* vol. ii. page 551.

really covered with small red vascular asperities, in which, with the aid of a strong magnifier, or, still better, of a microscope, we can see red capillaries terminating, which are distended at the points corresponding to those papillæ; the false membrane presents small red spots which evidently correspond to the rugæ, each of which, at each of the points, penetrates slightly into the substance of the plastic matter; for we find by the magnifier that the little spots in this matter are infundibuliform, and that the parietes of the little infundibula are lacerated. On examining with the microscope a small portion of false membrane that has reached this stage, we find that each of the small red infundibula serves as a base to one or two, and sometimes even three, yellowish, flexuous streaks, that take their course on the adherent surface of the membrane.

"It is more easy to distinguish these first rudiments of vessels, when their formation is a little more advanced. The rugæ of the serous membrane then become more strongly marked; and we can ascertain directly that they are nothing but vessels shooting into the false membranes."

I shall not attempt to discuss the facts that have been adduced in support of the two opinions; for I believe them to be all true. In

fact, after the knowledge that has recently been acquired respecting the capillary circulation, it is idle to inquire how and where the vessels of the false membranes take their rise. Either in the organizable matter, or in the points where it adheres to the serous membrane, or in that membrane itself, there must begin to move some globules, which, after proceeding in various directions, and tracing out passages for themselves, shall end by falling into currents already long established. For these phenomena to take place, it is sufficient that an impulse of vitality shall have been given to the organizable matter. This impulse once given, sanguineous currents must be established in it in all directions ; some arriving from the surrounding tissues, and others proceeding from its own substance, and hastening to join the old currents existing around it. There is, then, nothing contradictory in the facts detailed above ; but, in my opinion, they have been ill understood, and wrongly interpreted, from a desire to explain the phenomena of the capillary circulation by those of the great arterial and venous circulation.* Thus, in a false

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* For the better understanding of what has been said, I beg to refer the reader to the note at page 469 of this volume, and, what he will find still more satisfactory, to a very interesting work by Dollinger, on the circulation of the blood, translated in the ninth volume of the *Journal des Progrés des Sciences et Institutions Medicales.*

membrane we may and ought to find, 1. some blood not contained in vessels, arranged in dots or lines, and formed in the false membrane or coming from the serous membrane ; 2. vessels that do not communicate with those of the surrounding tissues ; 3. others which do communicate with them. Moreover, according to the case, one or other of these dispositions may predominate ; but they all can occur, and so far are they from being inconsistent with each other, that the existence of any one of them infers that of both the others.

The period at which the false membranes become vascular is very variable : they are sometimes traversed by multitudes of vessels in only twenty-four hours after the commencement of their formation ; in other cases, there is not the slightest trace of vascularity at the end of several months.

One of the most remarkable instances of the rapidity with which vessels can be developed in a false membrane, is the case related by Home. A man whom he had operated upon for strangulated hernia died in twenty-nine hours afterwards, having been for the last five hours of his existence without any perceptible pulsation. Upon opening the body, there was found on the strangulated coil of intestine a false membrane so very vascular, that both an artery and a vein

were demonstrated in it by injection. Now these were not formed till after the operation; since, at that time, the same portion of intestine did not present, upon examination, the slightest trace of a false membrane on its surface.

In a longer or shorter time after the establishment of a circulation in the false membranes, they are observed to lose the red colour they had on first becoming vascular. Their vessels become less apparent, and colourless, and the false membrane, whose organization may then be considered complete, assumes the exact appearance of a natural serous membrane, or of a portion of cellular tissue. At this stage, the false membranes can no longer be considered as belonging to the morbid state; they no longer occasion any disorder in the functions, nor excite any morbid sympathy. In how many subjects, for instance, do we find numerous adhesions between the pleura costalis and pulmonalis, without there having been any sign of their existence during life. More than once, too, I have found the circumvolutions of the intestines united by cellular adhesions, although during life the abdomen had been long free from any pain, or functional derangement.

Thus, there are three states through which the organizable matter of the serous membranes

passes in succession.   In the first state, it is an amorphous substance, without trace of organization, and presenting no constant character except spontaneous coagulability.   In the second, it appears on its way towards organization, and it is then the sanguineous currents become established in it.   In the third, its organization is complete, and it has acquired all the properties either of the cellular tissue, or of the serous membranes.   In the second and third states, it may become the seat of various morbid changes.   For instance, it often falls into a state of hyperæmia ; in other cases, it produces new false membranes in its turn, exhales blood, or secretes pus, tubercle, or melanosis.   Lastly, through a modification of its nutritive action, it may undergo various transformations ; as for instance, into the fibrous, cartilaginous, or osseous tissue.

Some facts would lead us to conclude that the false membranes of the serous cavities may be absorbed, and disappear, after having existed for a certain time.   Thus, M. Ribes observed that sometimes there was no trace of false membranes in the peritoneum to be found in the bodies of invalid soldiers, who had received penetrating wounds of the abdomen a long time before death.   Beclard had an opportunity of examining the body of a madman, who at differ-

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ent periods of his life had given himself up-
wards of a dozen stabs of a knife in the abdomen.
In the situation of the most recent wounds the
parts were united by false membranes of consi-
derable size. Beneath the scars of longer stand-
ing, in place of the false membranes, he found
merely slender cellular fræna; and lastly, in the
parts corresponding to the oldest wounds, there
was no trace whatever of adhesion or of false
membrane. The following fact, observed by
M. Dupuytren, appears also very well suited to
demonstrate the possibility of the disappearance
of adhesions of the serous membranes. " An
artificial anus, through which the fæces passed
only for the space of twelve days, was formed in
the groin of a woman who had a femoral her-
nia. The woman died in seven months after-
wards; and on opening the body it was found
that the whole coil of intestine that had been
the seat of the accidental opening, and that was
expected to be found adhering to the cicatrice,
was four or five inches from it. A cellular co-
lumn resembling the isolated adhesions of the
splanchnic cavities, broad at its extremities, and
narrow and almost filiform in the middle, ex-
tended from the cicatrice to the coil of intestine,
with the interior of which it had no communi-
cation."*

* Consult on this subject an excellent article by M. Villermé, in the *Dic-
tionnaire des Sciences Medicales,* vol. xxxii.

SECOND SPECIES.

ORGANIZABLE MATTER OF THE TEGUMENTARY SURFACES.

A substance capable of coagulating spontaneously is sometimes deposited on the free surfaces of the mucous and cutaneous membranes, as well as on those of the serous. It has been chiefly observed under the following circumstances: 1. extending in a membraniform layer over a portion of mucous membrane in a state of irritation ; 2. uniting more or less closely two opposite surfaces of a mucous, or cutaneous membrane, that have been accidentally placed in contact.

The chemical composition of the substance that forms the membraniform layer is not as yet well known ; it is neither mucus nor albumen, these two principles not being susceptible of spontaneous coagulation ; at least, not in their natural condition. Its tendency to organization is much less marked than that of the coagulable matter of the serous surfaces. In general we find on the surface of the mucous membrane nothing but a white or grey layer of solid matter of variable thickness and consistence. It is as it were applied to the surface that has secreted it, and may be detached from it in large shreds, without any laceration in the tissue of

the membrane itself. In some cases, there is secreted beneath the pseudo-membrane a more fluid substance, of a serous or purulent nature, which produces its detachment. In others, it gradually becomes thinner and thinner, is reduced to a transparent pellicle, and finally disappears as if it had been gradually absorbed. In all this, there is generally no trace of organization to be detected. Indeed, we have scarcely any cases that prove that vessels have been observed in the pseudo-membranes of the mucous surfaces. I have myself so often sought for them in vain, that I should have been induced to deny their being ever found there, were it not that a gentleman upon whose observations we may place the greatest reliance, M. Guersent, has recorded some cases, in which he saw vessels ramifying in the false membranes of croup, and anastomosing with those of the mucous membrane.

But if this spontaneously coagulable matter has so little tendency to become organized, when extending as a membrane on the surface of the mucous tissue, the case is very different when it is secreted between two surfaces of mucous membrane or of skin that happen to be accidentally kept in contact, and that are at the same time in a state of irritation. Under such circumstances, a close adhesion takes place be-

tween the two surfaces, and if we examine the
nature of the substance that unites them,
we find it composed sometimes of a dense cel-
lular tissue traversed by more or less numer-
ous vessels, sometimes of a true fibrous tissue,
and lastly, sometimes of a tissue of new forma-
tion which has a more or less perfect analogy
with the mucous or cutaneous tissue it serves to
unite. Here we observe the same develop-
ment, the same stages of organization as in the
adhesions of the serous membranes. The vagi-
na, uterus, fallopian tubes, ureters, and biliary
ducts, are the parts where such adhesions have
been most frequently observed. It is not un-
common to find two or more fingers thus united
after a burn. M. Gendrin saw a case of adhe-
sion between the skin of the cranium and the
external ear.* It took place by means of a very
close cellular tissue, adhering strongly to the
skin, which itself appeared to have been con-
verted, where the adhesion existed, into a lami-
nated tissue of great density.

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* *Op. cit.* vol. ii. page 528.

THIRD SPECIES.

ORGANIZABLE MATTER OF THE VASCULAR SURFACES.

Whenever the circulation ceases to be kept up in a vessel, the internal surface of that vessel tends to become the seat of an exhalation producing that same organizable matter of which we have already followed the formation on the serous, mucous, and cutaneous surfaces. By this means, the different points of the internal surface of the arteries or veins adhere to each other, and the vessel becomes obliterated. I content myself for the present with merely pointing out this remarkable fact, to which I mean to return hereafter, when we come to consider the *Diseases of the Circulatory Apparatus.*

SECOND GENUS.

ORGANIZABLE PRODUCTIONS DEPOSITED UPON ACCIDENTAL SURFACES.

When any tissue has suffered a solution of continuity, from both surfaces of the wound exhales a matter which, like those we have just examined, becomes solid, organized, and vascular, and is thus converted into a genuine tissue.

Sometimes the new tissue is exactly analogous to the divided one; sometimes it merely approaches more or less to it; and lastly, it sometimes continues in the state of a cellulo-fibrous texture. It is this transformation of a plastic matter into a tissue more or less analogous to the divided tissue, that constitutes cicatrization. As for the rest, we could but repeat what we said in speaking of the false membranes of the serous cavities, if we attempted to describe the manner in which it becomes organized; as the phenomena are the same in both. When treating of the diseases of the several organs, I shall point out the peculiarities that each of them presents, in the efforts made by nature to repair the solutions of continuity it may have suffered. I shall only say at present that the process is similar, and the commencement the same in all; it is uniformly a secreted matter that becomes solid and organized. The difference lies in what succeeds to this first process: the cellulo-vascular texture, when once formed, becomes subject to different transformations, which vary with the nature of the tissue to be repaired.

It is this same spontaneously coagulable and organizable matter, that is deposited on the internal surface of the parietes of certain accidental cavities. There, also, vessels are developed, and different tissues produced. A fibrous or

serous tissue, for instance, is often produced in such situations ; or else a tissue approaching more or less to the nature of the mucous tissue. It may, however, be difficult to distinguish whether the principal part in the formation of these new productions belongs to a plastic matter deposited there, or to the cellular tissue, which, having deviated from its natural mode of nutrition, is transformed into other tissues. (See, above, the article on the transformations of the cellular tissue.)

The deposition of organizable matter in the interior of accidental cavities, is followed, according to the case, by two different results. 1. It may produce a membraniform layer, varying in its nature, that shall line the parietes of the cavity. 2. It may be so disposed as to give rise to the formation of adhesions tending to unite the different points of the surface of the cavity, and thus gradually produce its obliteration. Thus, around a coagulum of blood in the brain, there is first a serous cyst formed ; the newly formed serous membrane then absorbs the coagulum ; this done, a little serosity is exhaled into the cyst for a certain period ; and at last its parietes approximate, touch, adhere, and the whole cavity disappears.

SECOND ORDER.

ORGANIZABLE PRODUCTIONS DEPOSITED IN THE SUBSTANCE OF THE VARIOUS PARTS OF THE BODY.

These productions, infinitely varied as they are with respect to their physical appearance, have all as a common character either a tendency to become organized or an already existing organization. Amidst the numerous varieties of figure, size, colour, and consistence, which they offer, all that seems particularly worthy of notice may be reduced to what follows.

Some of these productions are of a homogeneous texture, and on cutting into them, there is nothing found in their interior but a substance of the same appearance throughout. This substance sometimes resembles a portion of fibrine that had been long coagulated, and deprived more or less completely of its colouring matter; sometimes it is much harder, being of the consistence of fibrous tissue or cartilage, and bearing a pretty close resemblance to the substance of a turnip. In other cases, its consistence is much less, and, properly speaking, it cannot be said to be solid; still, however, it is not completely fluid, but resembles a piece of

cerebral pulp, softened by putrefaction or pro-
longed trituration.

In others of these productions, the texture
is found to be heterogeneous ; that is to say,
their component particles are not all of the same
nature, or, at least, have not all the same ar-
rangement. Their structure is sometimes fila-
mentous, and sometimes areolar ; in other in-
stances we find them presenting lobes or cells ;
and, lastly, in others, different kinds of canals af-
fording a passage to fluids. Indeed, in almost
all of them, there is a mixture of solids and
liquids.

The liquids entering into their composition
may be either white, colourless, or more or less
like the serum of the blood. In other cases
they are coloured, being in fact regular blood
that is formed in these productions, just as we
have already seen it formed in false membranes.
It is not uncommon to find at the surface or in
the interior of these productions (whatever be
their texture) certain red points, isolated from
each other, and resembling spots of blood laid
on with the tip of a pencil. On other occasions,
we observe irregular red streaks, in which case
the blood does not appear to be as yet con-
tained in any vessels. These streaks frequently
intersect each other, leaving in their intervals
areolæ of various sizes and shapes. At last,

there appear true vessels, which may be isolated from the mass they traverse, by submitting it to a very gentle trituration, or a slight washing. When thus separated, they sometimes resemble a network of very fine hair dyed red. In some cases, they may be seen opening into the vessels of the surrounding parts ; but, in others, this inosculation cannot be detected, and we see well formed vessels with very distinct parietes, gradually losing their vascular character and becoming confounded with the reddish streaks or the irregular spots above described.

Either before or after the formation of these vessels, it may happen that the blood is deposited in such considerable quantities in the morbid production as to produce a real hæmorrhage. We then find in its interior one or more collections of blood, like those, for instance, that are found in the brain after an attack of apoplexy : the effused blood may be either fluid or coagulated. Instead of being collected into circumscribed masses, the blood sometimes infiltrates the whole of the morbid mass, which then presents throughout a reddish tint of greater or less depth, and is often reduced, in some parts, or in its whole extent, into a kind of pulp or pap something like the red matter contained in the cells of the spleen when in a peculiar softened state.

We are justified, then, in admitting that the morbid productions under consideration are possessed of vitality, since they have the power of forming blood, and since passages for this blood are opened in their interior. If they are endued with life, they must be capable of absorbing and secreting, as also of growing, not by juxta-position, like tubercle, but by a true intus-susception. Lastly, being possessed of life and organization, like the false membranes of the serous cavities, they must, like them, be susceptible of irritation and congestion, and of producing various morbid secretions, such as pus, tubercle, saline or colouring matters, &c.

At an uncertain period after their formation, these productions begin to experience the effects of that law by virtue of which the animal œconomy must make efforts to get rid of every foreign matter that may be injurious to it. The surrounding parts, as well as the morbid mass itself, take on them a state of irritation ; then commences a process of elimination, which effects the destruction of the morbid mass. After this has been absorbed or expelled, the ulcer which occupies its place sometimes heals with greater or less rapidity ; but, too often it continues, or extends more and more: too often, also, the disposition that had caused the formation of the morbid production, is not destroyed by its

removal, but produces another of the same kind either in the same place, or in other parts of the system. Indeed, one of the most remarkable features in the history of these productions, is the tendency they have to occur in a great many organs at once. It is often at the very period when one begins to be eliminated, that others begin to be deposited elsewhere. In other cases, it is only after the removal of one by the knife, that this singular multiplication of the affection commences.

The symptoms attendant on morbid productions of this class may be arranged, with respect to the general features they have in common, in the following series.

The first series depends simply on the development of the morbid production in the midst of a living tissue, and on the amount of vital energy consumed in this development. From thence sometimes arise some local symptoms, such as pain of different kinds and degrees of intensity ; sometimes there is a complete absence of local symptoms, and merely an alteration in the general nutrition, gradual loss of flesh and strength, and some erratic paroxysms of fever. In some cases, it is impossible to discover the origin of this deranged state of health.

The second series takes its source from the

various pathological conditions to which the morbid production itself is subject. If, for instance, it happens to be in a state of irritation and congestion, we may observe during that time either an unusual pain, a febrile reaction, or different nervous derangements.

The third series is connected with the state of the parts around the morbid production. According as they continue healthy or become diseased, according to the degree and nature of the affection, and according as it is acute or chronic, continued or intermittent, we observe different groups of symptoms that do not belong to the morbid production itself. It is of importance not to lose sight of this circumstance, as the practical consequence to be drawn from it is, that when such symptoms appear, we may attempt to combat them, without seeking directly to modify the production itself.

The fourth series begins to appear when the eliminatory process is going on, and consequently when the morbid production is near being removed. At this period the local pains commence or increase, a constant febrile excitement prevails, a considerable decay takes place, and, lastly, the blood, being modified in its composition, gives the skin that peculiar yellowish tinge that has been considered as characteristic

of the state called by authors the *cancerous cachexy*.

The fifth and last series of symptoms occurs along with the ulceration that ensues upon the removal of the morbid production. They vary according as the ulcer tends to heal, or extends still wider, and according as the morbid growth is reproduced, either in the same place or else-where.

I have already said that, in the present state of the science, I considered it useless to attempt to designate by particular names the infinite variety of appearances that may be assumed by organizable morbid productions deposited in the texture of the various parts of the body. It is my business, however, in this place, to bring be-fore the reader some of the names that have been employed, and to explain how they were applied.

In some cases the organizable morbid pro-duction consists of a reddish flesh-like tumour, traversed by vessels more or less numerous. It cannot be better compared than to a portion of fibrine that had coagulated in a blood-vessel and become organized. This kind of tumour has been denominated by Abernethy *common, fleshy, or vascular* sarcoma. It sometimes contains cells with exceedingly vascular parietes, and filled with a serous fluid. In that case it is called by

Abernethy, *cystic sarcoma.* He has seen other cases, in which the newly formed substance, instead of presenting a uniform mass, was composed of granules, which resembled the structure of the pancreas in their arrangement. Accordingly, this kind has received from him the name of *pancreatic sarcoma.**

When the organizable morbid production appears as a greyish or whitish substance, without trace of vessels or of blood, and often divided into regular lobules by something like fibrous intersections, of sufficient hardness to grate under the knife, it is called *scirrhus.* I have said elsewhere, that scirrhus often appeared to me to be nothing but cellular tissue in a state of hypertrophy and induration ; but it is not the less true that in many cases of scirrhus there is more than mere induration, there being especially a deposition of a morbid matter that becomes solid and acquires a tendency to organization. Thus, according to my ideas on the subject, *scirrhus* is a tumour distinguishable by certain well marked physical characters, and that may depend on two kinds of morbid affections, 1. on a simple alteration of nutrition of the cellular tissue, and, 2. on a morbid secretion.

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* *Melanges de Chirurgie etrangere,* published at Geneva, vol. ii.

When a scirrhous tumour assumes a dead white tint, and blood-vessels appear in it, Laennec, instead of continuing to call it *scirrhus*, has given it the name of *encephaloid tissue in the crude state* ; an improper term, inasmuch as at this stage there is no resemblance between the substance in question and the cerebral pulp. Besides, we have no proof that the semifluid matter compared with great reason by Laennec to the substance of the brain, and denominated by him *encephaloid tissue in the state of softening,* but which, I think, might more properly be called *encephaloid matter,* can only occur subsequently to another stage in which it was hard and of a dead white colour.

The encephaloid is, in fact, one of the most marked varieties of the organizable morbid productions. It is characterized by its perfect resemblance to cerebral pulp that is just beginning to soften; and generally contains vessels, or, at least, some blood. It is found sometimes by itself, and sometimes in the tumours above described; but I know not any fact to prove that they are transformed into it. It is a substance deposited in the midst of another; not, as is asserted, one and the same production, that has passed from a state of crudity to a state of softening.

It is this same substance that has been described by some authors under the name of *medullary sarcoma.*

As to *fungus hæmatodes,* in my opinion, it is a generic term comprehending several morbid productions of different kinds. Thus we have already seen (page 218 of this volume) that the name of fungus hæmatodes is often given to a development of accidental erectile tissue. But the same name is also applied to tumours composed of sarcomatous, scirrhous, or encephaloid matter, especially the latter, of considerable vascularity, and with effusion or infiltration of blood in the interior. These are the same that have been also described sometimes by the name of *vascular sarcoma.* In order to prove the identity of those tumours, I shall content myself with transcribing the description given of fungus hæmatodes by Mr. Wardrop.*

" This morbid excrescence resembles in appearance the medullary substance ; it is chiefly formed of an opake, whitish, homogeneous substance, of the same consistence as the brain ; after having been for a short time exposed freely to the air, it becomes a diffluent pulp. The consistence of the tumour is not the same

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* *Dictionnaire des Sciences Medicales,* article, *Fungus Hematode,* by M. Breschet.

throughout ; the contained matter is sometimes like pap, and sometimes firmer than the firm part of a fresh brain. It likewise presents some varieties of colour. It very generally possesses both the colour and the consistence of the cerebral substance ; in some cases, part of it is redder and more like flesh ; lastly, in others, it might be taken for a *clot of blood*."

Now, is there not the greatest resemblance between this description of fungus hæmatodes, and that which has been given of encephaloid matter, by Laennec, and of medullary sarcoma, by Abernethy and others ?

I have now reviewed the principal varieties of appearance of the organizable morbid productions, without enumerating *cancer* among them ; neither have I included it among the other alterations of nutrition and secretion already treated of. Where then is cancer to be placed, and what is it ? In my opinion, cancer is not a distinct morbid alteration, but the name is applied to every lesion whether of nutrition or secretion, that has reached the period when it terminates in an ulcer constantly extending its ravages either in depth or surface. This metaphorical term, then, which like that of inflammation, belongs to the infancy of the science, expresses merely a termination happening in common to several very different kinds of alterations.

I imagine that no one at the present day can maintain, with Bayle and Laennec, that cancer is an alteration *sui generis*, characterized by the presence of the scirrhous and encephaloid tissues, isolated or combined. In fact, on the one hand, it is by no means unusual to discover both these productions in a subject, although during life there was no appearance of the symptoms which, according to authors, are attendant upon cancer; so that we have the anatomical characters of a disease without its symptoms. On the other hand, we often meet the symptoms attributed to cancer, in cases where dissection can discover no trace either of scirrhus or encephaloid. In fact, the preternatural development of a capillary network on the surface or in the texture of the internal or external tegumentary membranes; a determination of long standing towards a portion of mucous membrane, without any real change of texture; a small portion of that membrane, or of the skin, in a state of hypertrophy; a pimple or an excrescence on the mucous or cutaneous surfaces, formed merely by an expansion of the proper tissue of the membranes, without any trace of a new formation; the thickening of the cellular tissue; the infiltration of its meshes by an albuminous or gelatinous matter; the red or white induration of the lymphatic ganglions, which has no more

to do with accidental tissue than the red or grey hepatization of the lungs; these are all so many lesions, which, equally with encephaloid and scirrhus, may terminate in the destruction of the part in which they are developed, and in the production of an ulcer incessantly extending in every direction: all these lesions, though possessed of no anatomical character in common, may have this mode of termination in common; they all, in the last stage of their existence, become what is called *cancer*. The best way, then, for the practitioner to proceed, in the present state of the science, is to endeavour to ascertain from his past experience, whether such or such a lesion seems, from its mode of development, progress, or accompanying symptoms, local or general, likely to terminate in an ulcer which, instead of healing, will have a tendency to extend in every direction, and to destroy either slowly or rapidly all the surrounding tissues. Such a lesion, let him call *cancer*, not because it consists of such or such a morbid production, but because it tends to proceed to the termination above described, by producing in the system a general derangement proportioned to the severity of the local affection.

THIRD CLASS.

MORBID PRODUCTIONS THAT ARE ORGANIZED AND ENJOY AN INDIVIDUAL EXISTENCE.

ENTOZOA.

UNDER the generic term *entozoa,* have been designated the different living beings that are produced and developed within other living beings. The *entozoa* must be distinguished from the *ectozoa ;* that is to say, from those living beings that are also found in the bodies of animals, but that have been introduced there from without. Thus, insects or other animals may become lodged in the skin or under it, in the nasal fossæ and adjacent parts, and in the stomach and the rest of the alimentary canal. At certain periods of the year, for instance, the internal surface of the whole of the splenic portion of the stomach of the horse is found covered with immense numbers of small worms which adhere very strongly to it, even leaving in the place they had occupied a slight solution of continuity, when detached with violence. Now, these animals are not produced in the stomach, but are introduced into it in the state of eggs along with the food. The stomach of the horse is the

place assigned them by nature for their first metamorphosis, and after attaining in it their complete larva state, they leave it, pass into the intestine, quit the body along with the fæces, and having once returned into the open air, they pass from the form of a worm to that of the fly known to the naturalists under the name of *æstrus communis.*

Entozoa have been found in most animals. In the first place, they have been met with in all the mammalia from man down to the ceta-cea. The three other classes of the vertebrata are likewise subject to them; perhaps, indeed, there is a greater number of entozoa found in birds, reptiles, and fishes, than in the mammalia. The invertebrata have likewise their own ento-zoa; thus, they have been ascertained to exist in all the classes of insects : in these, however, it is but one species, the *filaria,* that is always found.

In all these animals, the entozoa have two distinct classes of habitations : 1. in the cavities ; 2. in the parenchyma of organs. Each of them has its own peculiar habitation ; thus the *ascaris lumbricoides* is never found but in the intestine ; the *strongylus* resides chiefly in the urinary passa-ges, the fluke *(fasciola hepatica)* in the liver, and the *filaria* in the cellular tissue, &c.

The entozoa assume three principal varieties

of form : some are cylindrical or fusiform ; others flat like a riband ; and, lastly, others are vesicular.

Their organization is very variable. There are some entozoa that consist of nothing but a parenchymatous mass, without any distinct cavity, or very perceptible organ. Others resemble simply a bladder filled with water. Besides such beings as these, whose rude and imperfect organization confines them to the lowest rank in the zoological scale, we find other entozoa possessed of a very evident muscular system, a complete alimentary canal, well developed organs of generation with distinct sexes, rudiments of a circulation, and apparently even some vestiges of a nervous system.

The entozoa have been classed by turns according to their habitation, their form, and their organization.

Linnæus chose to found his classification of the entozoa upon their difference of habitation, and divided them into two classes ; the first comprehending the worms that reside in the alimentary canal (*vermes intestinales*) ; the second, those residing in the substance of the different organs or tissues (*vermes viscerales.*)

Rudolphi* selected their form as the distin-

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* *Entozoorum, sive vermium intestinalium historia naturalis, auctore Rudolphi,* 3 vol. in 8vo.

guishing mark, and has arranged them in the five following classes.

CLASS I. Nematoidea. (νημα, *filum,* ειδος, *forma.*)

These have a cylindrical or thread-like form. Their structure is very complicated; they are furnished with a digestive apparatus with two orifices, and distinct genital organs.

The *ascaris lumbricoides, strongylus, oxyuris,* and *trichocephalus* belong to this class.

CLASS II. Acanthocephala (ακανθα, *spina,* κεφαλη, *caput.*)

These have a sacciform or utricular body, terminated by a retractile head armed with one or more proboscises and prickles. They are without any trace of an intestinal canal, but have distinct genital organs, and a difference of sex.

To this class belongs the *echinorhyncus,* found in the intestine of the hog.

CLASS III. Trematoda. (τρημα, *foramen ;* τρηματωδης, *foraminosus.*)

These have a flattened body, remarkable for the more or less numerous pores on its surface. According to the number of these pores they have been divided into *monostoma, distoma, te- trastoma, polystoma, &c.* They are without an intestinal canal, and have the organs of both sexes united in the same individual.

CLASS IV.   Cestoidea.   (κεστος, *cingulum,*
tænia, ειδος, *forma.*)

These are distinguished by their elongated,
flattened body, resembling a riband. It is
sometimes articulated and sometimes not. The
form of the head is very variable. There is no
vestige of a digestive tube ; in some, a few nu-
tritive vessels may be traced. Ovaries are found
in some species ; in others there is scarcely any
appearance of genital organs.

The *tæniæ* belong to this class.

CLASS V.   Cystica.   (κυστις, *vesica.*)

These have the form of a bladder, surmount-
ed by, or containing in it, one or more appen-
dices. Their organization is still more simple
than that of the *tæniæ.*

This class comprises the hydatids.

M. Cuvier* has divided the entozoa into two
grand classes, founded upon a difference in their
organization. The first class contains all those
that have a distinct digestive cavity ; these he
calls *cavitaires.* The second class all those in
which no alimentary canal can be traced in the
interior of the body, and which in general pre-
sent merely an amorphous parenchyma ; these
he calls *parenchymateux.*

The *nematoidea* of Rudolphi are the *cavitai-*

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* *Tableau du regne Animal,* 4 vol. 8vo.

res of Cuvier. The four other classes of the German naturalist fall under the second of the other.

Class I. *Entozoa Cavitaria.*

Character : Digestive tube very distinct, contained in an abdominal cavity ; form roundish.

This class contains three orders, established on the differences of form presented by the entozoa comprised under them.

Order I. *Body cylindrical.* This order chiefly comprises the genus *filaria.*

Order II. *Body fusiform.* Chiefly comprising the *ascaris lumbricoides* and the *strongylus.*

Order III. *Body more slender towards one extremity than towards the other.* This is the case sometimes towards the head, as in the *trichocephalus ;* and sometimes towards the tail, as in the *oxyuris.*

All these entozoa have the same organization. It has been particularly studied in the *ascaris lumbricoides,* and the observations I am now going to make on the organization of this genus are applicable to the rest. The detailed account of each will be given in the second volume, in treating of the different organs it chiefly infests. Thus, the trichocephalus will be described

in the article on the diseases of the alimentary canal ; the strongylus in that on the diseases of the urinary passages, &c.

In the ascaris lumbricoides we find an external integument, muscles, a digestive apparatus, and genital organs. It is even supposed that traces of a nervous and of a circulatory system have been discovered in it. The organs of digestion, and of generation, are bathed in an unctuous fluid, secreted in the interior of a great cavity in which they are contained.

Immediately beneath the skin, the muscular apparatus forms a general envelope for the whole animal. It is composed of two plates of fibres ; the one set circular or transverse, the other longitudinal. The arrangement of these fibres is best compared to that of the fibres of the muscular tunic of the intestines in the mammalia.

The alimentary canal is without any circumvolutions ; it is straight, and nearly as long as the body. It is distinguished by its generally brownish colour, depending on the matter contained. It begins by a mouth with a triangular orifice furnished with three tubercles, disposed in such a manner that two are inferior and one is superior.* The mouth, which is covered in-

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* These tubercles may serve to characterize the *ascaris lumbricoides,* being found in that species exclusively.

ternally with small granules constituting perhaps a secretory apparatus, communicates with a duct with thick parietes, which, in form and situation answers to the œsophagus. To this succeeds another, somewhat wider, part, which may be considered as the stomach ; lower down it grows narrow again, and becomes an intestine opening externally close to the extremity opposite that with the three tubercles.

From the external surface of the alimentary canal proceed a great number of filaments, that swell out into *culs-de-sac* at a certain distance from the intestine. Their nature and use are unknown.

The generative apparatus fills a great part of the body. We can perceive its numerous whitish filaments through the skin, and on cutting through this latter and the subjacent muscular fibres, the first thing that strikes us is the innumerable quantity of these filaments, which appear to form an inextricable tangle around the alimentary canal. On a more attentive examination, we find that they differ according to the individual in which they are examined, forming in some a male, and in others a female generative apparatus.

The male organs of generation consist of a penis, a seminal reservoir, and a testicle.

The penis is situated close to the anus, and is found protruded or retracted according to cir-

cumstances. It is continuous with a straight canal with thick parietes; this may be consi-dered either as a vas deferens or as a vesicula seminalis. This canal is succeeded by another, distinguished, 1. by its much greater tenuity; 2. by its innumerable flexuosities; and, 3. by its terminating in a cul-de-sac floating freely in the abdomen. This very slender and tortuous tube, which forms by its convolutions an almost inextricable knot, and is nearly three feet long, is evidently analogous to the testicle. In this organ there is no other condition requisite for the accomplishment of its secretion than the ex-istence of an immense surface; in like manner, in many animals the liver is nothing but an as-semblage of numerous canals, terminating in culs-de-sac, without the presence of what is called *parenchyma*. In fact, I am inclined to think that this latter is said to exist when the tubes, becoming too numerous, form a still more inextricable knot, or a still closer network.

The generative apparatus of the female com-mences externally, by a cleft or vulva situated at the same side with the anus, at the distance of one third of the length of the body from its anterior extremity. This is the entrance to a distinct vagina that leads to a uterus equally well formed. This uterus soon divides into two long horns, which, after proceeding a certain

distance, lose their straight direction, and be-
come canals remarkable for their great tenuity,
their numerous windings, and their terminating
in a cul-de-sac.   Each of these canals is analog-
ous to an ovary, which, like the testicle, is thus
reduced to a flexuous cavity of immense surface.
Thus, in the ascaris, there is apparently no
great difference of form and structure between
the organ that secretes the seminal fluid, and
that which produces the ova ; and yet what a
difference there is in their productions !

M. Jules Colquet maintains that the two
whitish lines observed, one on the abdominal,
the other on the dorsal surface of the ascaris,
are rudiments of a nervous system ; and com-
pares them to ganglionic nervous cords.   Ac-
cording to the same author, the two other late-
ral, slightly coloured lines, commencing between
the inferior and superior tubercles, and termi-
nating towards the tail, are vessels in which the
blood or analogous fluid oscillates ; and there is
some resemblance between the lateral lines and
the dorsal vessel of insects.

CLASS II.   *Entozoa Parenchymatosa.*

Character.   Digestive tube wanting.
The entozoa comprised under this class
have nothing in common but this single nega-

tive character, and the extreme simplicity of their structure, which is such that, with the exception of some appearance of locomotive organs, there is no distinct organ to be discovered in them.*

Nothing can be more varied than their form : some are still a little elongated and rounded like the *cavitaires* ; others are flat ; and others spheroidal.

This class contains the *acanthocephala, trematoda, cestoidea,* and *cystica.*

It is not my intention to say any thing at present of the three first of these orders, because, as the entozoa they contain infest principally the digestive organs, I shall have to describe them in treating of the diseases of those organs, in the second volume. With the cystica, however, the case is different, as they may be developed in all the organs indifferently. It will not, therefore, be amiss to give a general account of them in this part of the work.

The *cystica,* so called from the word κυστις, *vesica,* have long been known under the name of *hydatids.* They have also been frequently described by the name of *vesicular worms,* (*vers*

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* Those who wish for a detailed account of the organization of the *ascaris lumbricoides,* may consult with much advantage an excellent treatise by M. Jules Cloquet, entitled *Anatomie des vers Intestinaux,* 1 vol. 4to. Paris, 1824.

vesiculaires.)   In fact, their distinguishing cha-
racter is a spherical form, either with or without
appendices resembling heads, snouts, hooks, or
pores, according to the species.

Some kinds are found in clusters, and live
in a state of aggregation like some of the *po-
lypi.*

They may occur in any part of the body.
Thus they have been found, 1. in the different
parenchymas, without a single exception ; 2. in
the cavities, whether mucous, serous, or vascu-
lar ; 3. in the free cellular tissue interposed be-
tween the different organs.

Hydatids have been divided into two classes.
Those of the first consist of a simple bladder
without any appendix ; these are called *acepha-
locysts.*   The others consist of a bladder, to
which are attached one or more appendices ;
these are the *cephalocysts.*

The class of acephalocysts was established
by Laennec, who regarded as animals those
productions which before his time had been
considered simply as cysts.   Whatever be the
opinion adopted on this head, we must acknow-
ledge that these cysts are so far remarkable,
that they have no kind of connexion with the
tissues in which they are developed, and that,
without forming adhesions, or receiving their
nutrition from the rest of the body, they float

free and independent in a fluid of variable na-
ture, whilst that which they contain in their in-
terior is always the same. (See the observa-
tions in page 476 of this volume, on the animal
nature of these cysts.) It is asserted that spon-
taneous movements have been observed in the
acephalocysts ; it appears to me that this is one
of those observations that require to be repeated
before we give them implicit credence.

The acephalocysts exactly resemble a hol-
low sphere with transparent parietes, whose
bulk may vary from that of a filbert to that of a
large orange. Nothing can be more simple than
their structure. The bladder-like sphere is filled
with a colourless transparent fluid, as limpid as
the purest rock water. Its parietes are formed
of a greyish white substance, generally transpa-
rent, but sometimes sprinkled with opake white
spots. I know not any thing better to compare
this substance to, than the laminæ that are de-
tached from the transparent cornea after seve-
ral days' maceration in water. We should have
but an inexact idea of these parietes from com-
paring them to a serous membrane : they differ
very perceptibly from it. Between the fingers,
they feel tremulous like an animal or vegetable
jelly, and are tolerably elastic, without, at the
same time, having much cohesion, so that they
are readily torn by a gentle pull. Their exter-

nal surface is smooth ; their internal surface may be so likewise ; sometimes, however, it is found studded with small bodies, of a white or grey colour, and more or less regularly rounded : these are sometimes few in number, and sometimes quite crowded together; they vary in bulk from the size of a very small grain of millet to that of a lentil or an ordinary pea. The nature of these bodies is still unknown ; they have been considered by some as buds or even eggs that were eventually to become new acephalocysts. A circumstance that may have given some weight to this opinion is, that we often find, inside one acephalocyst of a certain size, another production of the same kind, like one box contained in another. It sometimes happens that this second cyst encloses a third ; and we may even find as many as four or five thus contained one within the other. This singular phenomenon has been explained by supposing that some of those small bodies above described were transformed into acephalocysts, which were consequently enclosed within the one that produced them ; and as it is not unusual to find beside whole acephalocysts others of larger size that are torn, it was imagined that this was caused by the newly formed cysts, which, when arrived at a certain degree of development, burst the one that produced them, which was

called the *mother cyst*. This whole theory appears to me to be merely an ingenious mode of connecting these singular phenomena, or of assisting the recollection.

When the acephalocysts are developed in a parenchyma, they are generally separated from it by a fluid of different kinds, contained in a cyst that forms around them, as it does around every body which by its presence tends to irritate the parts in contact with it. This surrounding fluid often consists of pus; in other cases, it is serous, or tinged with blood; in others, tuberculous; and in others, cretaceous. These different substances, constantly increasing, naturally compress the acephalocyst, and may even rupture and destroy it, so as to leave only some scattered fragments floating through them. I recollect that I once found the fragments of membranes of acephalocysts floating thus in the midst of a vast abscess in the neighbourhood of the kidney. The parietes of the cyst formed around the acephalocyst are either simply serous, or fibrous, or sometimes even partly or wholly osseous.

The tissues in which the acephalocysts are developed may continue for a long time perfectly sound: thus it is not very uncommon to find the existence of a hydatiferous cyst unattended by any disagreeable symptom, or any derange-

ment of health, even in cases where, being developed near the integuments, they project out beneath them.

In other cases, the surrounding tissues take on them a state of irritation, and from thence may result different fatal lesions ; but there may also result a solution of continuity allowing the acephalocysts to make their way out, and in this manner becoming, in some cases, a means of recovery. The very hardest parts may, under such circumstances, be perforated to give exit to the entozoa. A man was taken in at *La Charité*, who had over one of the scapulæ a tumour the nature of which could not well be determined. From this tumour proceeded a great number of acephalocysts. The patient having died, a cluster of these entozoa was found lodged in the infra-spinous fossa, and another in the subscapular fossa ; the two clusters communicated with each other through a hole wrought in the substance of the scapula not far from its spine.

When the acephalocysts leave the spot in which they were developed, they may be removed immediately out of the system, through a fistulous passage of greater or less length, terminating on the cutaneous surface. In other cases, they reach some mucous surface, from whence they may subsequently be eliminated in the same manner as in the preceding case.

Thus, fragments of acephalocysts that had been developed in the kidneys have been known to be voided with the urine; others, that had been produced in the lungs, or even in the liver, have been expectorated; and others again, vomited or passed by stool. Lastly, these acephalocysts sometimes happen to fall into a serous cavity, and thus produce on a sudden the most serious consequences.

The cephalocysts differ from the preceding class, in that the bladder constituting the greatest part of their body is surmounted by one or more appendices, termed *heads*. Sometimes there is but one, sometimes two or more : hence they are divided into monocephalocysts and polycephalocysts.

The monocephalocysts comprehend a species of entozoon generally designated by the name of *cysticercus (vesica caudalis,)* which is distinguished by the following characters : it consists of a bladder, usually of small size like that of the acephalocysts, from one point of which rises a small appendix of a dead white colour, which is sometimes found protruded from the bladder, and sometimes retracted within it. The latter case is the most common, and the cysticercus then resembles a small acephalocyst with a point of a dead white colour in its interior. It is asserted that spontaneous

movements have been observed in the cysticer-
cus; that it has been seen alternately protrud-
ing and retracting its head; so its claim to the
rank of an animal seems much less doubtful than
that of the acephalocyst.

The cysticercus has been discovered in the
most different parts of the body both in man
and in animals.

In man, it has been found in the substance
of the brain, in the choroid plexus, (in which
situation it must not be confounded with the
serous cysts so frequent there,) in the lungs,
and in the muscles. It is very common in the
omentum of rabbits, and it has been found also
in the sheep and in the ox. Lastly, in that dis-
ease to which pigs are subject, known by the
name of *measles*, the most general and constant
lesion observed is the simultaneous existence of
great numbers of cysticerci in most of the tissues.
The free cellular tissue interposed between the
different organs is particularly infested with
them, on such occasions. In two measly pigs I
had an opportunity of dissecting, I found cysti-
cerci, 1. in the subcutaneous and intermuscular
cellular tissue, where they were exceedingly
abundant; 2. in the different folds of the perito-
neum; 3. in the liver; 4. in the lungs; and, 5.
in the substance of the heart.

Among the polycephalocysts are comprized,

1. the *ditrachyceros*, a species that has been found in the intestines of animals, and sometimes even of men ; and, 2. the *polycephalus*, which is produced chiefly in the brain in sheep, and which is supposed to be the cause of the disease called the staggers, to which these animals are subject. (For their history, see volume the second.)

After having thus given a rapid sketch of the entozoa, we must confess our complete ignorance with regard to the causes of their formation. In this case, as in that of all other productions that have come before us, irritation may sometimes give rise to them, solely, however, by deranging the natural mode of nutrition or secretion ; so it is merely an accidental agent in the business. It is remarkable that the entozoa have a peculiar tendency to be developed and to increase when the external agents to whose influence the subject happens to be exposed are such as tend to prevent the complete development of the process of nutrition in the different tissues ; as if, under such circumstances, the organic particles, thus prevented from being completely assimilated, proceeded to arrange themselves so as to produce an inferior being, an entozoon. In fact, it is in moist countries that entozoa, the intestinal species especially,

are most common in man ; and it is in these countries particularly that we observe in a great many affections, what is called by authors *complicatio verminosa*. As to animals, we may create entozoa in them in a manner at will, by exposing them to the influence of great damp, and depriving them of insolation and exercise. It is thus the cysticerci become very numerous in the rabbits that are confined in damp coops, without sun and air. In like manner, it is probable that the measles in pigs depend on the damp, confined habitations, in which they are usually kept. A species of the *trematoda*, the *distoma hepaticum*, is produced in sheep that are pastured for a certain time in very wet grounds, where they are often in water half way up their legs, and where, at the same time, the herbage they feed on is too watery. But, why are some intestinal entozoa (as the *ascaris lumbricoides*, and the *trichocephalus*) much more common in children than in adults ? How does it happen that, in Paris, this same ascaris, and still more, the tænia, are found much more frequently in the dog than in man ? And why does one particular species, the *filaria Medinensis*, or *dracunculus*, form a singular exception to the habits of the rest, being the only one that is found exclusively in dry and torrid countries ?

CHAPTER IV.

Gaseous Secretions.

PHYSIOLOGISTS have proved that gases are exhaled by several membranes while in the natural state. In the first place, there is a continual exhalation of some kinds from the cutaneous surface. Besides the gases introduced into the alimentary canal from without, or formed in it by the mutual chemical action of the various substances taken as food, there are also some that are furnished directly by the mucous membrane lining the internal surface of the stomach and intestines. Lastly, the learned and ingenious researches of M. Edwards* leave no doubt that the mucous membrane of the air passages exhales, besides the aqueous vapour, carbonic acid and azote, the quantity varying according to the difference of age, season, and climate. There are some animals provided with an organ for the express purpose of secreting gas : such are those fishes that have an air-bag or swimming-bladder.

It is highly probable that, in a great many diseases, the gases that should naturally be se-

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* *De l'Influence des Agens physiques sur la Vie*, 1 vol. 8vo.

creted from the skin, and from several portions
of mucous membrane, are modified both as to
their quantity and quality. In this respect,
there is still room for researches of importance.
It is very evident, however, that the mere cir-
cumstance of the gaseous secretion being modi-
fied might well be the cause of different morbid
states. Who can tell but that it is of the great-
est importance for the proper discharging of more
than one function, that the quantity of hydrogen,
azote, oxygen, or carbon, which escapes from
the body in the state of gas, should escape only
in certain quantities both absolutely and rela-
tively? The great frequency of that dreadful
disorder, the gravel, in cold, damp climates, has
been attributed to a state of irritation in the kid-
neys, from their function becoming more active
in consequence of the diminished activity of the
functions of the skin. But, in cold and damp cli-
mates, there is another circumstance that occurs
at the same time with this superabundant for-
mation of uric acid ; namely, a notable diminu-
tion in the quantity of azote exhaled from the
lungs ; at least we are warranted in concluding
that this does take place, from M. Edwards hav-
ing proved such to be the case in the damp win-
ter of France. Now, may not the excess of uric
acid that is then formed in the kidneys, be
formed for the purpose of making up for the

diminished exhalation of azote by the respiratory passages? According to this hypothesis, the irritation established in the kidneys is only a secondary phenomenon, and we must seek for the origin and the real cause of the disease else-where than in the organ in which it appears wholly to reside. Thus, then, in this case, as in many others, the source of the disease may lie in a different place from that where we observe an alteration of function or of texture.

The gaseous secretions, like all the rest, may present alterations some of which relate to the quantity, and others to the quality of the ex-haled gas. Besides, it may occur, that in the morbid state, we find gases in certain parts where none exist in the healthy state. Hence arises the following division :

First Class.

Alterations of the gaseous secretions of the natural condition.

Gaseous secretions of the skin   }   { In quantity.
            of the lungs   } altered {
            of the alimentary canal }   { In quality.

Second Class.

New gaseous secretions produced.

> Gaseous secretions in the cellular tissue.
> in the serous cavities.
> in the uterine cavity.
> in the circulatory apparatus.

We are completely ignorant of the causes that influence the production of gases in these different situations. I do not speak here of those cases in which the gases are introduced from without ; for that is not secretion. If these gaseous secretions are preceded or accompanied by any alterations of texture, they are such as entirely to escape our notice. The history of each will be given in treating of the morbid anatomy of the apparatus in which it is situated.

SECTION VI.

LESIONS OF THE BLOOD.

AT a period when an exclusive solidism was the prevailing theory in France, Bichat, in the introduction to his *Anatomie generale*, wrote as follows : " The humoral pathology has, no doubt, been carried too far ; but it is founded on truth, and, *in a great many cases*, we must allow that all should be referred to morbid humours." This idea was in a manner lost in his work, without being followed up either by himself or his contemporaries. The humoral theories of the preceding ages had led to such false conceptions of the nature of a great number of diseases, and still more to such fatal plans of treatment, that it was not surprising that every one should be on his guard against opinions and facts tending to attribute to the fluids any share whatever in the production of diseases. For a long period, humorism seemed to be condemned without appeal ; and the numerous facts bearing on the subject, which have been since again brought forward, seemed to be forgotten, or continued

unproductive, nobody attempting to draw conclusions from them. It was, however, easy to
foresee that the theory of exclusive solidism,
after having been followed up through all its
consequences, would eventually be rejected, in
consequence of its being found incapable of
affording an explanation of every case; and
that it would then be necessary to have recourse
to some other system for a more satisfactory solution of the difficulty. This first step towards
a return to humorism is, therefore, but a natural
consequence of the progress of the spirit of
science, and should be viewed and received as
such. Let us then join in it, by collecting the
facts that have given rise to it, and drawing up a
kind of inventory of all we are in possession of
that bears on the subject; and let us endeavour
to determine accurately where we are, in order
that we may know where we are going, to
what conclusion we are proceeding, and how we
are to arrive at it.

The alterations of the fluids should be studied,
1. in the blood; and, 2. in the different humours
which concur in forming the blood, or which
emanate from it. Of these humours, there are
two especially, the chyle and the lymph, whose
qualities must have a direct influence on the
state of the blood. We must observe, however,
that if the other humours happen to be modi

fied in quantity, or quality, their modifications may infer modifications in the blood also, as their constituent principles proceed from that fluid.

The blood, while circulating, seems to be under the influence of two forces. The one imparts to the mass an intestine motion, by virtue of which each of its globules moves on by itself, surrounded by an envelope of colouring matter, and keeping at a certain distance from the rest. This double action of attraction and repulsion ceases to take place the moment the blood leaves its vessels. The other force, directly opposite to the preceding, tends to bring the blood to a state of repose : it is exerted in the organic parenchymas at the point of contact of the solids and the blood. The blood, when examined with a microscope in these parenchymas, has been compared to a kind of whirlpool, from which particles were incessantly detached to be lost in the solid substance, whilst others were quitting this latter and returning into the vortex. If, then, there is a great difference between the blood contained in the large vessels and the different solids, that is by no means the case in the capillaries ; in these, the blood and the tissues to which it is distributed tend to be confounded together. At their point of contact, the blood assumes the nature of the solid, and becomes

organized; so that its vitality is no longer dubious. But it is not there only that we can discover a power of organization in the blood; we find it active and prolific wherever the fibrine coagulates, whether in the vessels or out of them. I have already shown how, under such circumstances, vessels make their appearance in the fibrine, how a circulation becomes established, secretions take place, and tissues are developed in it. If we analyze the blood and the solids, we discover the same proximate principles in both. If we examine their physical structure, we find it identical, both consisting of globules mixed with an amorphous substance. Bordeu acknowledged this identity of composition when he said that blood is fluid flesh, " *Le sang est de la chair coulante.*"

Thus then, in the three-fold respect of the vital phenomena,* intimate structure, and che-

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* It is admitted that the phenomena called *vital* do not display themselves unless in certain states of arrangement of the particles of a body, termed *organization*; but the meaning of this last word is far from being fully determined, and we must not imagine that manifestations of vitality can occur only where there exists an organization such as is observed in the higher orders of animals, and such as we are accustomed to figure to ourselves as existing in every case. If we follow the series of living beings, we shall find the vital organs gradually diminishing in number and complexity; nay, even disappearing altogether, and yet life continuing. Life exists likewise in the seed in vegetables, and in the drop of fluid that constitutes the first rudiments of the embryo in animals; yet in these, we find

mical composition, no line of demarcation can be drawn with strictness and precision between the blood and the solids. Physiologically speaking, it is impossible to conceive that one of these two parts of the same whole could be modified without the other being so likewise. On the one hand, inasmuch as the blood nourishes the solids, and as without its presence they cannot support life, the state of the solids cannot but be influenced by the state of the blood. The chemist might as well say that the nature of a body does not depend on the nature of the elements that compose it. On the other hand, the solids, considered with respect to their relations to the blood, form but two classes : the one contributing to *make* the blood, such as those concerned in the actions of absorption, digestion, arterial circulation, and respiration ; the other contributing to *unmake* it, those, namely, concerned in the actions of venous circulation, secretion, and nutrition. No one solid, therefore, can undergo the slightest modification,

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still less appearance of what is called *organization*, than there is in the blood. We see, then, that vital actions take place without the presence of that peculiar formation to which common opinion attaches the idea of vitality ; so that observation, far from leading us to infer that certain conditions of arrangement are necessary for the manifestation of life, teaches us that in a thousand different cases life is revealed to us, not by forms but by acts.

without producing some derangement in the nature or quantity of the materials destined to form the blood, or to be separated from it. Physiology, then, leads us to the conclusion that every alteration of the solids must be succeeded by an alteration of the blood, just as every modification of the blood must be succeeded by a modification of the solids. Viewed in this light, there is no longer any meaning in the disputes between the solidists and the humorists; the system appears to constitute but one great whole, indivisible in the state of health as well as in that of disease; the division of the parts of the body into solids and fluids seems to be a distinction of small importance, and one that is not always just, since it ceases to exist in the intimate structure of the organs, in which all the grand vital phenomena take place, and in which also, occur all the changes that constitute the morbid state.

This intimate and necessary dependence of the blood and solids on each other having been once taught us by physiology, what remains to be done? Merely to have recourse to observation for facts, and to draw legitimate conclusions from them. The plan I have adopted has led me already, at the commencement of this volume, to treat of the alterations the blood may undergo in its quantity, and of the morbid states

produced by such alterations. At present, then, all we have to do is to turn our attention to the alterations in its qualities of which the blood is susceptible, and of the influence they may have in the production of diseases.

Chemical analysis has proved that human blood is composed of fibrine, albumen, a particular animal matter to which the blood owes its colour, free soda, oxide of iron and lime found in the colouring matter, and different salts, namely, lactate of soda, muriate of soda and of potash, phosphate of soda, phosphate of magnesia, and carbonate of lime and of soda ; all which different elements are in solution in a certain quantity of water. Moreover, recent researches have discovered in the blood some carbonic acid (Vogel) ; a matter very much resembling mucus, found in the cells of the coagulum (Brande) ; an oily matter (Traill) ; an azotized fatty matter, similar to that of the brain and nerves (Vauquelin, Chevreul) ; a yellow colouring matter, resembling that of the bile and of the urine (Chevreul, Lassaigne, Magendie, &c.) ; a substance analogous to urea (Prevot and Dumas, Vauquelin and Segalas). Thus then, from the analyses of the blood that have been hitherto made, though not near so numerous as they ought, this remarkable result has been obtained, namely, that the elements

of most of the organs, and of some of the se-
creted fluids, are to be found in it.

When blood is drawn from the vein of a
healthy person, it separates into two parts ; the
one, termed *clot*, solid, and principally composed
of fibrine and colouring matter ; the other fluid,
consisting chiefly of water and albumen. The
same phenomena occur in arterial blood. In
like manner, in the dead body, we find in the
different vessels coagulated fibrine either com-
bined with some colouring matter, or separated
from it. In a great many morbid states, the
blood, during life or after death, presents diffe-
rent appearances that constitute in it so many
genuine pathological states. Let us now study
these in each of the elements of the blood.

The fibrine may be altered either in quan-
tity or in quality. In the first place, there are
cases in which this principle is more abundant
than usual, or at least in greater proportion
relatively to the water and albumen. In such
cases, the blood, when drawn from a vein, forms
in the vessel that receives it a clot with little or
no serum. These are however to be divided
into two classes. In the first class of cases,
the fibrine constituting the clot, still contains
a pretty large quantity of serum, which may be
separated from it by pressure ; in these the
coagulum has but little density. In the second,

on the contrary, the clot is very dense, and a little fluid albumen can with difficulty be squeezed out of it. In the first class the relative increase of quantity of the fibrine is only apparent; in the second, it is real. We must take care not to confound them, as they belong to different states of the system. The very fibrinous blood is commonly called *rich blood:* it may either depend simply on a vigorous constitution, or on certain morbid states.

In place of being superabundant in the blood, the fibrine may, on the contrary, be quite the reverse. There are, in fact, some persons whose blood, when taken from a vein, presents but a very small coagulum in proportion to the large quantity of serum in which it appears. But, here likewise we must make a distinction. The diminution of quantity of the fibrine may be only apparent; as happens when its particles, being very strongly condensed, are much closer to each other than in their natural condition; the clot is then very small, aud remarkably firm; this occurs very often, for instance, in patients suffering under acute rheumatism. In other cases, the clot is not only very small, but also very soft; and there is then really a deficiency of fibrine. This may be observed in many cases of chronic disease, or in persons with a slender muscular system, and habitually pale skin.

We learn, then, from observation, that in the same quantity of blood the fibrine may exist in various proportions, being sometimes above and sometimes below the regular complement. Now, this fibrine is itself composed of determinate quantities of oxygen, hydrogen, azote, and carbon; and if these elements are derived from the air and food, and are found in more or less considerable proportions in the different excretions, it is natural to suppose that they may also exist in variable proportions in the fibrine, and thus modify its nature; and, indeed, it is possible that their relative excess or deficiency may have some influence in the production of certain morbid states.

The force that tends to keep the globules of fibrine at a certain distance from each other during life, may be so modified as that they shall have a tendency to run together, as they naturally do after death; and hence may result the spontaneous coagulation of the blood in its vessels during life. There have been too many cases of this nature observed, for us of the present day to attempt to deny the possibility of its occurence. Sometimes it takes place without any known cause; and sometimes it appears to accompany a state of irritation in the parietes of the containing vessel. When the blood once becomes solid, it displays indubitable symptoms

of vitality : vessels are produced, and secretions formed in it ; and different alterations of nutrition, resembling those observed in the tissues, may also occur. If we examine whence this coagulated blood derives its vitality, we find that it cannot partake of the common life of the rest of the body, since it very often merely touches the surrounding tissues, without being in any manner continuous with them. We must therefore admit that these polypiform concretions, or *polypi*, as they are called, may possess a proper vitality, by means of organs they have created themselves.

We have just been considering the cases in which there is a real augmentation of the force of aggregation that keeps together the particles of the fibrine of the blood. In other cases there is, on the contrary, a diminution of this force ; and the result is, either a less tendency in the blood to coagulate, or a total absence of coagulum. When there is one, it is remarkably soft, offers scarcely any resistance to the finger, and is converted by a slight agitation into a reddish fluid. In other cases, there is no coagulum, and we find the fibrine broken up into small fragments that remain suspended in the serum, or fall to the bottom of the vessel. Lastly, in other cases, there is not any appearance even of these fibrinous particles, but the fibrine is

completely mixed with the serum, producing a fluid mass of a reddish or blackish colour. These different appearances presented by the blood when drawn from a vein, may be observed also in the vessels in the dead body ; these are sometimes filled with coagulated blood of greater or less consistence, while, on other occasions, there is nothing to be found in the heart, arteries, and veins, but a perfectly fluid blood, resembling water charged with a red, brown, or black colouring matter. In such cases, it has been ascertained by chemical analysis that the fibrine is not absent, but that it is altered in its nature so as to be no longer spontaneously coagulable. In some few cases, I have seen the fibrine assuming still another appearance ; instead of a coagulum, there was, at the bottom of the vessel, a homogeneous stratum, sometimes of a deep brown, and sometimes of a dirty grey, resembling bad pus more than blood.

In certain cases in which the natural consistence of the fibrine is increased, or even without any very decided augmentation of its density, another very remarkable phenomenon is observed ; the portion of fibrine at top of the coagulum parts with the colouring matter, and forms a whitish, yellowish, or slightly greenish layer, that may vary in thickness from less than a line to some inches. This layer is known by the

name of the *buff*, or buffy coat ; and although its formation may be more or less favoured by certain circumstances that have nothing to do with the accompanying morbid state, such as the size of the orifice, the manner in which the blood flows, and the form of the vessel that receives it, yet it is not the less true that it can occur only in certain states of the system which I shall presently explain. The buffy coat is formed of pure fibrine, with which is mixed a certain quantity of serum, which, according to the researches of Dauler and of Gendrin, contains much more albumen than the serum of the rest of the blood. The greatest analogy exists, both in respect of appearance and of chemical composition, between the buffy coat of the blood and the substance that constitutes the false membranes of the serous cavities.

The albumen, which always exists in a small quantity in the coagulum, and which, united with water, almost exclusively forms the serum, may be modified as well as the fibrine. In the first place, there are cases in which, in a given quantity of serum, the albumen is found in much greater quantity than usual in proportion to the water ; of this we may easily be convinced by exposing the serum to heat. The researches of Doctor Traill, which are confirmed by the more recent ones of M. Gendrin, have proved that, in

the state termed inflammatory, the serum of the blood contains nearly twice as much albumen as in the healthy state. This increase of the albumen may be detected simply by the touch, the serum being then remarkably viscid. In other cases, on the contrary, the very small coagulum obtained by heating the serum, the greatest part of which evaporates, proves how much the quantity of albumen is diminished.

Is it to a particular alteration in the nature of the albumen of the blood we are to attribute the presence of a *mucous layer* that has been sometimes observed by M. Gendrin at the bottom of the serum, or suspended in it like a cloud? In one of the cases he mentions, the blood was taken from an individual affected with empyema; in another, there was a vast abscess in one of the thighs.

The serum, in respect to its composition, presents several varieties that we must not confound: 1. it may contain at the same time much water and much albumen; 2. the latter principle may predominate, the quantity of water remaining the same, or even being diminished; 3. the reverse may take place, and the serum be composed of much water, and little albumen.

Whatever be the composition of the serum, it is sometimes found in small quantity in proportion to the coagulum, and sometimes the re-

verse is the case. All these differences should be noted, as corresponding to so many particular morbid states.

It is worth while remarking, in many of these cases, how very just are the common expressions of *impoverished blood, watery blood, blood turned into water, &c.*

In some persons, the blood drawn from a vein is remarkable for the intensity of its colour ; in others, on the contrary, it is exceedingly pale, the coagulum is of a rose-coloured white, and the serum resembles water ; in this case the colouring matter of the blood is either diminished in quantity, or altered in its nature. This in general co-exists with an increase of the serous part of the blood. The human being, in such cases, appears in this respect to descend in the zoological scale, and his blood tends to become analogous to the naturally colourless blood of certain animals. The same causes that we have already seen producing anæmia, are generally those also which tend to diminish the quantity of the peculiar animal matter to which the blood owes its colour.

The blood, considered generally as a compound fluid, may be altered by its mixture with different substances not usually found in it. In other parts of this work, I have mentioned cases in which there were discovered in the blood

not only different elements of the secreted fluids, but also sundry morbid productions, such as pus, encephaloid matter, entozoa, and calculous concretions. I do not now want to discuss the question whether these substances originated in the blood or were introduced into it; whatever be their origin, it always happens that they are not merely mixed with the blood, but by combining with it, alter it so far as completely to change its physical properties. In such cases, instead of blood, we often find only a curdy friable matter, of a dirty grey colour, and greater or less consistence, and resembling, as the case may be, either the semiconcrete pus of certain chronic abscesses, the sanies that flows from malignant ulcers, or the encephaloid masses of the liver, when broken up and reddened with a little blood. Sometimes I have found such a matter in some vessels only; sometimes it existed in the greatest part of the circulatory system. Now, who could assert that in such cases the blood is not deeply altered in its nature. Besides, most commonly there are at the same time in the texture of many of the solids, morbid secretions, purulent or otherwise, formed of a matter that has the greatest analogy to that found in the vessels. Amongst the cases of this description I have had an opportunity of observing, I shall adduce the following. In a woman

who died at *La Charité* with all the symptoms of a chronic affection of the lungs and of the digestive passages, I found in front of the vertebral column an enormous tumour composed of an agglomeration of lymphatic ganglions, which, instead of their natural tissue, presented merely an inorganic pap, of a greyish or reddish colour. A similar substance appeared in the liver, in the form of roundish isolated masses; it was also found in the spleen, in the cells of which it appeared to be deposited in place of the blood they usually contain; lastly, in several points of of the lungs, the lobules were infiltrated with the same substance. But that was not all; for in both lungs, a great number of the branches of the pulmonary artery contained, instead of blood, a curdy matter of a reddish grey colour, resembling in appearance the morbid matter found in the mesenteric ganglions, liver, spleen, and lungs. The right cavity of the heart, the pulmonary artery, and its first divisions, contained a blood of little colour, and poor consistence. In another woman, who had a broken down cancer of the uterus, all the veins of that organ, and the trunk of the vena cava up to its passage under the liver, were full of a semifluid sanious matter of a greyish or reddish white. In a man far from being advanced in life, who had in a great many organs, encephaloid masses in a state

of softening, the inferior vena cava, the renal and splenic, and some branches of the superior hepatic vein and of the pulmonary vessels, were filled with a kind of detritus of a reddish grey colour, without its adhering to the venous parietes, which, in this case, as well as in the preceding cases, presented no appreciable trace of alteration. Facts similar to those just mentioned have also been observed by others. Thus, Beclard mentions a case in which the heart and principal trunks of the vessels were filled with a solid clot, the interior of which presented numerous collections of encephaloid matter. M. Velpeau found a mass of encephaloid in the midst of a clot of blood contained in the vena cava. He also cites a case of a man that died almost suddenly, after having shewn some symptoms of cerebral congestion, and in whom, upon examination, there was found through the whole extent of the circulatory system, a blood of a pultaceous consistence and blackish red colour, resembling the matter of certain abscesses of the liver.

Bichat, in his *Anatomie generale*, has related a case in which the vena portæ and the hepatic and splenic veins, instead of blood, were filled even to their very last ramifications with a greyish sanies. I have already brought forward cases in which a matter exactly similar to pus

was found in the midst of a clot in one of the cavities of the heart, without any purulent collection existing elsewhere in the body.

The alterations of the blood may be ascertained in still another manner than by simple inspection or chemical analysis. We know that, in general, the blood of one animal may be introduced into the body of another without any injury to the latter. But where that is not the case, and where the blood of a diseased individual, when introduced into the body of another individual, proves a real poison, it is impossible to resist the conclusion that the nature of the blood is really changed. Now, let us see what has been observed on this head.

M. Gendrin, in his work on fevers (vol. ii. p. 145) gives an account of a flayer whom he attended in a putrid fever with an eruption of gangrenous pustules. An ounce of blood drawn from one of the patient's veins was injected into the cellular tissue of the groin of a cat. The consequences to the poor animal were copious vomitings of bile, at first yellow, and then greenish, dyspnœa, a small, frequent, and irregular pulse, a dry and brown tongue, a constantly increasing prostration of strength, and, towards the close of the scene, some slight convulsive motions at intervals. Death ensued in six hours and fifty minutes after the injection. The

appearances observed on examining the body are described as follows :—The skin of the groin did not adhere to the subjacent parts; the cellular tissue was soft and almost pulpy, and of an ashy yellow colour; it exhaled a fetid odour, and was dotted with small red spots; the gastro-mucous membrane of the stomach and intestines was in the natural state, that of the respiratory passages was of a reddish brown; the lungs, especially the left, contained black blood, and were full of brownish black spots; the blood throughout the whole body was black and fluid; in the left pleura were about two ounces of very serous black blood; the heart was soft and flaccid; there was no appearance of lesion in the brain or spinal marrow; the body speedily began to exhale a fetid odour.

Some blood that proceeded from an epistaxis that occurred in the same patient, was injected into the femoral vein of a dog. The animal exhibited the same series of symptoms as the one in the preceding experiment, which, in like manner, terminated in death.

In another work (*Histoire des Inflammations,* vol. ii.) M. Gendrin relates some experiments in which he injected into the veins of animals the blood of persons labouring under confluent small-pox. Very severe symptoms, which rapidly proved fatal, ensued; and on opening the bodies,

several organs were found in a state of high inflammation.

M M. Dupuy and Leuret introduced into the cellular tissue and veins of a sound horse, blood that came from horses affected with malignant anthrax, ("*charbon*") and thus succeeded in producing the disease. It is, then, beyond all doubt, that in this case the blood itself was altered in its nature, since it proved capable of transmitting the affection.

These facts bring to our recollection some others, for an account of which we are indebted to the celebrated Duhamel. He has related a case where an ox, that was over-driven, having been slaughtered at an inn at Pithiviers, the butcher put into his mouth, for a few moments, the knife he had employed for the purpose. The consequence was, that in some hours afterwards his tongue swelled, his breathing became difficult, and then blackish pustules broke out all over his body: at the end of four days he died. The inn-keeper wounded himself with a bone of the same ox in the palm of his hand; his arm mortified, and he died in seven days. Two women having received some drops of the blood of the same animal, the one on her hand, the other on her cheek, these parts were seized with a gangrenous inflammation. Is it not likewise the simple contact of the blood of diseased

animals that produces malignant pustule in man ?

From these facts we must conclude that, under certain circumstances, the blood may be altered in its intimate nature, so as to acquire noxious properties, which display themselves when it is mixed with the blood of healthy animals.

The alterations of quality of the blood I have hitherto treated of may be ascertained by experiment ; there are others, which, in my opinion, should likewise be admitted, simply from induction. If, for instance, an individual breathes an atmosphere loaded with deleterious miasmata, or uses unwholesome or insufficient food, and becomes sick in consequence, physiology would lead us to conclude that in such a case the blood has been at least the vehicle of the morbific matter residing in the air or food. If it be consistent with sound physiology to admit that bad diet must produce bad chyle, must not this in its turn form bad blood ? But when we inject into the veins of animals different organized substances in a state of putrefaction, the blood, in such a case, is not merely a vehicle to carry to the solids the deleterious substances that inflame them ; its unusual appearance leaves no room to doubt its being really altered in its nature ; thus, it readily putrifies, it has lost the power of coa-

gulating, the force of aggregation uniting its molecules is singularly diminished, and the most of the tissues become like filtres through which it oozes on every side. Various animal poisons, such as those of several of the snake tribe, and different mineral poisons, as mercury, for instance, act upon the blood in the same manner.

There are, again, other modifications the blood may undergo, which will probably be studied with care at some future period, but of which we have as yet only some very vague notions. Thus, according to Bellingeri, the appreciable quantity of electricity is diminished in the venous blood both in old age and in certain diseases ; and if we are to believe Rossi, the blood, in severe fevers, presents characters, with respect to its electricity, that differ from those it has in the healthy state.*

Barthez has said a great deal about a direct influence exercised by the nervous system over the blood. I grant that such an idea seems unfounded, if we consider the blood only as it is in its great vessels : but, in the capillaries, where it comes into contact with the solids, and is confounded with them, where it manifests signs of

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* These facts, with respect to the modifications of the electricity of the blood, are to be found in an excellent thesis On the alterations of the Fluids, sustained before the Faculty, by M. Saucerotte, in August, 1828.

vitality and where, in conjunction with the nerves, it gives life to the organs it traverses; in these, I say, who will venture to deny the influence of the nerves over it? In the capillaries is exerted in full force that law of mutual dependence that connects all the parts of the system, and makes, of so many different elements, but a single whole—of so many partial lives, a single life. In them, the nerves must act on the blood, as the blood acts on the nerves. M. Dupuytren proved, long ago, that cutting the pneumo-gastic nerves prevents the venous from being converted into arterial blood in the lungs. Dr. Mayer, from an experiment of his own, maintains that the nervous system has an influence over the blood, not only in the capillaries, but even in the large vessels. He observed, that, whenever he tied both pneumo-gastric nerves in animals, the blood in the whole of the pulmonary system coagulated, and the colouring matter separated from the fibrine; and he took care to ascertain that these were not the consequences of death, by opening the animals the very moment they expired.

The learned and indefatigable Professor at Alfort, M. Dupuy, having lately tried upon horses the experiment of cutting the pneumo-gastric nerves in the cervical region, has ascertained that under such circumstances the quan-

tity of fibrine in the arterial blood drawn from the carotid is notably diminished. A certain quantity of blood, taken from the artery at the moment after the operation, contained twenty-one grains of fibrine. In four hours after, the same quantity contained only nineteen grains; at the end of sixteen hours, eighteen grains; at the end of forty hours, twelve grains. In fifty-two hours after the operation, the animal died in a state of suffocation; and then the same quantity of blood, still taken from the carotid, contained but seven grains of fibrine. Now, it may be asked, whether the section of the nerves produced this progressive diminution of the quantity of fibrine directly; or merely indirectly, by disturbing more and more the progress of san-guification in the lungs.

M. Dupuy has likewise seen the fibrine diminished in quantity in the blood of a horse, affected with what is called *roaring*, after its respiration had been rendered laborious by running it too long at full speed. In this case, the modification of the hæmotosis is in direct proportion to the difficulty of the respiration.

Besides, it should be well ascertained whether, when an animal is bled several times at very short intervals, there is not always less fibrine found in the last bleedings.

M. Dupuy asserts that he found the blood

entirely dissolved in the animal in which he had cut the pneumo-gastric nerves. He adds, that, by injecting this blood into the jugular vein of another horse, he produced in the latter a gangrenous affection. These experiments would lead us to such extensive conclusions, that I shall not venture to admit their results positively, until they shall have been repeated.

I have now stated the facts and arguments which, in the present state of the science, ought to lead us to acknowledge the existence of certain alterations in the blood. What I have already said on the subject, in my opinion, sufficiently demonstrates not only that these alterations are real, but also that they are often primary, that they precede those of the solids, and that, consequently, the origin of many diseases lies in the blood. If it is true that the mass of the blood may, in certain cases, be primarily altered, it follows that the existence of general disease is not merely imaginary. In fact, when all the tissues thus receive a vitiated blood, is it not consistent with sound physiology to admit that their regular modes of vitality, nutrition, and secretion, must be more or less deeply modified? We must either admit this conclusion, or deny the influence which, according to every physiologist, the blood exerts over each solid. It may then happen that one or more organs are affected in a more decided man-

ner than the rest, and there may thus be pro-
duced in them various lesions that are only acci-
dental and secondary ; but it is not in these le-
sions the origin of the affection lay ; it is not on
them all the symptoms depend ; nor, lastly, is it
to them alone we are to have recourse to throw
a light upon the true nature of the disease, as
well as upon the treatment proper to be pursued.
Experience also teaches us, that these lesions
may be either severe or slight, present or absent,
similar or dissimilar, and that, notwithstanding,
the disease, though presenting so many different
shades in its variable symptoms depending
on these lesions, does not the less exist, as it
really consists in the constant symptoms depend-
ing on the state of the blood.

We must not, however, forget, that different
alterations of the blood may exist, and have ac-
tually been observed, in persons presenting every
appearance of good health. But such persons
are on the brink of disease, and if any cause
whatever chances to derange the equilibrium of
their system, some of the morbid phenomena
that occur are sure to depend on the state of
their blood.

The diseases that seem to be connected with
a morbid state of the blood may be either acute
or chronic. I shall now offer some observations
on each class successively.

I have already established the fact that, under the influence of a state of general hyperæmia, every organ becomes excited, that death may result directly from such excitation, and that then a superabundance of blood is found all over the body, but in no part is there any serious lesion, any alteration of texture. In such cases there exists that state of pyrexia termed by nosologists inflammatory fever. But if, instead of being simply in excess, the blood contains more fibrine than ordinary, its exciting power will be still greater, and what it did in the former case merely by its increased quantity, it will do now by its alteration in quality.* Under such circumstances, is it not evident that one of the indications to be fulfilled must be to dilute the fibrine with more water ? Hence the utility of administering plentifully aqueous drinks. M. Piorry has lately announced that one of the means of preventing the formation of false membranes in croup is to gorge the patient with water; and we know that M. Magendie has seen the symptoms of meningitis diminished by injecting water into the veins of the patient.

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* An increase in the quantity of fibrine in the blood produces some remarkable effects on several vital actions. Thus, M M. Prevost and Dumas have ascertained that the faculty of producing heat increases in animals in proportion to the number of the globules of the blood.

The qualities of the blood may also be modified so as to give rise to the formation of the buffy coat. Now, the buff is not the result of a process of local irritation, inasmuch as it may be found before any such process exists, simply from the presence of a plethoric habit, or of a disposition to active sanguineous congestions ; it is found in pregnant women, who are so disposed to hyperæmias subsequently to their delivery. The ancients, then, were, perhaps, in the right in admitting an *inflammatory state* of the blood, of which the phlegmasiæ of the solids were often merely the effect and external manifestation as it were. On this inflammatory state of the blood would appear especially to depend, in certain cases, the phlegmasiæ of the membranes of the serous and articulating cavities. In the first place, we are to observe that the morbid secretion that takes place in the surface of several serous membranes when inflamed, is exactly similar, in its physical and chemical properties, to the albumino-fibrinous substance that forms the buff ; and that it may be organized even within the vessels (provided there be a stagnation of the particles that form it) just as it is observed to become organized on the serous membranes on which it has been deposited. Now, if we mark the symptoms and progress of acute rheumatism, we find that very often a well marked febrile action, with a

strong reaction, but without any symptom what-
ever of local affection, precedes the pains. In
a word, there is first an inflammatory fever, and
then rheumatism. Next observe the extreme
mobility of these rheumatic pains; they run
along in a manner wherever the blood is distri-
buted; the application of leeches often removes
the pain from one part, but it soon shifts to ano-
ther; and not unfrequently it quits the articulat-
ing tissues, and fixes upon different internal or-
gans, producing by the derangement of their
functions, symptoms more or less severe. It
often happens that a bleeding from a large ori-
fice puts an end to the disease; as if, by dimi-
nishing the mass of blood, it proportionably
diminished the stimulus that produced all these
shifting irritations. When that occurs, in the
subsequent bleedings the buffy coat becomes less
apparent, and at last disappears. But if, on the
contrary, the rheumatism does not yield to vene-
section, the buffy coat persists, and even be-
comes more apparent as venesection is more fre-
quently resorted to; the serum increases while
the coagulum diminishes, and yet, be the coagu-
lum ever so small, it is nevertheless covered
with a buff as long as the rheumatism continues.

What I have just been saying is, however,
merely a probability; a point of view in which,
when supported by facts, we may be permitted

to consider an obscure question, to prepare the way to a full and complete solution hereafter.

The introduction of certain deleterious substances into the blood, such as pus, putrid substances, and poisons from the three kingdoms of nature, beyond all doubt produces in it different changes, through which it loses its property of coagulating, and acquires a rapid tendency to decomposition. When these changes have been thus produced, the following phenomena are often observed ; 1. the nervous centres become affected, producing, according to the degree or nature of the affection, instantaneous death, a more or less considerable prostration of strength, convulsions, delirium, &c., or dyspnœa, palpitations, and vomitings; 2. gangrene of one or more parts ; 3. various serous or sanguineous exhalations ; 4. unusual gaseous secretions ; 5. a more or less general derangement of the functions of the different organs.

On opening the bodies of the animals that presented these different morbid phenomena, we are sometimes unable to discover any appreciable lesion ; sometimes we meet with congestions or effusions of blood resembling those that had been observed during life ; and, lastly, we sometimes discover greater or less alterations in the texture of the different solids. Along with these variable phenomena we always observe the

two following constant ones; 1. a remarkable fluidity of the blood; and, 2. a more rapid decomposition than ordinary of the blood itself, or of the different solids it penetrates.

Where is the source of these various phenomena? Is it not evidently in the blood, into which the deleterious substances have been introduced? Now, those derangements of functions and organs produced by the experimenter, when he introduces different deleterious substances directly into the blood, are likewise those that are produced by the sting or the bite of certain animals; they are also those that take place from touching the flesh of animals that die of the plague, as well as those observed in small pox, measles, and scarlatina, of a malignant nature, as it is called. They are the same derangements that appear in persons exposed to putrid emanations, vegetable or animal, and to miasmata from the bodies of other persons that are themselves diseased and crowded in confined places where the air is constantly receiving the infection, without being changed by ventilation. Lastly, they shew themselves also in individuals whose blood is only imperfectly or badly repaired by insufficient or unwholesome diet.

In all these cases what do we discover to be the common element of the disease, if I may so express myself? Not any determinate lesion

of one or more organs ; for, on examination of the body after death, we often find none ; or else perhaps, we observe congestions resembling those found in a thousand other cases without producing any similar effects. What is it, then, I repeat? A vitiation of the blood by the commixture of deleterious substances ; next, in consequence of such vitiation, an alteration of the functions of the nervous system ; and lastly, the blood that supports the organs, and the nervous system that animates them, having suffered a general injury, a constant, though not always appreciable modification of these organs in their functions or in their texture.

To conclude, diseases resembling many of the preceding, whether in their symptoms, or in the appearances discovered after death, not unfrequently occur in cases in which no deleterious substance has been introduced into the blood, and in which there is no direct proof that any alteration of that fluid has been the primary cause of the morbid phenomena. If, however, these phenomena are perfectly identical with those evidently produced by vitiated blood, if, on examining the body we cannot detect here any more than in the preceding cases any constant lesion in the solids, and if we always observe a certain number of fundamental symptoms whether these lesions exist or not, what is

the conclusion consistent with true logic and
sound physiology? Certainly this, that here, as in
the preceding cases, it appears that the primary
cause of the disease should be referred to the
blood, which, in this case has altered its nature
under the influence of unknown causes, as it has
in the others in consequence of the commixture
of various foreign substances. Perhaps there
are cases of this kind in which the modification
of the blood is itself only secondary to a modi-
fication of the nervous system. If, for instance,
under the influence of a strong mental emotion,
this system, being suddenly perverted in its
action, ceases to exert its proper influence over
the different organs in which the blood is elabo-
rated, deposited, and receives new materials,
must not that fluid itself become altered in its
turn? If so, thence must arise a number of
organic and functional derangements, varying
greatly according to the mode and intensity of
the primitive alteration of the innervation. In
such cases, we may observe to occur sporadically
those same diseases, typhoid or other, that we
have just now seen prevailing epidemically un-
der the influence of manifest causes of infection
of the blood. All this is, undoubtedly, I again
repeat, probable, but not certain ; but is there
any greater degree of certainty in the opinion
of those who regard all these derangements as

the constant and necessary result of an acute inflammation of the stomach? I do not mean to say that this is never the case, and I am sure that no one would suppose me to entertain such an opinion. But, what I assert is, that often enough there is no proof whatever of the existence of this gastritis, that it can be admitted only by analogy, and that there is as much physiology in one hypothesis as in the other. If then, there are on all sides only more or less probable conjectures, it must be for the interests of the science that they should be all brought forward, provided that they are only given as conjectures, sufficiently founded, however, on facts and on physiological considerations, to entitle them to some share of attention. It appears to me quite certain that the theories of solidism in general, and that of irritation in particular, are insufficient to account for all the facts that have been observed. Under such circumstances what should we do? Take another position, and try what we shall gain by it.

So far, I have given a summary account of the cases of acute disease, the primary cause of which may, with some reason, be referred to an alteration of the blood. It seems, however, that certain chronic affections may also be referred to the same source. Let us now see what experience has to teach us on this head.

When a person is in the habit of taking too much food, and that containing a great deal of azote, while at the same time his body loses little by exercise or otherwise, his blood becomes very rich in fibrine, and he acquires a disposition to those inflammatory diseases already mentioned. This is often all that is observed. In other cases, however, under similar circumstances, a superabundant secretion of uric acid takes place in the kidneys, and gives rise to the complaint called the gravel. It often happens, too, that at the same time that this acid exists in the urine in much greater quantities than usual, it occurs as a morbid secretion in several other parts of the system. It fills the joints, is deposited between the surrounding fibrous tissues, and is found in masses between the fasciculi of several muscles, in the subcutaneous cellular tissue, and even in the spongy extremities of the bones. I have found deposits of uric acid in all these parts simultaneously in the body of a patient that died at *La Charité*, whose case is to be found described in the inaugural dissertation of Dr. Fauconneau Dufresne. In such cases, it appears that this uric acid which thus appears in all parts of the body, and which we know from chemistry to be one of the most highly azotized proximate animal principles, is formed in excess

in the blood under the influence of a strongly azotized diet; and that it is separated from it by its natural emunctory, as well as in the texture or on the surface of other organs. Accordingly, as Magendie remarks, the best way to put a stop to this superabundant secretion of uric acid is to change the diet of the person affected, and give him food containing as little azote as possible. Now, what is the prominent feature in all this? The modification in the composition of the blood by the food, and the production of disease in consequence. According, then, to this view of the subject, there is something more in affections termed gouty, than a merely local irritation of an organ; the latter is only a secondary phenomenon, and we have other indications to fulfil than that of combating the pains in the joints by blood-letting. This theory is not incompatible with the fact that gravel and the different other deposits of uric acid are sometimes observed in persons who are far from living on such diet as I have just described; for we may conceive that independently of any influence of diet, the azote of the blood may become spontaneously predominant, and consequently a greater quantity of uric acid be formed : it is however well known that this is not the most common case.*

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* It has been lately proved by the experiments of M. Edwards, that ani-

In the valuable work of Professor Dupuy on tuberculous affections, we find a fact that bears upon those just mentioned. He states, that in several cows in whose lungs were found abundant deposits of carbonate of lime, it was ascertained that the milk also contained a much greater quantity than usual of the same salt. At that advanced period of life in which we so frequently meet with deposits of phosphate of lime in several organs, it is, perhaps, in the blood, which then contains a superabundance of that salt, we are to seek for the cause.

Under the influence of other conditions in the external agents by which the blood is repaired or elaborated, namely, in the food and air, we observe different kinds of diseases produced, whose source, in my opinion, should still be referred to the blood: moreover, these different diseases arise more or less frequently without there having been any previous modification of the air and food; but, as the symptoms remain the same, it seems reasonable to conclude that the cause is the same, and that it always exists in the blood. In fact, where the effects are the same, is it not natural to conclude

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mals expire less azote during the cold season. Is not this one of the causes that may contribute to the superabundant formation of uric acid in cold, damp countries ? This would be one secretion supplying the place of another.

that the causes are also the same? Let us now consider some of those morbid states in the production of which the alteration of the blood appears to me to play a principal part.

In times of scarcity, the whole population of a country has been known to be reduced to have recourse to the herbs of the field for support, and to live more or less exclusively on that poor sustenance. Now, in such cases, there has been always observed to appear, in consequence of such diet, the same morbid state, namely, dropsy; as if, in proportion as the blood became poorer and more deficient in fibrine, and approached nearer to pure serum, it escaped the more easily from the vessels, and accumulated either in the cellular tissue or in the different serous cavities. This sort of serous diathesis may, however, also appear spontaneously. I have elsewhere (*Clinique Medicale*, vol. iii.) recorded the history of some dropsical patients, on the examination of whose bodies no appreciable alteration in the solids could be detected, but in whom, instead of blood, there was nothing but serum; or at least the blood was in a very peculiar state throughout. It was devoid of colouring matter, and if it still contained any fibrine, it was such as had lost the power of coagulating, and it was dissolved in the superabundant serum which was the predominant chemical element.

The dropsy accompanying such a state of the blood may appear either in persons who were previously in good health, or in those exhausted by long sickness. The first sort seem to have been in a manner disposed to it, from their pale, dead colour, their soft flesh, and the habitual state of simi-infiltration of their subcutaneous cellular tissue. If we apply leeches to their skin, in place of true blood, we often observe only a reddish serum issuing from the bites; and, as, in such cases, it is not possible for coagulation to take place, it is sometimes not without the greatest difficulty we can succeed in stopping it. Again, if we produce any irritation, there is but little appearance of redness; but a rapid accumulation of serum in the cellular tissue subjacent to the irritated part takes place. Thus, in this case, the result of the irritation is determined by the state of the blood; a very evident fact, and of some importance with respect to what may be drawn from it. Compare the bloodless skin of such individuals with the brown firm skin of stout healthy persons, with the bright rosy tint that marks the state of plethora; and the three, with the habitually yellow tinge in persons of a bilious temparament, as it is called, who are yet in good health; compare them, I say, and it will be evident that we cannot consider the fluid traversing the cellular tis-

sue of the skin in these different individuals, as possessing the same properties, as containing the same principles, and as capable of acting similarly on the tissues ; now, this fluid is, after all, but a part of the whole mass of the blood, and from the state of that part we can judge of the state of the whole.

There is a disease which has shaken the belief of most of the solidists in their doctrine ; I mean the scurvy. The causes under the influence of which it is developed epidemically, the symptoms that characterize it, the remarkable state of the blood itself, and the nature of the lesions discovered on examining the bodies, all combine to prove that this disease depends on a primary alteration of the blood. But, there are some cases in which this vitiation of the blood in scorbutic persons is evidently the result of the bad qualities of the air and food. There are, again, other cases in which the disease comes on quite spontaneously. In such cases, will any one deny that the blood is altered, because he cannot discover a cause for the alteration ? That would be forgetting that every day we observe lesions in the various solids, the determining cause of which is equally unknown to us. Besides, there are certain poisons, which, when introduced in small doses into the system for a long time together, at last produce, in the solids

or in the blood, alterations exactly resembling those attributed to the scurvy : mercury is a poison of this kind. In such cases, we are induced to conclude from analogy, that the pernicious effects of that mineral often result from the primary alteration produced by it in the blood. Moreover, whatever be the external or internal cause that has altered the blood, we observe in the solids different alterations well worthy of notice in this respect, that they prove that many a lesion apparently inflammatory, whether of an organ or of a function, is far from depending simply on a local morbid state, but, being connected with certain conditions of sanguification, can be removed only by the return of that process to its natural state. Of this description are the numerous effusions of blood which so readily appear in all the organs of scorbutic persons, the tumefaction of the gums, the ulcers that occur on different parts of the cutaneous envelope, the congestion of the spleen, and the dyspnœa and palpitations of the heart of which they complain so much, &c. Now, if it is undeniable that there occur in scorbutic persons local affections very different from one another, that are produced and kept up by a more general affection, which is their primary cause and common tie, is it not natural to suppose that the scurvy is not the only disease so circumstanced ? Is it

not natural to suspect, that in every case where we see in like manner a great many organs simultaneously affected in their nutrition, where they are also simultaneously the seat of morbid secretions more or less similar in their nature, and where, moreover, as those simultaneous alterations of nutrition and secretion appear in the same order and manner in numbers of persons, it is impossible to assert that they are merely a chance assemblage ; it is not natural, I say, to suspect, that there as well as in the case of scurvy, there is in the system a pre-existing morbid condition that reveals its existence by these various local affections, so that to drive away the latter, we must attack the former ? Now, it is evident that this general morbid condition, of which every organ feels the influence, can hardly consist in any thing else than a modification of one or other of the two equally general systems, the sanguineous and nervous, which give life and support to each organ. Every one is acquainted, for instance, with the very striking features that characterize the scrofulous constitution, and every one must allow, on ever so little reflection, how impossible it is to confine such a state to any one particular part, whether the health still exist, or have been deranged by the alterations of nutrition taking place on all sides. In such cases, as there is no escaping the influence

of the morbid condition which prevails over the whole system, and is present every where in the blood, every process of nutrition will be altered, and every secretion modified ; every hyperæmia accidentally produced will present a peculiar character in its symptoms, progress, duration, termination, and in the effects of therapeutic agents on it ; and every process of suppuration will furnish a fluid of equally peculiar characters. At the same time, there is not a single one of these alterations that may not be, in other cases, purely and simply a local affection ; such is the case, for instance, with pulmonary tubercles. That, however, is precisely what it is important to distinguish ; and I have already had occasion to establish this distinction when treating of tubercles.

I have attempted to demonstrate, above, that there must be an alteration in the qualities of the blood, when there is an alteration in the secretions. In consequence of the vitiation of these latter, there appear different morbid states in the production of which the qualities of the blood bear an important part. This is what occurs when the liver, for instance, no longer abstracts from the blood in proper quantities the materials of the bile, they being either formed more abundantly than usual in the blood, or the liver, whether appreciably altered or not in its

texture, having lost the power of secreting them.
They then remain in the blood, and thence re-
sults a yellow tinge, of greater or less intensity,
in the skin and several other tissues. They may
also escape from the blood with the elements of
other secretions, and are to be found in the sweat,
urine, lymph of the thoracic duct, fluid furnished
by the mucous membranes, and that exhaled on
the surface of the serous membranes.   It even
occurs, sometimes, that the bile forms deposits
in the parenchyma of different organs ; where
it is found accumulated, in the same manner as
purulent collections are found in others.   The
resinous matter of the bile has sometimes been
found in these various fluids and solids, but its
yellow colouring matter is of much more fre-
quent occurrence.   When the bile has once
passed into the blood, to use the common ex-
pression, (which here again, happens to be con-
sonant with the science,) is it not reasonable to
admit that that fluid, being altered by its un-
usual mixture with the elements of the bile,
can no longer exercise its regular influence over
the different organs to which it is distributed ?
Hence must arise different series of symptoms,
according, 1. to the state in which these organs
are ; and, 2. according as the mixture of the
bile, or, at least, of its elements, with the blood,
is more or less intimate, more or less prolonged,

and more or less abundant. I may, perhaps, be mistaken; but it seems to me that such a cause is very capable of producing some of those febrile states that have been denominated bilious fevers, a generic expression answering to more than one kind of morbid state. In fact, let us consider, in a number of individuals, how the symptoms of this disease are grouped together, and how they succeed each other; let us observe the very remarkable yellow tinge of the face and conjunctiva, the slight icteric suffusion which sometimes affects more or less the rest of the cutaneous surface, the yellow tinge of the various excreted fluids, such as the urine, the mucus of the nasal fossæ, and the expectoration, the yellow coat of the tongue, and the very abundant bilious evacuations that often take place both above and below at the same time; sooner or later after the appearance of this kind of bilious plethora, different functions become disordered, and at last the fever is kindled. Now, where are we to suppose the cause of all this to reside? Is it in the irritation of an organ, of the digestive canal, for instance? The fact of the matter is, that the existence of such irritation can often be admitted only by hypothesis. Before the fever begins, and while there is yet only a bilious state, to use the phrase of some writers, should we attempt to remove

it by blood-letting? Experience has proved its inefficacy in such cases. If it was proved, on the contrary, that such medicines as evacuate the intestinal canal, when properly employed, restore the patient to health, we might explain their success by the greater activity they give the secretion of the liver, thereby producing a more complete depuration of the blood, and a cessation of the bilous symptoms, as they are called. I have had opportunities of examining the bodies of different persons that had died of jaundice after suffering under the disease for several months; they had fallen by degrees into a state of marasmus, and at last went off insensibly, without having ever presented symptoms of irritation in any one organ. In many of these cases, I could not discover any appreciable lesion in the liver, or other organs. What, then, was the cause of the disordered functions, emaciation, and death? Was it the prolonged infection of the blood by the bile?

Every body knows what serious symptoms appear in animals when their ureters are tied; and in man when any cause suspends the secretion of the urine or prevents its excretion. Whether the materials of the urine have not been separated from the mass of the blood, or have re-entered it, that fluid becomes changed, and we observe that assemblage of symptoms

comprized under the generic term of adynamic,
putrid, or ataxic fever, &c. In such cases a
urinous smell is often exhaled from every part
of the body, and the fluid itself is not unfre-
quently found in different parts of the system
either in substance or elements.

An able observer, Doctor Dance, has de-
scribed, in his inaugural thesis, the very peculiar
state in which females are after their delivery ;
he details the symptoms that may occur, and
the particular form assumed by the diseases that
may attack them, when the materials of the
milk are not properly secreted by the mammary
glands at the usual period, or else when the
secretion is suddenly interrupted after having
begun to take place. When the lacteous prin-
ciples thus remain in the blood, or are
thrown back again into it, I would ask, have
they any share in the symptoms that supervene ?
Is not this old idea supported by analogy with
what occurs in consequence of the suspension
of other secretions, the bile or urine, for in-
stance ? If we consider the mixture of the
materials of the bile or urine with the blood as
the cause of various symptoms, why should we
refuse to admit that derangements of a more or
less serious nature may also result from the pre-
sence of the principles of the milk in the blood,
or from their not being eliminated ? In the pre-

sent state of the science, are we to admit, without discussion, the exactness of the following case, recently published by M. Graefe of Berlin ?*

A miller's wife was delivered of a child, which she suckled herself. On the eighth day after her confinement, while in perfect health, the crash occasioned by the fall of a mill wheel frightened her so much, that her milk was totally suppressed. A state of constant febrile excitement then ensued, which degenerated into a tertian ague, during the course of which her legs became œdematous, and at the end of three weeks she became affected with anasarca and ascites. Three weeks after, as the dropsy did not diminish, recourse was had to paracentesis, and a bucket of fluid drawn off, which resembled whey, exhaled an acidulous odour, and, upon being boiled with dilute sulphuric acid, coagulated, and afforded a substance exactly resembling caseum.† Six weeks afterwards, the peritoneum being again filled, a second puncture was made, which gave issue to a fluid of a greenish yellow, without the least trace of caseum. The patient recovered.

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* *Revue Médicale*, January, 1827.

† I have already remarked, in another part of this volume, that cases of this kind are rendered less valuable, by the difficulty of distinguishing, in the present state of the science, between caseum and other proximate principles.

This fact, and others already brought for-
ward elsewhere in this volume, appear to de-
monstrate the possibility of the formation of one
of the most important principles of the milk in
other parts of the system besides the breasts.
In this last case, moreover, the succession of the
symptoms is very remarkable; subsequently to
a sudden interuption of the lacteous secretion,
we have first an intermittent fever, and next a
dropsy, the fluid of which contains a matter
resembling caseum. Was this immediate prin-
ciple, which necessarily remained in the blood in
consequence of the secretion of the milk, elimi-
nated from it at the surface of the peritoneum?
Were the morbid phenomena produced both by
the presence of the caseum in the blood, and by
the process set up for its removal? I know
with how much reserve we must receive such
facts, and, still more, explain them. But yet,
neither must we shrink from them; we must
not, if I may use the expression, be afraid of
their consequences, because they do not happen
to harmonize with such or such preconceived
ideas, seeing that it might well be that the error
lay in the latter.

It may be almost unnecessary for me to
speak of the influence of the composition of the
blood over that of the various secreted fluids;
and to remind the reader, that M. Magendie,

by changing the food of different animals, and consequently modifying their blood, has made the urine and bile of some of the carnivorous species resemble those fluids in the herbivorous; and that M M. Nicolas and Gueudeville have found in the blood of diabetic patients much more serum and far less fibrine than ordinary.* Thus, then, when the nature and the proportion of the constituent principles of the blood have undergone some of the changes already described, the result must be more or less appreciable modifications in the qualities of the secreted fluids, which may play a more or less important part in the production of certain morbid states. Thus it is easy to conceive, that if many of the alterations in the saliva, bile, urine, serum, &c., are the direct result of a lesion of the organ in which these fluids are elaborated, there are others, independent of the state of the secreting organ, and connected with an alteration of the common fluid from which they all emanate. If that is the case, we may go still farther; and since it appears that most of the morbid productions are deposited in the cellular tissue, in place of the small quantity of serum that usually lubricates it, we may ask if they also may not be accounted for by a vitiated state of the blood;

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* It is to be wished that these last experiments were repeated.

without, at the same time, meaning to assert, as I have already explained, that many of them may not likewise result from.a purely local alteration in the part where they are developed. In fact, what are these accidental productions but substances of various descriptions which are deposited in the framework of each organ, that is to say, in its cellular tissue, in place of its natural secretion ? Now, we can only conceive two reasons for their appearance ; either the blood on its arrival at an organ is wrongly elaborated by the nutritive parenchyma of that organ, or else it is altered before its arrival there. But, there are many cases in which there is no proof of there having been any thing wrong in the structure or action of the organ before the appearance of the morbid deposit ; and we may with especial reason doubt the previous existence of any fault in the part, when a great many organs simultaneously become the seat of similar accidental productions.

I have now reviewed and discussed the most striking cases in which we may sometimes affirm, and sometimes only suspect, that the cause of the acute or chronic morbid state resides in the altered condition of the blood. I do not, however, mean to anticipate the future. I know not how far such researches may be pushed, so as to escape from the uncertainty in which the

subject is still mostly involved. But what appears to me particularly important at present, is to shew that at least they are not to be despised. I grant, that in the present state of the science, it is the part of a sensible man not to adopt the doctrine of humorism too lightly, by judging from facts many of which require a re-examination before they are finally admitted; and that we ought to be particularly on our guard against being in too great a hurry to make practical applications of it; but, neither ought we refuse examining into what is as yet only probable or doubtful, for fear of there being some chance of the simple probability being eventually raised by facts to the rank of a truth. Now, many of the questions proposed in this section appear to me to be of this description.

SECTION V.

LESIONS OF INNERVATION.

In the preceding sections we have gone through the whole circle of the lesions that are appreciable by anatomy, without, however, having been able to account by them for all the functional derangements of the organs ; besides, they have often appeared to us to be themselves but an effect, so that to assert that the whole disease lies in them is not unfrequently putting off the difficulty without solving it.   We see then, that, in the present state of the science, to attempt to explain every physiological and pathological phenomonon by a difference of arrangement of matter in a healthy or diseased living being, is to have recourse to hypothesis. Many authors, struck with the insufficiency and the conjectural nature of this manner of explaining the phenomena, have had recourse to another, equally hypothetical, but at the same time, in their opinion, more comprehensive and systematical.   They assert that the *primum mobile* of every disease resides in the forces which

direct the actions of each living particle, forces of which the organs appear to be only the instruments, and which, while they display in each organ an independent power from whence results its *individual life*, combine also into one single force, producing the *life of the whole*. All the different systems have been founded on one or other of these hypotheses in turn; but, in my opinion, they would have been more complete and durable, had what was true and conformable with facts been selected from each. Let us now see how we can make use of the latter, as the science stands at present, since the other has not been able to account for every fact.

There is, in man and the creatures near him in the zoological scale, an apparatus which appears to preside specially over the different vital actions, and to be the source of those various phenomena of sympathy and mutual cooperation without which there could not be a living whole. This is the apparatus of innervation. In proportion, however, as we descend in the scale of beings, this apparatus becomes more and more simple, till it finally disappears; and yet life continues, and signs of sympathy and mutual cooperation may still be observed. In those beings that are completely destitute of a nervous system life is nevertheless destroyed by agents which are generally considered to produce that effect in man

solely by their deleterious influence over the
nervous system ; thus, hydrocyanic acid can
kill a vegetable as well as an animal. We see,
then, that the forces which develop and support
life may exist without the presence of a nervous
system. Nay, vital actions can proceed even in
an amorphous molecule, wholly destitute of or-
gans. Notwithstanding, inasmuch as in man
the accomplishment of these actions appears,
according to our present knowledge of physio-
logy, to be necessarily dependant on the ner-
vous system, we may, by hypothesis, consider
this system as the seat and instrument of the
vital power. In the same manner, too, we may
admit, for the sake of a more convenient expla-
nation of the facts observed, that there is formed
in the nervous centres a fluid, which may be
called nervous, vital, electro-vital, &c., and may
serve to represent the *unknown force* by which
these centres hold all the organs under their influ-
ence.* The term *innervation* merely expresses

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* To admit the existence of a *vital fluid*, in order to explain the pheno-
mena exhibited by living beings, is imitating the natural philosophers, who
have long distinguished by the name of *electric fluid*, the unknown agent of
a force that displays itself in nature by the appearance of a determinate se-
ries of phenomena. That this vital fluid may be identical with the electric
or some other fluid, is possible, but unimportant ; because we must never-
theless continue to give it a special name, as long as we cannot discover,
from observation, an identity between the phenomena occurring in organized,
and in inorganic bodies. By this means, then, we remain faithful to the

the influence exerted by this force every time a
vital action takes place. When this force is dis-
turbed or embarrassed in its action, we say there
is a lesion of the innervation, and consequently
a morbid state produced. Such lesion is some-
times followed by lesions of tissues appreciable
by our various physical means of investigation ;
and hence result all those alterations which are
the study of pathological anatomy. Sometimes,
again, the lesion of innervation is followed only
by a lesion of the actions or functions of the
organ affected. There are certain symptoms
which never appear but in the first case ; while
there are others which appear indifferently with
or without appreciable lesions of organization.

Newtonian system, which, in fact, is merely that of observation, 1. in adopt-
ing, provisionally, the hypothesis of a fluid in order to discover the laws of
the vital phenomena ; and, 2. in considering this fluid as *sui generis,* because
it manifests its existence by phenomena equally so ; it being a principle in
natural philosophy to attribute to different forces phenomena that differ from
each other in appearance. We had certainly admitted, by hypothesis, the
identity of cause and nature of the electric and magnetic phenomena, long
before it was demonstrated by the splendid researches of the modern philo-
sophers ; but then, we allowed it was not demonstrated, and, until it was,
the philosophers never thought of confounding the electric and magnetic
fluids under the same name. In like manner, until it is proved that the
forces which, in a living body, interrupt the play of the natural chemical
affinities, maintain a proper temperature, and preside over the various ac-
tions of organic and animal life, are analogous to those admitted by natural
philosophy, we shall act consistently with the principles of that science, by
giving distinct names to these two kinds of forces, and employing ourselves
in calculating the different laws they obey.

Hence we have often a perfect similarity between the symptoms, although the lesions discovered by anatomy are very dissimilar, or even although there are none to be detected in one of the cases; hence, too, the little agreement often observed between the functional derangements of an organ, and the lesions observed in it after death; because, before these lesions were produced, a disordered state of the innervation had arisen in the organ, which was of itself sufficient to derange its actions materially.

Thus, in every disease not immediately produced by external violence, the symptoms that occur depend either on a lesion of the forces that animate every living part, (that is to say, on a lesion of innervation) or, on a lesion of organization. The former is primary and constant; the latter is secondary, variable in its nature, and inconstant in its existence.

In studying the diseases of the various apparatuses, in the second volume, we shall often have occasion to return to these two grand divisions; in fact, we shall have to notice them in every case. How often do we observe various disorders of the digestion, circulation, respiration, and secretions, without being able to discover by dissection the least derangement in the organs that execute those functions. Still more frequently, again, in cases in which there has

been some disorder of the different actions of animal life, the examination of the nervous centres will not reveal to us the cause. There are certain morbid states in which, before life has ended, the usual physical laws tend to resume their empire : in such cases we may observe in an individual, while still living, a remarkable diminution of the resistance opposed by the body to the grand law of the equilibrium of caloric ; the chemical affinities of inorganic matter begin to act, and there arise those phenomena long known by the name of *putrid symptoms.* This term, though it has been singularly abused, undoubtedly expresses something real, and its exactness in certain cases has been ascertained by observation. Perhaps we shall be able, at some future period, to explain, by lesions of organization, those remarkable phenomena which betray in the body while still endowed with life a less resistance to the ordinary laws of physics ; but, until then, let us consider them as the external manifestation of a lesion of the vital powers themselves, and let us call them *lesions of innervation.*

Are we able to discover the causes that influence the production of these lesions of the vital force ? We are, in certain cases. It appears to be affected primarily by a great many poisons, by the vegetable or animal emanations known by the name of *miasmata,* and by various modi-

fications of the external agents which are incessantly acting on us, such as want of due exposure to the sun, too damp an atmosphere, and unwholesome diet. If, for instance, a very slight difference in the moisture of the air is sufficient to produce a variation in the phenomena proceding from what we call the electric fluid, why might not the same external influence also produce a variation in the phenomena proceeding from a cause, which being equally unknown with the electric fluid, may with equal reason be considered by hypothesis as a fluid ? I would prefer, however, calling it *vital*, to calling it *nervous* fluid, since there are beings in which the same phenomena appear, although they have no trace of a nervous system.

The same effects as are produced by external causes may also be produced by causes originating in the individual. Thus, whenever the blood is altered in quantity or quality through any of the causes already described, or whenever any solid is the seat of a severe lesion of organization, the vital force no longer displays itself by its ordinary phenomena, and there is a general disorder in the system which cannot be accounted for by any particular lesion, but is considered to be produced by sympathy : but what is sympathy ? The existence of this general derangement is betrayed to us by symptoms which may

be referred, 1. to an excitation of the vital force ;
2. to its being lowered below the regular stand-
ard; 3. to its perversion. Hence the existence, in
every disease, of three fundamental dispositions,
which, whether preceding it or produced by it,
impress on it in every instance a peculiar cha-
racter, direct its progress, produce its compli-
cations, determine its severity, and, lastly, regu-
late the indications of treatment. These may
be termed the *hyperdynamic,* the *adynamic,* and
the *ataxic* disposition. Thus, then, in every
disease, to study the various circumstances ex-
ternal or internal, which, with or without an
accompanying lesion of organization, determine
the predominance of one or other of these three
dispositions ; to estimate the influence which
these dispositions exert in their turn, over the
organization ; to distinguish the modifications of
treatment they require ; and to reduce to laws
the results of these observations ; such should be
the end of the physician. As for myself, it is
sufficient for me to have pointed out this, with-
out attempting to traverse the path that leads to
it ; for that would be altogether quitting the do-
main of pathological anatomy.

END OF THE FIRST VOLUME.

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