CHAPTER II.

Of Reproduction in general.

WE ſhall now examine more cloſely this property, which is common to the animal and vegetable, this faculty of producing beings ſimilar to themſelves, this ſucceſſive chain of individuals which conſtitutes the real exiſtence of the ſpecies: And, without limiting our reſearch to the generation of man, or of any particular animal, let us contemplate the general phænomena of reproduction; let us collect facts, and enumerate the various methods employed by Nature for the renovation and tranſmiſſion of organized exiſtences.

The firſt, and apparently the moſt ſimple, method, is to aſſemble in one body an infinite number of ſimilar organic bodies, and to compoſe its ſubſtance in ſuch a manner, that every part ſhall contain a germ or embryo of the ſame ſpecies, and which might become a whole of the ſame kind with that of which it conſtitutes a part*.

* The intelligent reader will perceive that this ſentence, though not very obvious, contains the principle upon which the ſubſequent theory of generation adopted by the author is founded. It means no more than that the bodies of animals and of vegetables are compoſed of an infinite number of organic particles, perfectly ſimilar, both in figure and ſubſtance, to the whole animal or plant, of which they are conſtituent parts.

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This apparatus appears, at firſt ſight, to ſuppoſe a profuſion of expence. Such magnificence, however, is not uncommon in Nature. It is diſcernible even in the more common and inferior ſpecies, as in worms, polypi, elms, willows, and many other plants and inſects, every part of which contains a whole, and, in order to become a plant or an inſect, requires only to be unfolded or expanded. Conſidering organized bodies under this point of view, an individual is a whole uniformly conſtructed in all parts, a collection of an infinite number of particles every way ſimilar, an aſſemblage of germs or minute individuals of the ſame ſpecies, which, in certain circumſtances, are capable of being expanded, and of becoming new beings like thoſe from which they were originally ſeparated.

This idea, when traced to the bottom, diſcovers a relation between animals, vegetables, and minerals, which we would not have ſuſpected. Salts, and ſome other minerals, conſiſt of parts ſimilar to one another, and to the whole. A grain of ſea-ſalt, as we diſtinctly perceive by the microſcope, is a cube compoſed of an infinite number of ſmaller cubes*, which, as we diſcover

* Hæ tam parvæ quam magnæ figuræ (ſalium) ex magno ſolum numero minorum particularum, quæ eandem figuram habent, ſunt conflatæ, ſicuti mihi ſæpe licuit, obſervare, cum aquam marinam aut communem in qua ſal commune liquatum erat, intueor per microſcopium, quod ex ea prodeunt elegantes, parvæ, ac quadrangulares figuræ adeo exiguæ, ut mille earum

ver by a larger magnifier, are themſelves compoſed of ſtill ſmaller cubes. The primitive and conſtituent particles of this ſalt muſt, therefore, unqueſtionably conſiſt of cubes ſo minute, that they will for ever eſcape our obſervation. Plants and animals, which poſſeſs the power of multiplying by all their parts, are organized bodies compoſed of ſimilar organic bodies, the primitive and conſtituent particles of which are alſo organic and ſimilar. Of theſe we diſcern the accumulated quantity; but we can only recogniſe the conſtituent particles by reaſon and analogy.

From this view, we are led to conclude, that there exiſts in nature an infinity of *organic living particles* *, of the ſame ſubſtance with organized beings. A ſimilar ſtructure we have already remarked in more inanimated matter, which is compoſed of an infinite number of minute particles that have an exact reſemblance to the whole body. And, as the accumulation perhaps of millions of cubes are neceſſary to the

myriades magnitudinem arenæ craſſioris ne æquent. Quæ ſalis minutæ particulæ, quam primum oculis conſpicio, magnitudine ab omnibus lateribus creſcunt, ſuam tamen elegantem ſuperficiem quadrangularem retinentes, fere . . . . . Figuræ hæ ſalinæ cavitate donatæ ſunt, &c.; *See Leeuwenhoek, Arc. Nat. tom.* I. *p.* 3.

* To avoid the introduction of terms which might not be generally underſtood, it is neceſſary to inform the reader, that the phraſes *corps organiques vivans*, *parties organiques vivantes*, et *molecules organiques vivantes*, which occur ſo often in this volume, and form the baſis of our author's theory, are uniformly, in the verſion, expreſſed by the words *organic particles*.

formation

formation of a ſingle grain of ſea-ſalt that is perceptible by our ſenſes, an equal number of ſimilar organic particles are requiſite to produce one of thoſe numberleſs germs contained in an elm, or in a polypus. A cube of ſea-ſalt muſt be diſſolved before we can diſcover, by means of cryſtallization, the minute cubes of which it is compoſed: In the ſame manner, the parts of an elm or of a polypus muſt be ſeparated, before we can recogniſe, by means of vegetation, or expanſion, the ſmall elms or polypi contained in the different parts of theſe bodies.

The difficulty of aſſenting to this idea proceeds from the well known prejudice, that we can only judge of the compound by the ſimple; that, to diſcover the organic ſtructure of any being, it muſt firſt be reduced to its ſimple and unorganic parts; and that hence it is more eaſy to conceive how a cube muſt neceſſarily be compoſed of other cubes, than how a polypus can be compoſed of other polypi. But, if we examine attentively what is meant by ſimple and compound, we ſhall find, that in this, as in every thing elſe, the plan of Nature is very different from the groſſneſs and imperfection of our conceptions.

Our ſenſes, it is well known, convey not to us exact repreſentations of external objects. When we want to calculate, to judge, to compare, to weigh, to meaſure, &c. we are obliged to have recourſe to foreign aid, to rules, to prin-

 ciples,

ciples, to uſages, to inſtruments, &c. All theſe adminicles are efforts of human genius, and belong more or leſs to the abſtraction of our ideas. This abſtraction, with regard to us, conſtitutes the ſimplicity of things; and the difficulty of reducing them to this abſtraction is the compound. Extenſion, for example, being a general and abſtract property of matter, is not much compounded. In order, however, to judge concerning it, we have imagined ſome extenſions to have no thickneſs, others to have neither thickneſs nor breadth, and points, which are extenſions without being extended. All theſe abſtractions have been invented as ſupports to the underſtanding; and the few definitions employed in geometry have given riſe to numberleſs prejudices and falſe conceptions. Whatever is reducible under any of theſe definitions is called ſimple; and ſuch things as cannot be eaſily reduced to this ſtandard are conſidered as complex. Thus, a triangle, a ſquare, a circle, a cube, and alſo thoſe curves of which we know the geometrical properties, are regarded as ſimple. But every thing which we cannot reduce under theſe figures, or abſtract rules, appears to us to be complex. We never reflect, that all theſe geometrical figures exiſt no where but in our own imaginations, or that, if they are ever found in Nature, it is only becauſe ſhe exhibits every poſſible form; and the appearance of ſimple figures, as an exact cube, or an equilateral pyramid, is, perhaps,

perhaps, more difficult and rare to be found in Nature, than the complex forms of plants or of animals. It is in this manner that we perpetually conſider the abſtract as ſimple, and the real as complex. But, in nature, no abſtract exiſts; nothing is ſimple; every object is compounded. We are unable to penetrate into the intimate ſtructure of bodies. We cannot, therefore, determine what objects are more or leſs complex, unleſs by the greater or leſs relation they have to ourſelves, and to the reſt of the univerſe. For this reaſon we regard the animal as being more complex than the vegetable, and the vegetable than the mineral. With reſpect to us, this notion is juſt; but we know not whether the animal, vegetable, or mineral, be, in reality, the moſt complex or the moſt ſimple; and we are ignorant whether the production of a globe or a cube requires a greater effort of Nature than that of a germ, or an organic particle. If we were to indulge in conjectures upon this ſubject, we might imagine that the moſt common and numerous objects are the moſt ſimple. But this would make animals more ſimple than plants or minerals; becauſe the former exceed the latter in number of ſpecies.

But, without dwelling longer on this ſubject, it is ſufficient to have ſhown, that all our notions concerning ſimple and compound, are abſtract ideas; that they cannot be applied to the complex operations of nature; that, when we

attempt to reduce all bodies into elements of a cubical, priſmatic, globular, or any other regular figure, we ſubſtitute our own imaginations in oppoſition to real exiſtences; and that the forms of the conſtituent particles of different bodies are abſolutely unknown to us; and, of courſe, we may believe or ſuppoſe that organized beings are compoſed of ſimilar organic particles, as well as that a cube conſiſts of other cubes. We have no other method of judging but by experience. We know that a cube of ſea-ſalt is compoſed of many leſſer cubes, and that an elm conſiſts of a great number of minute elms; becauſe if we take a piece of a branch, of a root, of the wood ſeparated from the trunk, or a ſeed, from all theſe a new tree is produced. The polypus, and ſome other ſpecies of animals, may likewiſe be multiplied by cuttings ſeparated from any part of their bodies; and, as our rule of judging in both caſes is the ſame, why ſhould we form a different opinion concerning them?

The above reaſoning renders it extremely probable, that there really exiſts in Nature an infinite number of ſmall organized beings, every way ſimilar to thoſe large organized bodies which make ſuch a conſpicuous figure in this world; that theſe ſmall organized beings are compoſed of living organic particles, which are common both to animals and vegetables, and are their primary and incorruptible elements; that an aſſemblage of theſe particles conſtitutes an animal

animal or a plant; and, conſequently, that reproduction or generation is nothing but a change of form, effected ſolely by the addition of ſimilar particles; and the death, or reſolution of organized bodies, is only a ſeparation of the ſame particles. Of the truth of this doctrine not a doubt will remain, after the proofs delivered in the following chapters are peruſed. Beſides, if we reflect on the growth of trees, and conſider what an immenſe maſs is produced from ſo ſmall an origin, we muſt be perſuaded that this increaſe of matter is effected by the ſimple addition of organic particles which are ſimilar to one another and to the whole. The ſeed firſt produces a ſmall tree, which it contained in miniature within its coats. At the top of this ſmall tree a bud is formed, which contains the tree that is to ſpring the next ſeaſon; and this bud is an organized body ſimilar to the ſmall tree of the preceding year. The ſmall tree of the ſecond year, in the ſame manner, produces a bud which contains a tree for the third year; and this proceſs uniformly goes on as long as the tree continues to vegetate: Buds are likewiſe formed at the extremity of each branch, which contain, in miniature, trees ſimilar to that of the firſt year. It is evident, therefore, that trees are compoſed of minute organized bodies ſimilar to themſelves, and that the whole individual is formed by a numerous aſſemblage of minute and ſimilar individuals.

But, it may be demanded, were not all theſe minute, and ſimilarly organized bodies, contained in the ſeed? and may not the order of their unfolding be traced from that ſource? for it is apparent, that the firſt bud was ſurmounted by a ſimilar bud, which was not expanded till the ſecond year, and the third bud was not unfolded till the third year; and, conſequently, the ſeed may be ſaid to have really contained the whole buds which would be formed for 100 years, or till the diſſolution of the plant: It is alſo apparent, that this ſeed contained not only all the ſmall organized bodies which muſt in time have conſtituted the individual tree itſelf, but likewiſe all the ſeeds, and all the individuals which would ſucceſſively ariſe, till the final deſtruction of the ſpecies.

This, indeed, is a capital difficulty: We ſhall therefore examine it with the greater attention. It is true, that the ſeed produced a ſmall tree the firſt year, ſolely by the unfolding of the bud or germ which it contained, and that this ſmall tree exiſted in miniature in the bud. But it is not equally certain that the bud of the ſecond year, and thoſe of the ſucceeding years, nor that all the ſmall organic bodies, and the ſeeds which muſt have been formed till the end of the world, or the deſtruction of the ſpecies, were contained in the firſt ſeed. This opinion ſuppoſes an infinite progreſſion, and makes every individual a ſource of eternal generations. The firſt

firſt ſeed, for inſtance, muſt have included all the plants of its ſpecies which have exiſted, or ever will exiſt; and the firſt man muſt have contained in his loins all the men who have appeared, or ever will appear, on the face of the earth. Every ſeed, and every animal, according to this doctrine, muſt have included in its own body an infinite poſterity. If we yield to reaſonings of this kind, we muſt loſe ſight of truth in the labyrinths of infinity; and, in place of ſolving, or of throwing light upon the queſtion, we will involve it in tenfold obſcurity. It is removing the object beyond the reach of our viſion, and then complaining that it cannot be ſeen.

Let us inveſtigate the nature of the ideas of infinite progreſſion and expanſion. How do we acquire them? In what do they inſtruct us? We derive the idea of infinity from the idea of what is limited. It is in this manner we obtain the ideas of infinite ſucceſſion, and geometrical infinity: Every individual is a unit; ſeveral individuals make a limited number; and a whole ſpecies is to us an infinite multitude. From the ſame data by which we have demonſtrated the nonentity of geometrical infinity, we might prove, that infinite ſucceſſion, or propagation, reſts on no firmer baſis; that it is only an abſtract idea, a mere deduction from the idea of finite objects, by lopping off the limits which neceſſarily terminate every magnitude*; and, of courſe, that

* See this fully demonſtrated in my preface to the French tranſlation of Newton's Fluxions, p. 7.

every

every opinion which infallibly leads to the idea of actual exiſtence, upon no better authority than what is derived from geometrical or numerical infinity, ought to be rejected.

The partizans of this opinion are now reduced to the neceſſity of acknowledging, that their infinity of ſucceſſion and of multiplication is only an indeterminable or indefinite number. But, ſay they, the firſt ſeed, of an elm, for example, which weighs not a grain, actually contains all the organic particles requiſite for the formation of this tree, and of all the individuals of the ſame ſpecies which ſhall ever appear. Is this a ſolution of the difficulty? Is it not cutting the knot, in place of untying it?

When in reply to the queſtion, how beings are multiplied? it is anſwered, that the multiplication was completed in the creation of the firſt individuals, is not this both an acknowledgment of ignorance, and a renouncing of all deſire of farther improvement? We aſk how one being produces its like? and we receive for anſwer, that the whole was created at once. A ſtrange ſolution; for, whether one only or a thouſand generations had paſſed, the ſame difficulty remains, and, inſtead of removing it, the ſuppoſition of an indefinite number of germs, all exiſting and contained in a ſingle germ, increaſes and renders it altogether incomprehenſible.

I allow, that it is much eaſier to find fault, than to inveſtigate truth, and that the queſtion concerning

concerning reproduction is perhaps of ſuch a ſubtile nature, as not to admit of a full and ſatisfactory explication. But we ought at leaſt to inquire whether it be altogether inſcrutable; and, in the courſe of this inquiry, we will diſcover all that can be known, and the reaſon why we can know no more.

Queſtions or inquiries are of two kinds; the firſt regard primary cauſes, the other particular effects. If, for example, it be aſked why matter is impenetrable? we muſt either return no anſwer, or reply by ſaying, that matter is impenetrable, becauſe it is impenetrable. The ſame anſwer muſt be made, if we inquire into the cauſe of gravity, of extenſion, of the inertia of bodies, or of any general quality of matter. Such is the nature of all general and abſtract qualities, that, having no mode of comparing them with other objects in which they do not exiſt, we are totally incapable of reaſoning concerning them; and therefore all inquiries of this kind, as they exceed the powers of human intellect, are perfectly uſeleſs.

But, on the other hand, if the reaſon of particular effects be demanded, we are always in a condition to give a diſtinct anſwer, whenever we can ſhow that theſe effects are produced by one of the general cauſes; and the queſtion is equally ſolved, whether the particular effect proceeds immediately from a general cauſe, or from a chain

chain of ſucceſſive effects, provided we have a clear conception of the dependence of theſe effects upon each other, and of their mutual relations.

But, when a particular effect appears not to have any dependence upon more general effects, or has no analogy to thoſe already known, we are then totally unable to give any explication of ſuch effect; becauſe we have no ſimilar object with which it can be compared. We cannot explain a general cauſe, becauſe it equally exiſts in every object; and, on the contrary, we can give no account of a ſingle or iſolated effect; becauſe the ſame quality exiſts not in any other ſubject. To explain a general cauſe, we muſt diſcover one ſtill more general; but a ſingle and detached effect may be illuſtrated by the diſcovery of an analogous effect, which experience or accident may exhibit.

There is ſtill another kind of queſtion, which may be called a queſtion of fact. For example, why do trees, dogs, &c. exiſt? All queſtions of this kind are perfectly inſolvable; for thoſe who ſolve them by final cauſes conſider not that they miſtake the effect for the cauſe: The relation of particular objects to ourſelves has no connection with their origin. Moral affinity or fitneſs can never become a phyſical reaſon.

Queſtions in which we employ the word *Why*, ought to be carefully diſtinguiſhed from thoſe in

in which we employ *How*, and ſtill more from thoſe in which we ought to uſe the words *how much* or *how many*. *Why* always relates to the cauſe of the effect, or to the effect itſelf; *how* relates to the manner in which the effect happens; and *how much* relates to the meaſure or quantity of the effect.

Theſe diſtinctions being eſtabliſhed, let us now examine the queſtion concerning the reproduction of beings. If it be demanded *why* animals and vegetables continue their ſpecies? we clearly perceive that this is a queſtion of fact, and therefore it is uſeleſs and inſolvable. But, if it be aſked *how* animals and vegetables are reproduced? we are enabled to ſolve the queſtion, by giving the hiſtory of the generation of every ſpecies of animal, and of the reproduction of every ſpecies of plant: After tracing, however, every poſſible method of propagation, and making the moſt exact obſervations, we have learned the facts only, but have not diſcovered the cauſes: And, as the means Nature employs in multiplying and containing the ſpecies, ſeem to have no relation to the effects produced, we are ſtill under the neceſſity of aſking, by what ſecret cauſe ſhe enables beings to propagate their kinds?

This queſtion is very different from the firſt and ſecond. It admits of nice ſcrutiny, and even allows us to employ the powers of imagination. It is, therefore, by no means inſolvable; for

for it belongs not to a general cauſe. Neither is it ſolely a queſtion of fact: And if we can conceive a method of reproduction, depending on primary cauſes, or which, at leaſt, is not repugnant to them, we ought to be ſatisfied with it; and the more relation it has to the other effects of Nature, it will reſt upon a firmer baſis.

By the nature of the queſtion, then, we are permitted to form hypotheſes, and to chooſe that which appears to have the greateſt analogy to the other phænomena of nature. But we ought to reject every hypotheſis which ſuppoſes the thing to be already accompliſhed; ſuch, for example, as that which ſuppoſes the firſt germ to contain all the germs of the ſame ſpecies, or that every reproduction is a new creation, an immediate effect of the will of the Deity; for all hypotheſes of this kind are mere matters of fact, concerning which it is impoſſible to reaſon. We muſt likewiſe reject every hypotheſis which is founded on final cauſes, ſuch as, that reproduction is ordained in order to replace the living for the dead; that the earth may always be covered with vegetables and peopled with animals; that men may be ſupplied with abundance of nouriſhment, &c.; for ſuch hypotheſes, in place of explaining the effect by phyſical cauſes, ſtand on no other foundation than arbitrary relations and moral affinities. We ought, at the ſame time, to deſpiſe thoſe general axioms and phyſical problems ſo frequently and ſo injudiciouſly employed

employed as principles by ſome philoſophers, ſuch as, 'Nulla fœcundatio extra corpus;' every living creature proceeds from an egg; generation always ſuppoſes ſexes, &c. Theſe maxims muſt not be taken in an abſolute ſenſe; they ſignify no more than that the thing happens more commonly in this manner than in any other.

Let us then endeavour to find an hypotheſis that will be liable to none of theſe defects or incumbrances; and, if we ſhall not ſucceed in explaining the mechaniſm employed by Nature for the reproduction of beings, we ſhall, at leaſt, be able to approach nearer to the truth than we have hitherto reached.

In the ſame manner as we make moulds by which we can beſtow on the external parts of bodies whatever figure we pleaſe, let us ſuppoſe, that Nature can form moulds by which ſhe beſtows on bodies both an external and internal figure; would not this be one method by which reproduction might be effected?

Let us firſt conſider whether this ſuppoſition be well founded; let us examine whether it contains any thing that is abſurd or contradictory; and then we ſhall diſcover what conſequences may be drawn from it. Though our ſenſes reach not beyond the external parts of bodies, we have clear ideas of their different figures and external affections, and we can imitate Nature, by repreſenting external figures in different

different ways, as by painting, by ſculpture, and by moulds. But, though our ſenſes be limited to external qualities, we know that bodies poſſeſs internal qualities, ſome of which are general, as gravity. This quality or power acts not in proportion to the ſurfaces, but to the maſſes, or the quantities of matter. Thus there are in Nature powers, and even of the moſt active kind, which penetrate the internal parts of matter. We are unable to form diſtinct ideas of ſuch qualities; becauſe, not being external, they fall not under the cogniſance of our ſenſes. But we can compare their effects, and may draw analogies from them, in order to account for the effects of ſimilar qualities.

If our eyes, inſtead of repreſenting to us the ſurfaces of bodies only, were ſo conſtructed as to perceive their internal parts alone, we ſhould then have clear ideas of the latter, without knowing any thing of the former. Upon this ſuppoſition, moulds for the internal conſtitution, which I have ſuppoſed to be employed by Nature, would be equally obvious and eaſy to conceive as moulds for the external figures of bodies; and we ſhould then be in a condition to imitate the internal parts of bodies, as we now imitate the external. Theſe internal moulds, though beyond our reach, may be in the poſſeſſion of Nature, as ſhe endows bodies with gravity, which penetrates every particle of matter. The ſuppoſition of internal moulds being thus

thus founded on analogy, let us next examine whether it involves any contradiction.

It may be alledged, that the expreſſion, *internal mould*, includes two oppoſite and contradictory ideas; for the idea of a *mould* relates only to the ſurface; but the idea of internal, as here employed, has a relation to the whole maſs; and therefore we might, with equal propriety, talk of a maſſy ſurface as of an internal mould.

I allow, that, when ideas are attempted to be repreſented which have never been expreſſed, we are ſometimes obliged to uſe terms that are apparently contradictory. To avoid this inconvenience, philoſophers have been accuſtomed to employ unuſual terms, inſtead of thoſe which have a received ſignification. But this artifice is of no uſe, when we can ſhow, that the ſeeming contradiction lies in the words, and not in the idea. A ſimple idea, however, cannot include a contradiction; *i. e.* whenever we can form an idea of a thing, if this idea be ſimple, it cannot be complex; it can include no other idea; and, of courſe, it can contain nothing that is oppoſite or contradictory.

Simple ideas are not only the firſt apprehenſions received by the ſenſes, but the firſt compariſons which we form of theſe apprehenſions: For the firſt apprehenſion is always the reſult of compariſon. The idea of the largeneſs or diſtance of an object neceſſarily implies a compariſon with bulk or diſtance in general. Thus,

when an idea includes nothing more than compariſon, it ought to be regarded as ſimple; and, conſequently, it can contain nothing contradictory. The idea of an internal mould is of this ſpecies. There is in nature a quality known by the name of gravity, which penetrates the internal parts of bodies. I underſtand the idea of an internal mould to be relative to gravity; and, therefore, as it includes only a compariſon, it can imply no contradiction.

Let us now trace the conſequences which may be drawn from this ſuppoſition; let us likewiſe inveſtigate ſuch facts as may correſpond with it; and the more analogies we can collect, the ſuppoſition will be rendered the more probable. We ſhall begin with unfolding the idea of internal moulds; and then explain how it may lead us to conceive the mode of reproduction.

Nature, in general, appears to have a greater bias towards life than death: She ſeems anxious to organize bodies as much as poſſible. Of this the multiplication of germs, which may be infinitely increaſed, is a convincing proof; and it may be ſafely affirmed, that, if all matter is not organized, it is only becauſe organized beings deſtroy one another; for we can increaſe at pleaſure the number of animals and vegetables; but we cannot augment the quantity of ſtones or of dead matter; which ſeems to indicate, that the moſt ordinary and familiar operation of Nature

ture is the production of organized bodies; and here her power knows no limitation.

To render this idea more plain, we ſhall calculate what may be produced by a ſingle germ. The ſeed of an elm, which weighs not above the hundredth part of an ounce, will, in 100 years, form a tree, of which the maſs will amount to ten cubic fathoms. But, at the tenth year, this elm will have produced 1000 ſeeds, each of which, in 100 years more, will conſiſt of ten cubic fathoms. Thus, in the ſpace of 110 years, more than 10,000 cubic fathoms of organized matter are produced. Ten years after, we ſhall have ten million of fathoms, without including the annual increaſe of 10,000 which would amount to 100,000 more; and in ten years more, the number of cubic fathoms would be 10,000,000,000,000. Hence, in 130 years, a ſingle germ would produce a maſs of organized matter equal to 1000 cubic leagues; for a cubic league contains only about 10,000,000,000 cubic fathoms. Ten years after, this maſs would be increaſed to a thouſand times a thouſand leagues, or one million of cubic leagues; and in ten more it would amount to 1,000,000,000,000 cubic leagues; ſo that, in the ſpace of 150 years, the whole globe might be converted into organized matter of a ſingle ſpecies. Nature would know no bounds in the production of organized bodies, if her progreſs were not obſtructed by matter

which is not ſuſceptible of organization; and this is a full demonſtration that ſhe has no tendency to increaſe brute matter; that her ſole object is the multiplication of organized beings; and that, in this operation, ſhe never ſtops but when irreſiſtible obſtacles occur. What we have remarked concerning the ſeed of an elm may be extended to any other germ; and it would be eaſy to ſhow, that, by hatching all the eggs which are produced by hens for a courſe of 30 years, the number of fowls would be ſo great as to cover the whole ſurface of the earth.

Calculations of this kind evince the tendency of Nature towards the production of organized bodies, and the facility with which ſhe performs the operation. But I will not ſtop here. Inſtead of dividing matter into *organized* and *brute matter*, the general diviſion ought to be into *living* and *dead matter*. That *brute matter* is nothing but matter produced by the *death* of animals and vegetables, might be proved from the enormous quantities of ſhells, and other relics of living bodies, which conſtitute the principal parts of ſtones, marbles, clays, marls, earths, turfs, and other ſubſtances that are commonly reckoned *brute matter*, but are, in reality, compoſed of decayed animals and vegetables. This doctrine will be farther illuſtrated by the ſubſequent remarks, which appear to be well founded.

The

The great facility and activity of Nature in the production of organized bodies, the exiſtence of infinite numbers of organic particles which conſtitute life, have been already ſhown. We now proceed to inquire into the principal cauſes of death and deſtruction. In general, beings which have a power of converting matter into their own ſubſtances, or of aſſimilating the parts of other beings, are the greateſt deſtroyers. Fire, for example, which converts almoſt every ſpecies of matter into its own ſubſtance, is the greateſt ſource of deſtruction that we are acquainted with. Animals ſeem to partake of the nature of flame; their internal heat is a ſpecies of fire approaching to flame. Accordingly, animals are the greateſt deſtroyers; and they aſſimilate and convert into their own ſubſtance all bodies which can ſerve them for nouriſhment. But, though theſe two cauſes of deſtruction be conſiderable, and their effects tend perpetually to the deſtruction of organized bodies, the cauſe of reproduction is infinitely more active and powerful. It even ſeems to derive, from deſtruction itſelf, freſh powers of multiplying; for aſſimilation, which is one cauſe of death, is, at the ſame time, a neceſſary mean of producing life.

The deſtruction of organized bodies, as has been remarked, is only a ſeparation of the organic particles of which they are compoſed. Theſe particles continue ſeparate till they be again

united by ſome active power. But what is this power? It is the power, poſſeſſed by animals and vegetables, of aſſimilating the matter of their food; and is not this the ſame, or nearly connected with the ſame power which is the cauſe of reproduction?

CHAP. III.

Of Nutrition and Growth.

AN animal body is a kind of internal mould, in which the nutritive matter is ſo aſſimilated to the whole, that, without changing the order or proportion of the parts, each part receives an augmentation. This increaſe of bulk has, by ſome philoſophers, been called an expanſion or unfolding of the parts; becauſe they fancied they had accounted for the phænomenon, by telling us, that the form of an animal in embryo was the ſame as at full maturity, and that, therefore, it was eaſy to conceive how its parts ſhould be proportionally unfolded and augmented by the addition of acceſſory matter.

But, how can we have a clear idea of this augmentation or expanſion, if we conſider not the bodies of animals, and each of their parts, as ſo many internal moulds which receive the acceſſory matter in the order that reſults from their poſition and ſtructure? This expanſion cannot be effected ſolely by an addition to the ſurfaces, but, on the contrary, by an intus-ſuſception, or by penetrating the whole maſs; for the ſize of