An essay on generation / by J. F. Blumenbach ; translated from the German.

ON

GENERATION.

AN ESSAY

ON

GENERATION.

BY

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TRANSLATED FROM THE GERMAN.

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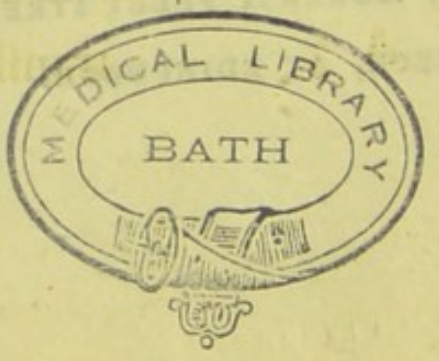

THE

Translator's Preface.

THE general curioſity, which has at times manifeſted itſelf among Phyſiologiſts, to diſcover the nature of that proceſs, by which the animal part of the creation is formed, and the difficulties which oppoſe themſelves to ſuch reſearches, might be conſidered as ſufficient motives for

tranſlating any new work, whoſe principal view conſiſts in endeavouring to correct ſome prevailing errors, or to enlarge our ideas in regard to the ſubject in queſtion.

The following Eſſay claims our attention in both theſe reſpects. It may be conſidered not only as an attempt at a refutation of one of the moſt favourite hypotheſes on the ſubject of Generation; I mean that of the Evolution of pre-exiſting organic germs; but alſo, as an attempt to eſtabliſh, upon the baſis of experiment, a better, and more conſiſtent theory.

The

The great knowledge and extenſive information, which my valuable and learned Friend the Author poſſeſſes, not only in phyſiology, and comparative anatomy, but in every branch of natural hiſtory, and, which he has ſufficiently evinced in his numerous writings; at the ſame time, that they prepoſſeſs us with the idea, that he is well fitted for ſuch an enquiry, ſerve alſo, as a further juſtification, if a juſtification be neceſſary, of the part which I have taken in it. Whether I have executed my taſk faithfully, I muſt leave to others to decide.

That

That the concluſions of Spallanzani, whoſe works may be conſidered as the chief ſupport of the theory of pre-exiſting organic germs, require both ſome degree of reſtriction, and a more accurate examination, than they have hitherto met with, will appear evident from the Second Section of the following Eſſay, where the doctrine of Evolution is particularly noticed.

If the admirers of Haller, Bonnet, and Spallanzani, be ſurpriſed at the manner in which their doctrines are attacked, they are to conſider, that controverſy

controverſy never yet injured the cauſe of truth, and that by open and candid examination alone, we are often able to remove the deceptions of prejudice and error. Never did a well-founded theory ſuffer by the moſt ſevere, and critical inveſtigation; on the contrary, nothing is better calculated to diſcover its value, and eſtabliſh its reputation.

I have only to add, that in tranſlating the compound word (*Bildungſtrieb*), I have been obliged to make uſe of a Latin expreſſion. The word *Niſus*, which conveys the full ſenſe of the

the word *Trieb*, does not appear to have any ſynonyme in the Engliſh language.

A. CRICHTON.

N°. 10, *Spring Garden*,
Nov. 23d, 1792.

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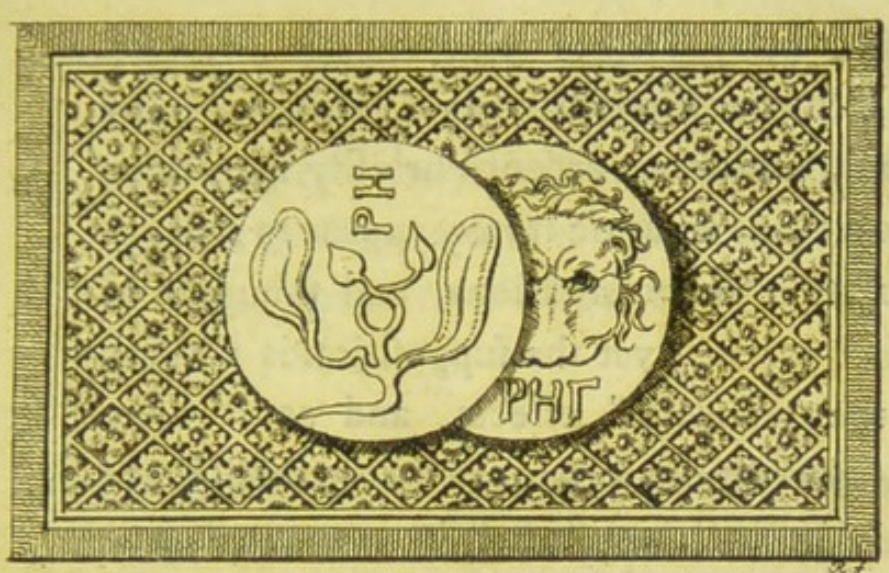

SECTION I.

Of the various Hypotheſes, by which the Phenomena of Generation have been attempted to be explained.

WHAT is the nature of that change, which takes place within a female, when after having experienced the moſt delightful of all ſenſual pleaſures, and being duly impregnated, form, and exiſtence are about to be given to her offspring?

Few queſtions have ever awakened more general, and more ardent curioſity than this; for however romantic it may appear to attempt to aſcertain the obſervations, and thoughts of our firſt parents, yet the ſuppoſition is natural, that the wonderful effects, and as it were repeated creations produced by the indulgence of this inſtinct, muſt firſt have excited their ſurpriſe, and then led them to a train of reflections.

Conſidering the innumerable times the phenomena of generation have occurred ſince the days of Adam, it becomes a humiliating reproach to the underſtanding of his deſcendants, that during all that long ſucceſſion of time, they have not been able to give any ſatisfactory explanation of the matter; eſpecially as it appears to have ſoon become a very early ſubject of ſtudy with ſpeculative men: at leaſt moſt of the phyſiological fragments of the ancient philoſophers and phyſicians,

cians(a), which have been handed down to us, conſiſt in general of inquiries into the myſteries of generation; and indeed ſince that, there is hardly a period in which the ſame kind of reſearches have not been more or leſs proſecuted.

Even in the darkeſt times of the middle ages, when the ſpirit of inquiry ſeemed almoſt entirely loſt in the lethargy of monaſtic barbariſm, this ſubject appears every now and then to have awakened a ſpark of curioſity, and to have ſtimulated ſome of the holy fathers of thoſe times to the compoſition of very ſenſual and obſcene works, ſome of which have reached our days(b), and ſerve to prove

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(a) *For inſtance, thoſe of Orpheus, Pythagoras, Anaxagoras, &c.*

(b) *Such as that of Pope John* XXth, *or Biſhop Abert the Great, or whatever holy father of the church it was, who wrote that vile book de Secretis Mulierum. One may alſo add Mich. Scotus, the ſcrutinizer of natural things.*

 that

that their authors were at leaſt intereſted in the theoretical, if not in the practical part of generation.

We are not therefore to be ſurpriſed, that the attempt to ſolve this great problem of nature encreaſed rapidly, beyond the power of numbering, leaving no paſſage untrod which afforded any hopes of leading to a ſolution of the myſtery; hence there hardly exiſts another ſpot in the whole region of natural knowledge, ſurrounded by more intricate labyrinths, or falſe guides than this.

Drelingcourt, a teacher of Boerhaave's, collected no leſs than two hundred and ſixty-two vague hypotheſes on generation, from the writings of earlier writers.

In ſpite of the aſtoniſhing variety, and number of paths, which ſeemed to lead to the ſolution of this phyſiological problem, yet they are all of them but ſo many branches of two principal roads; the one conducting to the doctrine

doctrine of *Evolution*, the other to that of *Epigeniſis*.

It is either ſuppoſed that the prepared, but at the ſame time unorganized rudiments of the fœtus, firſt begins to be gradually organized when it arrives at its place of deſtination at a due time, and under the neceſſary circumſtances. This is the doctrine of Epigeniſis;

Or, we deny every ſort of generation, and believe that the germ of every animal, and every plant that ever has lived and ever will live, were all created at one and the ſame time, namely, at the beginning of the world; and that all that is neceſſary is, that one generation ſhould be developed after the other. Such is the celebrated theory of Evolution.

But the manner in which this evolution happens, has been differently accounted for.

Heraclitus, ſurnamed the gloomy, and Hippocrates, or whoever the author of thoſe books on regimen was, which appeared under his name, together with many of their followers, were of opinion, that thoſe germs were ſcattered up and down the whole globe, where they wandered about, each in ſearch of the genitals of a ready made relation of their own kind, which having once found, they took lodgement there, threw off their envelopement, and now became fit for being themſelves evolved.

If we except the impoſing name of the authors to whom this theory is aſcribed, it has little elſe to recommend it to our attention. It is ſo completely built on fanciful ſuppoſitions, that it would be difficult to ſay, what hypotheſis might not be credited were we to yield the ſmalleſt faith to ſuch a doctrine. The late profeſſor Geſner, who wrote a commentary on this romance of Hippocrates, apologizes for himſelf by adopting the *bon mot* of Queen Chriſtina, " that the chi-

" meras

" meras of the ancients were juſt as good as " thoſe of the moderns."

More approbation has been given to two other theories of evolution, according to each of which, the germs did not wander about, but thoſe of the ſame kind were all neatly wrapt up, and encaſed one within another, ſo that the firſt parent of each animal, and plant was ſuppoſed to contain all the germs of every ſucceeding generation; copulation only ſerving to awaken them to their ſtate of evolution. The only difference between the two theories was, that the one ſuppoſed the germs to inhabit the teſticles of their father, whilſt the other would have it, that they reſided in the ovaria of their mother.

No ſooner was the art of making magnifying glaſſes diſcovered, and by that means an opening procured to a new world in the creation, than the novelty of the diſcovery, and facility of its application, by af-

fording an opportunity to a number of microſcopical experiments, naturally led to the moſt unexpected ſights.

Among the great amateurs of this kind of amuſement, was one Ludwig von Hammon, a young man born at Dantzig, who during the time of his ſtudying medicine at Leyden, and in the courſe of his microſcopical purſuits, diſcovered in the month of Auguſt 1677, in a drop of the ſemen of a cock recently diſſected, a kind of ocean, in which ſwam thouſands of little lively active animals.

The ſame unexpected phenomenon was alſo obſerved in the ripe ſemen of other male animals, and in theſe animalculæ were immediately thought to be ſeen, the germs of ſubſequent perfect animals. By this diſcovery, a key was ſuppoſed to be found, which would unlock the whole myſtery of generation.

Now I cannot conceive how ſome profeſſed philoſophers, and natural hiſtorians have been

been led to deny life and voluntary motion to thoſe animalculæ; but I am ſtill more at a loſs to imagine, how another ſet of philoſophers have been induced to dignify theſe animalculæ of a ſtagnant animal fluid, to the high rank of the organized germs of ſucceſſive generations.

Without entering into a long and tedious detail of all the doubts and difficulties, which riſe up in oppoſition to ſo ſingular a theory, I ſhall content myſelf with adding a few reflections, which to the moſt uninformed readers, will appear ſufficient for calling in queſtion this imaginary dignity of the animalculæ of the ſemen of animals.

How comes it that the animalculæ of the ſemen of animals the moſt nearly related, differ ſo much from each other, whilſt ſcarce any two things reſemble one another ſo much as the animalculæ of animals, the moſt oppoſite to each other, both in nature and form?

For inſtance, the animalculæ in the ſemen of frogs, as repreſented by Mr. von Gleichen, bear no kind of reſemblance to thoſe of the common newt, as repreſented by Spallanzani; whereas on the other hand, two drops of water cannot reſemble each other more ſtrongly, than the animalculæ of the ſemen of a man, and thoſe of an aſs, as repreſented by the firſt of theſe accurate obſervers.

This ſame modern advocate for the dignity of theſe animalculæ, has already diſcovered two kinds of them in the ſame drop of ſemen of a frog, and yet both of them are perfectly diſtinct from thoſe which Roeſel repreſents as animalculæ of the ſemen of the ſame animal; beſides the former were not only diſcovered in the veſiculæ ſeminales, but alſo in the kidneys: mere appearances, as evinced by the irregular and uncertain ſhape of the inhabitants of the male ſemen, and which irregularity and uncertainty refutes their pretended dignity ſo completely, that one might as well

hope

hope with Paracelſus(c), and the Painter Gautier(d), to be able to produce a perfect human embryo from male ſemen, or expect to ſee, as the famous academician Hartzoeker af-

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(c) *On the nature of things, addreſſed to John Winkelſteiner von Feyburg at Uchtland, in the ſixth volume of Huſer's edition of his works*, p. 263.

Amatus Luſitanas deſcribes a ſimilar production: Vide Curation, Medicinal Cent. VI. *curat.* 55, *ſcholi*, p. 612. " *Certo ſcimus chemico* " *artificio puerum conflatum eſſe et omnia ſua mem-* " *bra perfecta contraxiſſe, ac motum habuiſſe, qui* " *cum a vaſe ubi continebatur eſſet extractus mo-* " *veri deſiit. Novit hæc accuratius Julius Ca-* " *millus vir ſingularis doctrinæ et rerum occulta-* " *rum, et variarum hac noſtra ætate magnus ſcru-* " *tator et Hetruſca ſua lingua ſcriptor diligentiſſimus* " *et accuratiſſimus.*"

(d) *Vide Generation de l'Homme et des Animaux, Paris* 1750. 12. *Alſo his Obſervations ſur l'Hiſt. Nat.* 1 p. *and the miſhapen repreſentation of a fœtus drawn by himſelf and coloured after life. Tab.* A. *fig.* 3.

ſures us he did, the little embryo ſitting in the body of each animalcule, in the ſame crooked and confined poſture as in the female womb(c).

Long before the animalculæ of the ſemen were diſcovered, Joſeph de Aromatariis found out a third way to explain the myſtery of generation, by means of the theory of evolution; I mean that one which ſuppoſes the ovaria of every female, even before impregnation, to contain a whole proviſion of organized molecules or germs, perfectly ready for evolution.

Swammerdam alſo adopted this opinion, but owing to the great figure which the

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(c) *Eſſai de Dioptrique, Paris* 1694. 4. p. 230, *where the lynx-eyed man gives an accurate figure of a child, which he obſerved in the body of one of the animalculæ of the ſemen, and which appeared to him as if anxiouſly expecting its deliverance.*

animalculæ

animalculæ of the ſemen ſoon afterwards made in the world, it remained but little known until two very diſtinguiſhed authors, Haller, and Bonnet, at once raiſed its reputation.

According to this theory we, and indeed all the children of Adam, were at one time *ipſo facto*, pent up in the two ovaria of our common mother Eve. There we lay, as it were aſleep, and although aſtoniſhing little creatures, yet completely organized bodies, and perfect miniatures of the forms we have ſince aſſumed; for ſays Haller, "*All our viſcera, and the bones themſelves were then already formed, although in a kind of fluid ſtate.*" That which we call impregnation, is nothing elſe than the action of awakening the germ from its lethargic ſtate by means of the male ſemen, which ſtimulates the little creature's heart to the firſt pulſation; and ſo on.

The ſame kind of idea has lately induced a very celebrated naturaliſt of Geneva, and a warm advocate of this theory, to plan out for us a hiſtory of organized bodies previous to the ſtate of impregnation, from which we learn, *firſt*, that we are all much older than what we ſuppoſe ourſelves to be, *ſecondly*, that all mankind are exactly the ſame age, the great grandfather not a ſecond older than the youngeſt of his great grand children, *thirdly*, that this reſpectable age, which we are all of, may be about ſix thouſand years. The ſame natural hiſtorian alſo agrees entirely in opinion with Bazin; that ſince that charming long ſeries of years, when we were all packed together along with Cain and Abel, and the other two hundred thouſand million of men, which according to the beſt calculations, have ſince that period gone *quo pius Æneas quo Tellus dives et Ancus*; in a word, ſince the firſt creation, during which time we have been in a kind of lethargic ſleep, though not entirely without motion; that during

during the whole fifty-ſeven centuries, I ſay, previous to our being awakened by the above-mentioned ſtimulus, we were according to Bazin's opinion, always growing a little and little: for inſtance, we were moſt probably rather a little bigger at the time we lay beſide Cain's nieces, than when all their uncles and aunts were of the party, as it is very natural to ſuppoſe, that we muſt then have been conſiderably more pinched for room. In this manner our apartment became gradually more eaſy, and commodious in proportion as our forefathers were evolved, and we agreed with it, for we kept continually ſtretching ourſelves more and more, until the ſucceſſion of evolution came at laſt to our turn!!

However extravagant and romantic ſuch concluſions muſt appear, yet they follow as natural deductions from the premiſes of the theory, which gave riſe to them. In ſupport of this theory, its moſt celebrated abettors, Haller, and Spallanzani, adduced many experiments, and obſervations, which we ſhall examine

examine more particularly in the next Section. When we conſider how concluſive and ſtriking theſe obſervations appear to be at firſt ſight, we ſhall not wonder at the general aſſent, which during theſe thirty years paſt, has been given to the doctrine of the pre-exiſtence of complete organized molecules in the ovaria of females before impregnation. I myſelf not only believed in the truth of it, but defended it in many of my writings; ſo that in fact the preſent little volume contains a confeſſion of my former errors, in regard to which, I wiſh that may be true, which Mr. de Luc ſays ſome where or other, that, " An error once detected, " becomes a more material truth, than many " poſitive ones, which we immediately ac- " knowledge to be ſuch."

The unexpected ſucceſs of a ſmall experiment, which I made, however, with a view of aſcertaining the truth of the doctrine of evolution, firſt brought me back to the point from which I ought to have ſet out, and

opened

opened a new road to a very oppoſite doctrine. He who thus fights with nature, may from an unexpected ſight, often diſcover her moſt concealed treaſures.

What gave occaſion to the inſtituting the experiment was as follows: In one of my walks during ſome holidays which I ſpent in the country, I diſcovered in a ſtream, a ſort of green armed polypus, which differed from the common green kind by its long ſpiral body, and by having ſhort and rather immoveable tentaculæ. With the wonders of this little animal, I intended to amuſe my country friends. The delightful warm ſummer weather which then prevailed, and the hardy conſtitution of the polypus itſelf, favoured the experiments which we made, to diſcover its power of reproduction ſo much, that the act of renewal of the parts became almoſt perceptible. By the ſecond and third day, the maimed and divided animal was ſo many new ones, each with arms, body, tail, &c.

&c. But we plainly remarked that the regenerated animals, although ſupplied with plenty of proper food, were always much ſmaller than before, and a mutilated rump, always diminiſhed very evidently, both in length and diameter, in proportion as the loſt parts were renewed(f).

Soon after my return to town, I was called to a patient who had a caries. The diſeaſe occupied the lower end of the femur immediately above the knee, and had cauſed

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(f) *It is probable that this circumſtance has been either totally overlooked by ſuch as were engaged in obſerving phenomena of greater magnitude in the hiſtory of this animal, or if it has been obſerved by any, it does not ſeem to have appeared to them, of ſufficient importance to be noticed. That attentive, and accurate obſerver Roeſel, however, ſeems to have noticed this fact. Vide Hiſt. der Polypen, in the third vol. of the Inſecten-beluſtigungen.*

a pretty

a pretty extenſive and deep ulcer. It healed gradually, but in proportion as the wound filled up, and the cicatrix formed, all the ſurrounding parts ſunk ſo, that the edge of the cicatrix being almoſt on an equality with the neighbouring parts, the whole formed a broad, though rather ſuperficial excavation(g). This was exactly the ſame thing *mutatis mutandis*, with what happened to the polypus.

I have ſince that period, ſpent a great deal of my leiſure moments in the further inveſtigation of this ſubject, both in experiment and reflection; the conſequence of which has been to convince me fully.

(g) *An obſervation which has been alſo made by Meſſrs. Louis and Fabre, vide their treatiſes Des Playes avec perte de ſubſtance in the Mem. de l'Acad. de Chirurg.* vol. iv. p. 64 *and* 106.

That

That there is no ſuch thing in nature, as pre-exiſting organized germs: but that the unorganized matter of generation, after being duly prepared, and having arrived at its place of deſtination takes on a particular action, or niſus, which niſus continues to act through the whole life of the animal, and that by it the firſt form of the animal, or plant is not only determined, but afterwards preſerved, and when deranged, is again reſtored. A niſus, which ſeems therefore to depend on the powers of life, but which is as diſtinct from the other qualities of living bodies, (ſenſibility, irritability, and contractility) as from the common properties of dead matter: that it is the chief principle of generation, growth, nutrition, and reproduction, and that to diſtinguiſh it from all others, it may be denominated the Formative Niſus (Bildungſtrieb, or Niſus formativus).

It is to be hoped, that there is no neceſſity for reminding the reader, that the expreſſion Formative Niſus, like that of Attraction,

traction(h), ſerves only to denote a power, whoſe conſtant operation is known from experience, but whoſe cauſe, like the cauſes of moſt of the qualities of matter, is a *qualitas occulta* to us(i). We may ſay of this, as of all

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(h) *Vid. Newton at the ena of his Optics:* "*What I call ATTRACTION, may be performed* "*by IMPULSE, or by ſome other means unknown* "*to me. I uſe that word here to ſignify only in* "*general any FORCE by which bodies tend to-* "*wards one another, whatever be the CAUSE.*"

(i) *Qualitas occulta*—"*Se l'on entend par ce* "*mot un principe reel dont on ne peut rendre raiſon* "*tout l'univers eſt dans ce cas.*" *&c. ſays Voltaire, vid. his Elemens de la Philoſphie de Newton.*

And in another place he further adds, "*Il* "*falloit reſpecter les qualités occultes; car depuis* "*le brin d'herbe que l'ambre attira, juſqu'à la* "*route que tant d'aſtres ſuivent dans l'eſpace;* "*depuis la formation d'une mite dans un fromage* "*juſqu'à la Galexie; ſoit que vous conſiderer, une* "*pierre qui tombe, ſoit que vous ſuiviez le cours* "*d'une*

all ſimilar powers, what Ovid ſays:—*Cauſa latet, vis eſt notiſſima.* But the great merit in the ſtudy of theſe powers, is to aſcertain more accurately their effects, and to reduce them under general laws(k).

D'Alembert's ſucceſſor, Mr. de Condorcet, in his Eulogy on Haller, and when ſpeaking of Irritability, ſays, " The truth of " this doctrine was, as uſually is the caſe, at " firſt denied; but when it was diſcovered,

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" *d'une comête traverſant les cieux tout eſt qualité* " *occulte.*"

(k) *One of the moſt learned, and ingenious Engliſh phyſicians of the preſent time, Dr. G. Fordyce, has very lately ſaid, in treating a phyſiological point ſomething ſimilar to this,* " *Although the* " *ſtudy of cauſes of original powers be totally abſurd* " *and futile, yet the laws of their action are ca-* " *pable of inveſtigation by experiment, and ap-* " *plicable to the evolving much uſeful knowledge.*" *Philoſoph. Tranſ.* V. LXXVIII. P. 1. p. 36.

" and

" and that could not be done any longer with " honour, they concluded with obſerving, " that it had been diſcovered long before!"

When it is conſidered that ſome people have been lately poſſeſſed of ſufficient penetration to diſcover the doctrine of irritability in the writings of Homer, and the circulation of the blood deſcribed in the books of Solomon the Preacher; it would be really aſtoniſhing if this doctrine of the Formative Principle were allowed the merits of novelty, and that nothing of the kind were to be diſcovered in all the works which have been written on the ſubject within theſe two thouſand years paſt(1); eſpecially as the *Vis Plaſtica*

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(1) *No one has given ſuch a clear proof of this as Ad. Mich. Birkholz, Philoſ. et Med. Dr. et Facult. Med. Aſſeſſ. in his Diſſert. de Reſpiratione ejuſque fine ſummo atque ultimo, Lips.* 1782. *After informing us, that the animal ſpirits (Spiritus vitales)*

Plaſtica of the ancients, and more particularly of the peripatetic ſchools, would ſeem as far as the concordance of name goes to attempt one to ſuch a *qui pro quo.*

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vitales) *which the blood derives from the air, is nothing more than the principium vitale of the antients, or the irritability and ſenſibility of Haller, he adds,* " *Veteres philoſophi hoc principium agnorerint* " *vicarium Dei miniſtrum et preſidentiam ſuperioris* " *agentis, et apud Græcos quidem ſub perſona Jovis* " *colebatur: Jovis omnia plena! a vetuſtiſſimis phi-* " *loſophis, a Platone, et platonicis Arabibus, et le* " *Cat, appellatur anima, ſpiritus et idea mundi, vis* " *et natura genetrix et plaſtica, ideæ operatrices: a* " *Rayo flamma vitalis; ab eodem et poſtea imprimis* " *a Newtono principium trahens: a chemicis humi-* " *dum radicale, et quintum elementum: a Colonne* " *inviſibilia fermenta: a Blumenbachio niſus for-* " *mativus. A philoſophis Hermeticis mercurius* " *univerſalis et philoſophorum: a Thouvenel Gas* " *Aëroelectricum, ab aliis aliter appellatur.*"

I ſhould

I ſhould be extremely happy, however, if any perſon would name one of the old writers, who, in deſcribing the Vis Plaſtica, has given ſuch a diſtinct idea of it, or ſuch a one as correſponds ſo well with the phenomena of generation(m), as that which I have attempted to give (eſpecially in the Third Section) of this Eſſay.

(m) *Of all authors who have treated of this power, F. Bonamica, the well-known diſciple of Ariſtotle, explains himſelf perhaps the moſt correctly, de formatione fœtus,* p. 528. "*Spiritus* "*in aërea ſeminis ſubſtantia comprehenſus, aſperſus* "*autem a calore cœleſti, et vi a patre accepta, et* "*ea quam a cælo participat in uterum fœminæ con-* "*jectus, concoquet materias a fœmena infuſas,* "*et pro ratione ipſarum variis modis afficiens efficit* "*inſtrumenta. Dum vero ea fabricat appellatur.* "*Facultas* διαπλαστικη *ſeu* δημιουργικη. *Sed ubi ex-* "*tructa fuerint inſtrumenta, ut iis uti queat, quæ* "*prius erat vis formatrix, illis utens degenerat in* "*animam.*"

Profeſſor Wolff of Peterſburg, a phyſiologiſt of great penetration, hath explained the growth of Animals, and Vegetables by another power, which he calls *Vis Eſſentialis*, and which one on firſt hearing, might be apt to confound with the *Niſus Formativus*.

Whoever takes the trouble, however, of peruſing the ſentiments which Profeſſor Wolff entertains of the *Vis Eſſentialis*, as given in his *Theoria Generationis*, will ſoon diſcern the great difference there is between the two(n).

According

(n) *For example*, p. 12. "*Vis vegetabilium "eſſentialis ea eſt vis, quâ humores ex circumjacente "terra, vel aliis corporibus colliguntur ſubire radicem "coguntur, per omnem plantam diſtribuuntur, par-"tem ad diverſa loca deponuntur, partem foras "expelluntur.*"

P. 13. "*Quæ cunque vero ſit hæc vis, ſive "attractrix, ſive propulſiva, ſive æri expanſo debita "ſive compoſita ex omnibus hiſce et pluribus; modo "præſtet*

According to him the *Vis Eſſentialis* is only that power, by which the nouriſhment is diſtributed to the different parts of an animal, or vegetable. This is, indeed, neceſſary to the Formative Principle; but it is quite diſtinct from the principle itſelf. For this

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" *præſtet enarratos effectus, et ponatur, poſita planta*
" *et humoribus nutriciis applicatis, id quod experien-*
" *tia confirmatum eſt: ſufficiet ea præſenti ſcopo et*
" *vocabitur a me Vis vegetabilium Eſſentialis:*

And in reſpect to the generation of animals, p. 73. " *Embryonem hoc tempore* (*ovo ſc.* 36. *horas*
" *incubato*) *ex ſubſtantia ovi nutrire demonſtrant il-*
" *lius volumen auctum, perfectiones acquiſitæ, abſen-*
" *tia cujuſcunque alius materiæ conſumtio alluminis et*
" *vitelli ſuccedens, experimenta inferius recenſenda;*
" *conſequenter: tranſire particulas nurientes ex ovo*
" *ad embryonem: et exiſtere vim quâ id perficitur*
" *quæ non eſt ſyſtaltica cordis et arteriarum, neque*
" *hinc facta preſſio in venas vicinas neque harum*
" *compreſſio a motu muſculorum, dirigentem abſque*
" *canalibus viam determinantibus, adeoque analogam*
" *illi* (§. 1.) *quam æque vocabo eſſentialem.*"

Vis Eſſentialis exerts itſelf with equal force in the growth of even the moſt deformed, and unnatural excreſcences of plants, and trees, &c. where the Formative Principle does not ſeem to act at all, or at leaſt with no regularity.

On the other hand, the Vis Eſſentialis may be very weak, or deficient, as in ſuch organized bodies, which are badly nouriſhed, whilſt the Formative Principle remains in full force, and ſo on.

However unpleaſant it may be to me, yet I feel myſelf forced, before entering more particularly on the nature of the Formative Principle, to premiſe a refutation of the arguments which have been brought, and eſpecially by Baron von Haller, in favour of evolution of the female egg(°). What conſoles

(°) *But in doing ſo, I ſhall paſs over all thoſe arguments againſt the doctrine of evolution, which*

ſoles me, however, in being thus obliged to diſſent from the opinions of a man, to whoſe works and writings I owe ſo much, is, partly the reflection, that whatever uſeful may be contained in the preſent ſheets, was occaſioned by examining into, and proſecuting his enquiries, and partly my doubts whether he himſelf might not have altered his ideas, and have relinquiſhed, in a great degree, his old opinions on the ſubject, had he lived to have finiſhed that part of the laſt edition of his Phyſiology(P), which treats of this matter.

Indeed,

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which have lately appeared in a moſt ingenious and witty publication, written expreſsly for that purpoſe. Vide Doubts concerning the Theory of Evolution, in a letter addreſſed to Monſ. Sonebier, from L. P. (Patrin) tranſlated form the original French manuſcript into German by G. Forſter, Goettengen, 1788.

(P) *He himſelf wrote me a letter, dated the* 28*th Auguſt* 1776, *in which he ſays "I thank "Providence for having granted me ſo long a life*

Indeed, had Haller ſtill perſiſted to ſupport the doctrine of evolution, and oppoſe that of gradual formation, his fame would have ſuffered as little from it, as Harvey's from his denying the exiſtence of the lacteal veſſels, or Newton's from his diſbelief of the poſſibility of colourleſs tubes in the fern.

" as has enabled me to give an improved and " corrected edition of my Phyſiology, without which, " I muſt have left many errors to be detected after " my death."

SECT. II.

Examination of the principal Arguments in favour of the ſuppoſed Pre-exiſtence of Organized Germs in the Ovaria of Females, and Refutation of the Doctrine.

ON the 13th of May 1758 was read before the Royal Society of Sciences at Göttingen, the celebrated paper of Baron von Haller, (then preſident of the ſociety) on the formation of the heart in the embryo, in which it was believed an *argumentum crucis* was offered in ſupport of the doctrine of pre-exiſting germs. The author ſays, That he found that not only the membrane of the yolk of an incubated egg, but alſo its blood-veſſels, conſtituting what was called the *figura venoſa*, were a continuation of the membrane and blood-veſſels of the chick.

But the yolk of the egg exiſted in the hen previous to impregnation, and therefore moſt probably the embryo alſo, although too ſmall to be diſcovered by our eyes. The prudent author however expreſſed himſelf at firſt very cautiouſly and in an undecided manner on this ſyllogiſm(q).

Monſ. Bonnet, however, who ſoon after publiſhed his work on organized bodies, and, who was previouſly prepoſſeſſed in favour of the doctrine of the evolution of pre-exiſting organic germs, took hold of this obſervation of Haller's, and pronounced it to be abſolutely unanſwerable, and conſidered the truth of the hypotheſis as fully eſtabliſhed by it(r).

Haller

(q) " *L'evolution commence à me paroitre la* " *plus probable.*"

(r) *Vide his preface to the work alluded to.* Ed. 5th. " *Enfin cette decouverte importante* " *(que le germe appartenoit à la femelle, qu'il pre-* " *exiſtoit*

Haller alſo allowed himſelf to be daily more and more convinced of the force of his own obſervations, inſomuch that in his later writings he made little ſcruple of declaring them equally deciſive, as his friend Bonnet had done.

" *exiſtoit ainſi a la fæcondation, et que l'evolution*
" *etoit la loi naturelle des etres organisés) que*
" *j'attendois et que j'avois osé predire me fut an-*
" *noncée en* 1757, *par Monſ. le Baron de Haller*
" *qui la tenoit de la nature elle même.*" *La*
" *decouverte de Mr. de Haller prouvoit d'une ma-*
" *niêre inconteſtable que le poulet appartenoit ori-*
" *ginairement à la poule et qu'il pre-exiſtoit à la*
" *CONCEPTION.*"

And in his letter to Mr. von Haller, dated 30*th of October* 1757, *he ſays,* " *Vos poulets*
" *m'enchantent : je n'avois pas eſpéré que le ſecret*
" *de la generation commonceroit ſitôt a ſe devoiler.*
" *C'eſt bien vous, Monſieur, qui avez ſçu prendre*
" *la nature ſur le fait.*"

In acknowledging that I myſelf, as well as ſome hundred other phyſiologiſts, and naturaliſts, looked on this celebrated obſervation as the foundation ſtone of the theory of evolution; I think I need make the leſs ceremony in expreſſing my aſtoniſhment how we could have allowed ourſelves, as in the preſent caſe, to attribute ſo much force to an aſſertion which abſolutely proves nothing!

For, granting it to be fully proved that there exiſted a continuation between the membrane and veſſels of the chick and yolk, (granting it, I ſay; for, the fact as the moſt accurate, and ſcrupulous inveſtigation teaches, ſtill remains uncertain, as every one will readily acknowledge who has taken the pains of examining fecundated eggs,) yet it does not follow that the membrane and veſſels, even if they really were a continuation of each other, co-exiſted from the beginning. Do we not ſee many inſtances in organized bodies where this laſt mentioned circumſtance exiſts, and yet where it is impoſſible to grant the

the ſuppoſition which has been drawn as a concluſion from it. For inſtance, all thoſe ſingular vegetable productions, which are cauſed by the puncture of certain inſects in many plants. Thus the Spongiæ cynoſbatæ are produced entirely in conſequence of the puncture of the Cynips in the roſe-buſh. The bark of this ſhrub is continued over this ſpongy and quite *accidental* production; nay, if we take, and cut any freſh branch which has ſome of theſe ſpongy bodies on it, we ſhall find that the wood of the branch appears to be an evident continuation of the woody part of theſe ſubſtances. But ſhall we from hence conclude, that this accidental production originally co-exiſted with the ſhrub itſelf, and that in every trunk, and every branch of every roſe-buſh in the world, the enveloped germs of innumerable ſpongiæ cynoſbatæ ſhould have always lain there like ſo much hidden wealth, and would have always remained ſo until the thouſand thouſandth part of them were by chance excited

to evolution by the benevolent puncture of a little cynips.

Again, in the animal kingdom, do we not often ſee after an accidental inflammation of any of the viſcera, a new membrane formed as it were by the effuſion of the lymphatic part of the blood; and in the courſe of a few days, do we not obſerve many blood-veſſels produced in this membrane, which anaſtomoſe with the blood-veſſels of the neighbouring viſcera; and yet it would be ridiculous to ſuppoſe that theſe veſſels co-exiſted from the firſt with the old ones. And for fear that it be objected to us, that theſe are mere preternatural appearances in the diſeaſed ſtate of animals, we beg them to recall the late celebrated membrana decidua of Dr. Hunter, which after a fruitful impregnation, lines the whole cavity of the uterus, and whoſe blood-veſſels, eſpecially where the umbilical chord is inſerted in the placenta, are moſt evidently connected

and

and anaſtomoſe with the blood-veſſels of the mother.

In all theſe caſes, the new formed membranes, and their blood-veſſels are the mere productions of the neighbouring viſcera, which renders it probable, that the membrane and veſſels of the embryo in a fecundated egg, are produced in like manner from the membrane and veſſels of the yolk.

Mr. Paul(s), a natural hiſtorian of great penetration, hath objected to Haller's demonſtration, that allowing the membranes of the yolk with its inviſible veſſels to have pre-exiſted in the hen, yet it is poſſible that the embryo is only formed during incubation, and that its blood-veſſels afterward unite with the blood-veſſels of the membrane of the yolk, and thus form an anaſtomoſis.

(s) *In the preface to the 8th vol. of the Collection Academique par étrangere,* p. 22, ſqq.

Baron

Baron von Haller immediately declared loudly againſt this objection, and denied it altogether as a thing *impoſſible*, that the tender veſſels of the microſcopic embryo ſhould be capable of anaſtomoſing with the large blood-veſſels of the giant yolk(t).

But what is rather ſingular, is, that this ſame moſt ingenious and meritorious author, who denies the poſſibility of ſuch an anaſtomoſis, ſuppoſes without any heſitation, and in the ſame work(u), when explaining human conception, that the very minute germ as ſoon as it has arrived at the cavity of the uterus, forms an adheſion with it by

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(t) " *Nunquam fieri poteſt ut inter tubulum* " *millioneſies minorem, et millioneſies majorem con-* " *tinuitas oviatur.*" *Element. Phyſiol.* T. VIII. P. 1. p. 94. *compare with his firſt lines of Phyſiology*, § 883, *and with the Opera Minora*, T. XI. p. 419.

(u) *Elem. Phyſiolog.*

means

means of its placenta;—And how? Juſt in the ſame way that he denies it to the embryo of the hen; that is to ſay, by an anaſtomoſis taking place between the microſcopic and tender branches of the umbilical veſſels, and the giant ones of the maternal uterus.

The modern advocates for the theory of evolution, have taken this obſervation of the yolk of the egg, as the prop of their hypotheſis.

Long before this however, the ſpawn of the frog had been employed for the ſame ſervice.

Near a century indeed before that period, Swammerdam announced the wonderful diſcovery, that the black points in the ſpawn of a frog were ſo many perfectly formed little frogs, and that they pre-exiſted in the ovariæ, although not to be diſcovered by the eye(w).

The

(w) *Miracl. Natur.* p. 21. " *Admiratione* " *dignum eſt, nigrum illud punctum, quod in ovis* " *ranarum*

The good man ſeemed to have had a pre-ſentiment of the uncertainty and inſtability of all vain worldly honours, and he therefore, as is well known, ſoon after betook himſelf to a more ſolid myſterious enjoyment, in which Mlle. Bourignon bore a part. And, indeed, it happened as he appears

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" *ranarum videre eſt, ipſum ranunculum omnibus* " *ſuis partibus abſolutum; albicantem verum et* " *circumfuſum illum liquorem non niſi alimentum* " *ejus eſſe; quod ipſum ſenſim dilatatum ita at-* " *tenuatur, ut exire cum velet poſſit,*" &c.

" *Magis mirum eſt hunc ipſum ranunculum in* " *ovaris uſque adeo exiguum ortus et incrementi ſui* " *principium habere, ut fere viſum effugiat, ut* " *ipſum animal ſub hac tantula mole delitescat.*"

And a little way further on, he draws the general concluſion; " *Nullus mihi in rerum naturæ* " *generationi, ſed ſoli propagatione vel incremento* " *partium locus eſſe videtur ubi caſus omnis exclu-* " *datur.*"

to

to have foreſeen; for the ungrateful world now aſcribe the merits of that diſcovery to the celebrated Abbé Spallanzani, who has maintained it in ſeveral of his writings, but more particularly in the ſecond volume of his Eſſays(x).

He calls the little black points of the fecundated ſpawn of frogs, Tadpoles, or young frogs(y); and as this little black point exactly reſembles the ſame in the unfecundated ſpawn(z), he reaſons agreeably to his logic,

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(x) *Diſſertazioni di fiſica animale e vegetabile*, T. XI. *in Modena*, 1780, 8.

(y) " *A parlare filoſofocamente l'uovo non è* " *che il gerino in ſe ſteſſo concentrato, e riſtretto, il* " *quale mediante la fecondazione ſi ſviluppa ed ac-* " *quiſta le fatezze di animale.*" p. 11. § XVII.

(z) " *Queſti globetti non fecondati non ſono* " *per verun conto diſtinguibili dai fecondati.*" § XVIII.

that

that the tadpoles muſt have exiſted in the mother([a]).

I do not know what would be thought of that chemiſt who aſſertes that the Arbor Dianæ pre-exiſted in a maſs of Amalgam of ſilver, becauſe when a weak ſolution of ſilver was poured on it, a little tree ſeemed to ſpring out of it.

One ought to be aſhamed of waſting much time in the refutation of an aſſertion, the falſity of which any unprejudiced perſon who is not altogether unaccuſtomed to obſervations of the kind may convince himſelf of every ſpring.

([a]) " *Ma i globetti fecondati non ſono che i* " *feti ranini*, § XVII. *Adunque i globetti non* " *fecondati lo ſaranno altreſi; e conſiguemente nella* " *noſtra rana il feto eſiſte in lei pria che abbiaſi* " *la fecondazione del maſchio.*" p. 12. § XIX.

Whoever

Whoever has taken the trouble, accurately, to examine the ſpawn of the frog muſt confeſs, that the idea of demonſtrating the little black points contained in it to be ſo many complete formed tadpoles, partakes greatly of Brother Peters's method of reaſoning in the Tale of the Tub, where he demonſtrates to his brothers that the brown loaf is a piece of excellent roaſt mutton.

But the abettors of the theory of organized germs have gone a ſtep further in ſupport of their opinions. They refer to caſes where even young girls, in all their maiden innocence, have become pregnant from the untimely, and premature evolution of one of theſe organized germs.

The concurrence of facts is ſometimes moſt wonderful. It happened that in the very ſame year that Swammerdam announced his diſcovery in the ſpawn of the frog, that a caſe was publiſhed in the *Ephem. rerum. nat. curios.*

delivered

delivered to the ſociety by a celebrated court-phyſician of thoſe times Dr. Claudius, which exactly ſuited as a confirmation of Swammerdam's opinion.—— A miller's wife was delivered of a little girl whoſe belly ſeemed of an unuſual ſize. Eight days afterwards this little big-bellied child was ſeized with ſuch violent pains and reſtleſsneſs, that every one who was preſent thought it could not outlive the next inſtant. The ſick infant however in the mean time actually bore a well-formed, elegant, lively, little daughter about the ſize of one's middle finger, which was regularly baptized. During the time, and after the birth, the waters, placenta, and all other impurities were rightly diſcharged. But both the little mother and daughter died early the following day(b).

Baron

(b) *I adopt the very words of a contemporary phyſician, Dr. Otto, who was conſulted by the grandmother (the miller's wife) during her pregnancy*

Baron von Haller very judiciouſly claſſes this caſe with another from the Tranſactions of the Academy of Sciences of Stockholm, where on diſſecting a young girl, bones, teeth, and hairs were found in a tumor of the myſentery. Theſe two caſes he looks on as principal evidences for the truth of the doctrine of germs pre-exiſting in the mother.

In Schmucker's Miſcellaneous Surgical Eſſays an anonymus correſpondent ſends the hiſtory of the diſſection of a girl, in whom, inſtead of an uterus, there was found a hard hairy body of the ſize of a large walnut, and

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nancy. His nephew has vindicated and illuſtrated the whole hiſtory in a moſt learned and ſubtile manner. D. C. J. Aug. Ottonis Epiſtola de fœtu puerpera ſive de fœtu in fœtu. Weiſſenfels, 1748. 8vo.

That this extraordinary hiſtory is alſo well calculated to intereſt the caſuiſt is evident, from the Diſquiſitionum filiola, quam acto dierum enfans vivam enixa eſt babtiſmi capax?

which

which reſembled an ill-ſhaped head. It had two perfect teeth, and contained in its cavity ſomething like brain.

Now ſince the abettors of the theory of evolution ſo loudly remonſtrate againſt, and complain of the unfair method of proceeding by oppoſing mere argument to the facts which they bring forward in ſupport of their opinions, I ſhall for the preſent totally abſtain from all reaſoning, and endeavour to ſatisfy theſe gentlemen by adducing fact for fact, obſervation for obſervation, and thoſe of no leſs wonderful, and entertaining a nature than theirs; for they will prove, that not only men but male animals have been equally in a thriving way with young virgins; and I truſt the teſtimonies of the truth of theſe ſtories will be found equally reſpectable with thoſe of the oppoſite party.

To the caſe extracted from the Memoirs of the Academy of Stockholm I oppoſe one from the Hiſtory of the Royal Academy of Sciences

Sciences of Paris, where an Abbé was interrupted very *mal apropos* whilſt inſtituting ſome experiments on generation. He was alarmed by an extraordinary encreaſe of bulk in a certain part, which another Abbé (the unfortunate Abelard) was deprived of in conſequence of a ſimilar experiment.

The tumor encreaſed ſo much that he was obliged to ſubmit to an operation, and his ſurgeon aſſured the academy that he cut an oſſified child (c) from the part.

To the ſtory of the miller's wife I beg leave to ſubjoin one from the Philoſophical Tranſactions of London, where an account is given of a male greyhound that bore a living puppy *per anum*; and in the place of Drs. Otto and Claudius, who witneſſed the truth of the firſt fact, I ſhall mention two names of

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(c) "*On y diſtinguoit la tête, les pieds, et les yeux.*"

which

which England ought to boaſt: Dr. Wallis, and Edmund Halley.

Laſtly to the anonymous in Schmucker I oppoſe an anonymous in the works of the reſpectable Fr. Ruyſh, who was preſented with a ſimilar production. It was a bony caſe, half as big as a common walnut, together with four perfect *mollares*, and a knot of hair, which, he aſſured the doctor, he had cut from the ſtomach of a male ſubject.

Thus I have adduced authority for authority; nor do I believe it poſſible for any one to go more conſcienteouſly to work than I have done; and ſo far therefore I truſt we are quits.

Were I allowed however to ſpeak my mind freely on this matter, I ſhould adviſe all ſuch auxiliary troops to be withdrawn. My only reaſon for bringing them on the field was merely to oppoſe thoſe of my antagoniſts.

Theſe therefore are the principal arguments, which, I have to oppoſe to what the advocates for the theory of evolution conſider as the ſtrongeſt, and moſt deciſive proofs of their theory.

But experience ſupplies me with another ſource of facts, which may be uſed as arguments againſt this theory, and which, to unprejudiced, and judicious readers, ought to be ſufficient whereby to aſcertain its true degree of probability.

For inſtance, the well eſtabliſhed, and univerſal truth; that the firſt appearance of a newly conceived animal, or plant, is never to be diſcovered immediately on impregnation, even by the moſt powerful armed eye; no ſuch thing is to be ſeen until a conſiderable time has elapſed.

It is not worth while to enter into a refutation of the fabulous aſſertion of Hippocrates, and of ſo many others of his old and worthy followers, that perfectly diſtinct, and well

formed human embryos were to be ſeen in the very firſt days of conception. Conſidering the few aids, and little opportunity they had in thoſe days of making ſuch obſervations, great allowance is to be made; and the more ſo, when we conſider that even modern phyſicians of much more extenſive experience in theſe matters, have been guilty of ſimilar aſſertions. Mauriceau has amuſed us with repreſentations of fœtuſſes of one day, and of three days and a half, &c. and Malpighi and Croune have aſſured us that they had ſeen the embryo of the chick and its appendices in the egg of a trod hen before the egg had been ſate upon. The laſt author indeed obſerved it, he ſays, in the addle egg of hens that never had been cocked.

It is impoſſible however to diſcover any thing before the third week after conception, which any cautious and creditable obſerver would preſume to pronounce a human embryo, and in the fecundated egg nothing can be obſerved, which has even the moſt diſtant reſemblance

reſemblance to a chick in the firſt twelve hours, nor indeed until the end of the ſecond day. Previous to this period of time peculiar to each animal, and vegetable, (d) it is quite impoſſible to diſtinguiſh the newly conceived offspring; which circumſtance, conſidering the perfection, and powers of our microſcopes, is by no means favourable to the theory of evolution.

Nor, is it at all eaſy to comprehend how the advocates for that theory make the phenomena of the accidental origin and growth of certain preternatural parts agree with their doctrine of pre-exiſting organic germs.

A few inſtances of this kind will ſerve inſtead of many.

(d) *In the hare the firſt traces of the young are not ſeen until the ninth day; in the ſheep not before the nineteenth; in the deer not before the ſeventh week.*

A woman conceives, but the fœtus inſtead of being in the uterus, is ſituated in one of the Fallopean tubes. The tube at laſt burſts from the increaſe of bulk of this ſtrayed animal, and it falls into the cavity of the abdomen. What does nature do? She pours out a quantity of plaſtic lymph, which forms itſelf evidently into organized membranes, incruſting and inveloping the fœtus like a mummy, by which it is prevented from putrefaction; for were this allowed to take place, it would occaſion certain death to the mother, but who, preſerved by this contrivance, is enabled to carry the troubleſome, though not dangerous load, for a conſiderable number of years. On opening the body after death, we evidently perceive this new, and, accidentally formed membrane, to be richly ſupplied with blood veſſels, (c) which

(c) *In the eighth volume of the Commentaries of the Royal Society of Göttingen I have given the deſcription of a fœtus of this kind which had lain eight*

which it would be rather difficult to prove, had pre-exiſted in the organic germ.

A perſon breaks both bones of the fore-arm, but is ſo reſtleſs as to diſturb nature in her uſual proceſs of healing them, that is, by means of a new oſſification. In this caſe what does ſhe do? She forms a new joint of the broken ends of both bones; making as it were a ſecond elbow which can be moved at pleaſure without any aſſiſtance from the other hand.

Another perſon diſlocates his thigh bone from it's natural ſituation in the Ilium, and nature endeavours to remedy the evil, by forming a new ſocket for it(f).

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eight years within the mother. This ſpecimen was preſented to the Muſeum of the Academy by my very worthy friend Mr. Buchner of Gotha.

(f) *In my Oſteology I have given numerous examples of this, vid. page* 43.

A child is born with a hydrocephalus, occaſioned by mere accidental circumſtances; ſuch for inſtance as the frequent, and too violent connection of the father with the mother, during the time of her geſtation. Owing to this diſeaſe, the cranium becomes preternaturally diſtended, and immence ſpaces are left between the very thin, and greatly diſtended bones. In order to remedy this, nature forms detached oſſeous points in theſe interſtices, which points, at laſt become true *oſſa triquetra*, filling up all the dangerous voids, and uniting all the bones of the head together.

Theſe *oſſa triquetra* however do not belong to the natural ſtructure of the fœtus, and are very ſeldom to be met with in the ſculls of ſavages, or of brute animals. It is hardly poſſible therefore that they ſhould have pre-exiſted in the organic germ: and yet they are as perfect bones as any others of the head, having true, and well formed ſutures. The ſutures of theſe bones are not always locked

in

in with the ſutures of the other bones of the head; but it often happens, that they are ſo numerous, and ſo thick together, that thoſe in the middle evidently conſtruct their own ones. What is there however which exhibits more art than the ſtructure of a true ſuture; its double, nay treble row of teeth, the correſponding depreſſions, and the aſtoniſhing manner in which they are claſped together?

The concluſion which naturally follows, is, that if perfect bones, new and preternatural joints, new organized and vaſcular membranes can be formed, where there was no ground for ſuppoſing a pre-exiſting germ, what neceſſity is there for this doctrine of envelopement?

But the phenomena which occur in the generation of mules, ſo completely refute all our ideas of pre-exiſting organic germs, that one is at a loſs to imagine, how, after a due attention to this ſubject, ſuch a theory ſhould

have found any ſerious abettors. I ſhould ſuppoſe that a ſingle experiment, ſuch as that of Mr. Koelreuter, who by repeatedly producing prolific baſtard plants, transformed one ſpecies of tobacco *(nicotiana ruſtica)* into another *(nicotiana paniculata)* ſo completely, that it had not the ſmalleſt reſemblance to its maternal parent; that ſuch an experiment, I ſay muſt cure the moſt partial advocate for the theory of evolution, of his error. This excellent obſerver, by artificially impregnating the firſt ſpecies of tobacco with the farina of the laſt mentioned, obtained prolific baſtard ſeeds from it, and with the plants which ſprung from theſe, he repeated the ſame experiment, impregnating them with the farina of the Nicotiana paniculata. As the plants which he procured from the ſeeds of this laſt combination, differed more from the original maternal plant, he repeated the ſame proceſs with it, and proceeded to do ſo with every new offspring, untill he obtained ſix plants, which in every reſpect appeared perfectly ſimilar to the *paniculata*; ſo that in the claſſical work,

in

in which he gives a narrative of this, he appears perfectly juſtifiable in entitling it, *A complete metamorphoſis of one natural ſpecies of plants into another.*

I know perfectly well, that the favourers of the theory of evolution endeavour to explain the production of baſtards, or mules, by ſaying, that the male ſemen, beſides its ſtimulating power of awakening the female germs from their ſtate of ſtupor, and inactivity; alſo aſcribe to it certain *formative* powers, by which the germ may be altered in a certain degree, ſo as ſo reſemble the father a little. But what in the name of Heaven is ſuch a ſubterfuge than the ſilent acknowledgement of the inſufficiency of the germ theory, and of the neceſſity of having recourſe to formative powers, in order to extricate it? If theſe formative powers, however, are ſo ſtrong as totally to change the ſtructure and appearance of the maternal germ, and that in the courſe of a few generations, it is rather difficult to conceive the utility of ſuch a theory.

SECT. III.

Proofs of the Formative Niſus, and an Attempt to aſcertain ſome of its Laws.

IT is eaſier to overturn, than to eſtabliſh a theory; and the reproach has been often applied to old reformers, that they have ſucceeded better in attempts of the firſt, than of the laſt kind. Yet what Monſ. Bonnet excellently remarks on this ſubject may be very true(g), that the detection of an error is often of greater conſequence than the diſcovery of

(g) *Demontrer une erreur, c'eſt plus que decouvrir une verité: car l'on peut ignorer beaucoup; mais le peut que l'on ſcait, il faut au moins le ſavoir bien. Preface de l'Eſſai ſur l'ame.*

a new fact. In this reſpect therefore, I truſt the preſent ſheets will at leaſt be allowed ſome merits, ſince they point out the defects of a late beloved, and almoſt univerſally adopted theory. I hope, however, at the ſame time, that the one which I give in its place will be found more agreeable to what we obſerve in nature.

No one can be more fully perſuaded of the immenſe gap which exiſts between the organiſed, and unorganiſed, between the animated, and the inanimate world, than I am; and although I have the greateſt reſpect for the penetration of thoſe who diſcover a gradual ſcale of aſcent and deſcent in the works of nature, yet I confeſs I am at a loſs to gueſs how they make it paſs from organic to inorganic bodies. Such a reflection, however, ought by no means, to deter us from employing the phenomena of either of theſe claſſes of bodies for explaining the phenomena of the other: and ſo far do I conſider it as an argument, not of the leaſt importance, for

proving

proving the exiſtence of the Formative Niſus in organic bodies, that even in the inorganic ones there exiſts traces of a Formative Power; not of a Formative *Niſus* however, at leaſt, in the ſenſe this word is uſed in this work; for here it is conſidered as one of the properties of the living principle, and conſequently not to be imagined as belonging to dead matter: but that this laſt Formative Power is demonſtrated by the regularity and invariable ſhape of certain bodies which we find to be formed of it.

For only to adduce one or two inſtances, we find nothing more elegant, than certain metallic cryſtallizations, which as to their external aſpect, bear ſo ſtriking a reſemblance to certain organized bodies, that they become a very good example for explaining to us the manner in which bodies are formed from rude and unorganized matter. Such for inſtance, is that ſpecies of native dendritical ſilver, imbeded in a matrix of quarz from Mexico, *Farnkrautſilber*, and which reſembles the foliage

liage of the fern, or to name ſomething more common, that undeſcribable beautiful moſs-looking texture of braſs, which is obſerved in breaking a piece of it, after the firſt fuſion.

Theſe as I have already ſaid, are adduced as mere examples of the exiſtence of a Formative Principle in unorganized bodies.

And now for the true formative effort in the animated world.

I know no means ſo well calculated for rendering the exiſtence, and activity of this niſus evident to an impartial eye, as to obſerve the origin and progreſs of ſuch organized bodies, which increaſe ſo rapidly in bulk, that the action of the growth becomes almoſt evident; and which are of ſo delicate and ſemitranſparent a texture, as to be capable of being evidently ſeen through with the aſſiſtance of a microſcope, and a due degree of light.

The

The vegetable kingdom ſupplies us with a very good example of this kind, in the ſimple production of a moſt ſimple water plant, *(conferva fontinalis)* which is commonly to be met with every ſpring, in wells, ponds, and ſprings, or in the wooden pipes through which water flows.

The whole plant conſiſts of a ſingle uniform ſtraight fine thread, of a bright green colour, and about half an inch in length, and whoſe under extremity is generally inſerted in a bed of ſlime. As theſe threads, however, are extremely numerous, and grow very cloſe together, they look like a very fine fur of the moſt beautiful green colour, with which conſiderable ſpaces of the places above mentioned are ſometimes covered.

I have attentively obſerved the propagation of this water plant in the beginning of the ſpring, and to me it appeared to take place in the following manner. The upper end

of

of the fibrile began gradually to ſwell, and divide into a number of ſmall round points, which at laſt diſengaged themſelves from the parental thread, and in the number of ſome thouſands, attached themſelves to the ſides of the glaſs in which I made the experiment. Soon afterwards, theſe round bodies began to ſhoot out a ſmall point, which almoſt viſibly lengthened till they had acquired their due ſize. All this took place in the ſpace of twice twenty-four hours, counting from the firſt moment that the end of the old thread began to ſwell.

Both the rapid growth of this plant, and its tranſparent texture, afforded me means of diſcovering not only its ſtructure, but alſo the ſlighteſt changes that took place in it. This kind of moſs is equally ſimple internally, as externally; and under the ſtrongeſt magnifying powers, and by the beſt light, we can diſcover nothing elſe than a fine veſicular appearance, like a green froth, ſurrounded by a very thin delicate membrane.

But

But in ſpite of the diſtinctneſs of texture of the little green points which adhered to the ſides of the veſſel, there was nothing to be ſeen like the germ of an enveloped filament in them, ſuch as was ſoon to be produced from it: but only when the little round body had attained a certain degree of perfection, a ſmall ſhoot ſeemed to ſpring out of it, in ſuch a manner, that its act of evolution ſeemed to be promoted merely by that part of the veſicular texture of the round point, which was moſt contiguous to the filament, paſſing gradually over to it. As the filament encreaſed in length, the little round body gradually decreaſed in magnitude, and became of a paler colour, ſo that at laſt, when the filament had arrived at its full growth, there remained juſt a perceptible ſwelling at the inferior end, and which ſerved as a root to the new filament.

With an equal degree of diſtinctneſs with which the progreſs of the Formative Niſus of this plant becomes conſpicuous, we can alſo clearly diſcover it in many animals; eſpecially

eſpecially in ſuch, as like this kind of moſs, poſſeſs the advantages of a rapid growth, and great tranſparency of texture. This is the caſe with the armed polypi, which on account of the miracles they are capable of performing, have within theſe laſt forty years been an object of general ſurpriſe, and admiration. All the known ſpecies of this animal have a kind of gelatinous body, which, whether it be of a green, yellow or brown colour, &c. is ſtill ſufficiently tranſparent to be capable of being diſtinctly ſeen through, if a proper lens and light be employed. Its texture is uniform, and ſimple, and ſo homogenous, conſiſting entirely of gelatinous points, which ſeem to be kept together by a ſtill thinner jelly, that nothing ſeems concealed from or obſcured to the eye of the obſerver. Now, when this animal is about to produce its young, a ſwelling or tumefaction takes place on a ſingle ſpot of its body; and from this ſwelling there ſhoots out firſt the cylindrical body, and then the tentaculæ of the young polypus. Theſe are all of ſo conſiderable a ſize as to be obſerved with the

naked

naked eye: and when we conſider this circumſtance, and all the others already mentioned, there does not appear the ſmalleſt probable ground for ſuppoſing, that an organized germ had pre-exiſted there, and was now evolving.

I refer it to the internal feelings of every one who has attentively obſerved this kind of production in animals, and plants of ſo ſimple a texture as thoſe alluded to, and who at the ſame time have well attended to all the arguments brought forward in the foregoing ſection againſt the doctrine of the pre-exiſtence of the embryo of the chick in the yolk of the egg, whether in paſſing in his own mind to the generation of the more perfect or warm-blooded animals (as for inſtance by the moſt accurate inveſtigation of the phenomena of the beginning, progreſs, and form of the embryo in the fecundated egg, and alſo of the many other parts(h) which are

(h) *Nidus pulli, bulla amnion, figura venoſa, &c.*

never

to be found in the unfecunded one) whether, I ſay, his conviction leads him to believe in the pre-exiſtence of enveloped organic germs; or, in the exiſtence of a *niſus*, by which a new being is formed from the unorganized materials of generation.

All the arguments which have hitherto been deduced from the phenomena of generation in ſupport of the exiſtence of a *Niſus Formativus*, gains new, and additional weight from the conſideration of the phenomena of *reproduction*; this ſo wonderful power of organiſed bodies by which loſt, and mutilated parts are again renewed.

Generation, and reproduction are both modifications of one, and the ſame power; the laſt being nothing elſe than a partial repetition of the firſt. Whatever tends to elucidate the one, muſt therefore throw light on the other.

I have

I have frequently repeated the experiments alluded to in the Firſt Section, by which I endeavoured to diſcover the power of reproduction in the green armed polypus, and have conſtantly met with the ſame ſucceſs. The little mutilated animal was always diminiſhed in bulk, in proportion as its new arms or new body were puſhed out. It became evident with what efforts nature haſtened to renew the determinate form of the maimed animal, and alſo, that from the ſhort period of time, and the improbability of the polypus having taken a ſufficient quantity of nouriſhment to ſupply materials for the new members (ſince all wounded polypi eat leſs than uſual); From theſe circumſtances I ſay, it became evident, that owing to the force of the *Formative Niſus* with which the parts were endowed, the remaining portion of the mutilated animal, was in ſome degree, converted into the new members, and thus the diſturbed ſtructure renewed.

I am

I am well aware, that the advocates for the theory of Evolution, will, in order to help themſelves out of this difficulty, have recourſe to an hypotheſis, which of all improbable ones, may be ſtiled the moſt romantic, and improbable; and according to which it is ſuppoſed, " That in every part of " the polypus, there exiſts innumerable germs " enveloped, and torpid as it were, which " lie like a hidden ſtore, untill it ſhall pleaſe " the fancy of a naturaliſt to rouſe them " into action, and free them from their ſtate " of impriſonment, by the enlivening cut of " a pair of ſciſſars."

Now, let any one compare this explanation with the naked appearances which take place in the above, and many other experiments on the armed polypus, the proceſs of which are ſo eaſy to be diſcovered.—I ſhall at preſent content myſelf with relating two of theſe experiments. When we take the half of two polypi of different kinds, for inſtance, the

the anterior half of a green one, and the posterior half of a brown one, and bring them together at the bottom of a proper glass, they join together, and form in this manner, one of these monsters of mythology, representing a group compoſed of different parts of different animals.

According to the theory of Evolution, however, very different phenomena must have occurred. Instead of this junction between the two halves, each one ought to have evolved from an organic germ that part of which it had been deprived of; but this is not what we observe; it was more natural that the two parts should join by the means of their formative powers, than that each of the halves should of itself have been metamorphoſed to a complete animal by the manner described above.

There is a well known experiment however, which is admirably calculated to demonstrate both the improbability of the supposed

poſed pre-exiſting germs, and at the ſame time, the activity of the *Formative Niſus*. When we take the polypus, and do not divide it in pieces, but merely ſlit open its belly longitudinally, ſo as to deſtroy that cavity; and as it were, metamorphoſe the ſhape of the animal from a cylindrical to a flat form; inſtead of a number of organic germs being ſet free from the cut edges, and of their being each evolved, one of the two following occurrences takes place; either the animal rolls itſelf together in the uſual form, ſo that the edges of the wound meet and coaleſce, or if it remains like a piece of flat tape, it begins ſoon after to ſwell in the middle, as if it were blown up, and there is gradually formed within it a new belly.

In both theſe caſes there is no occaſion for new *materials*, all that is done is a mere *reparation* of the *diſturbed ſtructure*.

In man and other warm-blooded animals the power of reproduction is much more limited;

mited not only on account of the great diverſity of materials of which they are compoſed, but alſo the different quantity of living principle peculiar to each of theſe materials, and by the mutual dependance and action which they exerciſe on each other. And yet we often obſerve in them evident marks of this power of reproduction, tending to confirm all that has been ſaid on this head, concerning the polypus; nails have been obſerved to grow on the ſtump of a finger, even although the firſt joint was completely loſt (i). It would be rather a bold conjecture to ſuppoſe that nature had foreſeen ſuch accidents, and had therefore ſown all the fingers and toes with the organic germs of nails, &c. And on the contrary, how agreeable to nature is it to deduce the whole phenomenon from the activity of the formative powers, whoſe efforts are ſufficiently ſtrong to reproduce nails on the extremities of the fingers, nay even in unuſual parts.

(i) *Pecklin and Talp have ſeen inſtances of this kind.*

Another equally well known, and intereſting fact of this kind, is, where nature endeavours to ſupply the loſs of an extremity, whoſe complicated ſtructure it would have been difficult for her to reſtore, by the production of a more ſimple and uniform ſubſtance. Thus, that celebrated ſurgeon, Morand, gives the deſcription of a hare, which, a conſiderable time before its death, had had one of its fore legs ſhot off, the place of which nature had endeavoured to ſupply with a kind of bony ſtump, which, although not like the original, *quoad materiem*, yet reſembled *taliter qualiter quoad formam*(k).

If, as I flatter myſelf, the few phenomena of generation, and reproduction already taken notice of, are ſufficient to prove the un-

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(k) "*C'etoit,*" *to uſe his own expreſſion* "*une* "*eſpéce de jambe de bois, dont la nature ſeule avoit* "*faet le pais.*"

deniable

deniable exiſtence of the *Formative Niſus*, there remain many others tending to explain its *modus operandi*; and to aſcertain ſome of the laws by which that mode ſeems to be regulated. I look upon the following to be of this kind, that is, as the mere reſult of undoubted obſervation.

I. *The activity of the Niſus, is, in an inverſe ratio, to the age of the organized body.*

For however certain it may be, as has been formerly remarked, that ſome time is neceſſary before the firſt marks of the new conceived fruit becomes viſible, yet it is equally well aſcertained, that after this interval, the formation proceeds with aſtoniſhing celerity.

In general, the embryos of the earlier months are repreſented in a very unſhapely form, but this may be owing either to the perſon who gives the repreſentation; or to this, that ſuch abortions generally ſuffer much by external violence, are ſqueezed, compreſſed,

or from putrefaction having already begun, loſe much of their uncommon elegance, which otherwiſe render them objects of admiration. I poſſeſs ſome of theſe beautiful human fœtuſſes of the firſt months of pregnancy, eſpecially thoſe which I received from my dear friend Mr. Bückner of Gotha, where in one of five weeks old, and of the ſize of a common bee, all the features of the face, every finger complete, every toe, and the organs of generation were to be diſtinctly ſeen.

Now this early activity of the Formative Niſus, is by no means confined to the external form of the embryo, but is ſtill more remarkable in the internal ſtructure. I have often been aſtoniſhed at the early perfection of the vicera, which I have diſcovered in diſſecting recent human embryos of the firſt months. Thus, merely to mention one circumſtance in its head, which was hardly larger than a pea, the whole cartilaginous *baſis cranii*, with all its depreſſions, apertures, and proceſſes, were marked in the moſt ſharp and diſtinct manner,

manner, although, indeed, there was not the ſmalleſt point of oſſification, either in the ſphenoid bone, or the petrous part of the temporal one.

However difficult it may be on the ſuppoſition of pre-exiſting germs, to explain what becomes of them for ſo long a time after they arrive at the place of their deſtination, and are fecundated and ſtimulated to evolution; it is equally difficult to imagine, why immediately after this interval, they ſhould ſo ſuddenly acquire ſo reſpectable a ſize. On the contrary, after it has been fully underſtood, what was ſaid concerning the time neceſſary for the preparation of the fluids of generation, before the Formative Niſus takes place; there remains nothing puzzling in this, that then the new awakened action ſhould ſo ſoon form the ground work of the new animal.

That the inverſe ratio between the Formative Niſus, and the increaſe of age,

 continues

continues even after birth, is proved by the remarkable eaſe with which reproduction takes place in very young animals, eſpecially thoſe of the lizard kind, as in the common newt.

II. *The Formative Niſus is much more active in the embryos of mamelia, than in thoſe of oviparous animals.*

In the chick for inſtance, the firſt appearance of the ribs is obſerved one hundred and twenty-nine hours after impregnation. This period is equal to the nineteenth week of geſtation in the human ſpecies. But I have in my poſſeſſion, human fœtuſſes, which are not more than ſix weeks old, and yet in which, the cartilaginous rudiments of the ribs are to be diſtinctly diſcovered. It would appear as if nature made greater haſte with the formation of viviparous animals, to ſecure them againſt deformity, from acccidental cauſes, ſuch as preſſure, external violence, &c. from which cauſes all oviparous animals are defended by their ſhell.

III. *In*

III. *In the formation of ſome particular parts of any organized body, the Formative Niſus is much more regular in its proceſs, than in that of others.* Thus the brain, ſays old Conr. Vict. Schneider, a man much diſtinguiſhed in phyſiology, is ſeldom or never found to deviate from the uſual ſtructure(1). On the contrary, how great and frequent are the variations in many other parts, ſuch as in the kidneys, and Thoracic Duct, &c.

Amongſt the many deviations of the formative proceſs from its uſual courſe, theſe are principally to be mentioned.

1ſt, *Where one ſpecies of organic body takes on the action of that of another.*

To this belong ſome of the moſt unaccountable phenomena in nature, which, as

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(1) "*In corpore humano,*" *he ſays,* "*nulla* "*pars faciem ſuam rarius mutat quam cerebrum.*"

far

far as I am able to judge, cannot be explained in any ſatisfactory manner by the theory of pre-exiſting germs. It is a well-known fact, that women have in general, and according to the ſtrict laws of nature, only one uterus for the reception of the new conceived fœtus. But that moſt of the other females in the claſs of mamalia, have a double one. Yet inſtances are not wanting, where a real *uterus bicornis* has been found in women. This ſingularity, if I am not miſtaken, is accounted for by the previous reflection. In the ſame manner, I would reckon all thoſe hares, which have been ſo frequently obſerved with ſmall horns like thoſe of deers, and alſo many of thoſe ſtrange deviations, which take place now and then in the ſtructure of the vegetable kingdom, ſuch as the alder-tree with oak leaves, deſcribed by Gleditch(m).

(m) *Betula alnus quercifolia vid. Gleditch hinterlaſſene Abhandl. das practiſche Fortweſen betreffend.*

2dly,

2dly, *Where the organs of generation of one ſex take on more or leſs the ſtructure of that of the other.*

In our ſceptical days, the poſſibility of human hermaphrodites, and that of other warm-blooded animals, has been much doubted. And yet Baron Haller of this univerſity, and Mr. John Hunter of London, have inſtituted, and given relations of the moſt careful diſſections of ſuch animals, eſpecially in the cow, and goat tribes, and which leave no room for further doubts in this matter. It is true, that in none of the inſtances, the moſt eſſential parts of generation, for inſtance, the male teſticles, and female ovaria, were to be diſtinctly diſcovered in the ſame individual. But though the chief form ſeemed to be always that of one of the ſexes, yet there was evidently to be diſcovered in one part or another, the moſt unequivocal, though imperfect marks of the organs of the other ſex. In general, the male organs lay internally, whilſt the external ones had more the reſemblance of the female.

3dly,

3dly, *When the formative proceſs does not, as in the former inſtances, take an action which is* FOREIGN, *but one that is completely* PRETERNATURAL *to the individual.* And yet from an attentive conſideration of the aſtoniſhing uniformity, which reigns amongſt the different kinds of monſters, it would appear as if the cauſes of the deviation in their formation, was regulated by certain fixed laws. Whoever has ſeen any conſiderable number of monſters, or only looked into the looſe and wretched compilations of repreſentations of them, can hardly have eſcaped being ſtruck by the reſemblance which unites, even to the moſt inconſiderable parts, certain ſpecies of them, ſo that the individuals of that ſpecies, ſeem as if they had all been caſt in the ſame mould.

To conclude, there is ſtill one other phenomenon, which the reader is at liberty to explain, either on the principle of pre-exiſting organic

organic germs, or that of the Formative Niſus. Many animal monſters, ſuch for inſtance, as thoſe with two bodies and a ſingle head, are of that kind, according to the expreſs aſſertion of Baron Haller, and other evolutioniſts, that they cannot have ariſen from the accidental growth of two germs, but that the fault lies in the original monſtroſity of a ſingle germ. Now it is ſingular, that ſuch monſters are only common in animals which have been domeſticated, and that they are never, or at leaſt ſeldom to be heard of in their wild ſtate. Can the Author of nature have ordained it, that from amongſt the involved germs of any one ſpecies of animals, for inſtance, ſwine, the monſters ſhould arrive at evolution, juſt when taken under the care of men, and that the monſters ſhould be produced only by the tame, and not by the wild alſo?

On the other hand, there is nothing unreaſonable in ſuppoſing, that after the ſubjection of theſe animals, their whole frame

and

and œconomy ſuffer a very great change; that then the Formative Niſus deviates in ſome degree from its original laws, and therefore theſe animals as they degenerate into endleſs varieties, are alſo more ſubjected to monſtroſity.

Such, in my opinion, are the principal obſervations and experiments which ſerve to prove the exiſtence of the Formative Niſus, and to aſcertain ſome of its laws; obſervations which have drawn my conviction more and more from the ſyſtem of involved germs, and confirmed my belief in the very oppoſite doctrine, which I have endeavoured to eſtabliſh.

FINIS.

ERRATA.

Page	line		for	read
5	5		begins,	begin.
29	4	of the Note,	Sonebier,	Senebier.
38	4	of the Note,	oviatur,	oriatur.
42	4		aſſertes,	aſſerted.
45	7	of the Note,	Diſquiſitionum,	Diſquiſitio num.
71	13		dele	of.