ZOONOMIA;

OR,

THE LAWS

OF

ORGANIC LIFE.

VOL. I.

By ERASMUS DARWIN, M.D. F.R.S.
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Principiò cœlum, ac terras, campoſque liquentes,
Lucentemque globum lunæ, titaniaque aſtra,
Spiritus intùs alit, totamque infuſa per artus
Mens agitat molem, et magno ſe corpore miſcet.
VIRG. Æn. vi.

Earth, on whoſe lap a thouſand nations tread,
And Ocean, brooding his prolific bed,
Night's changeful orb, blue pole, and ſilvery zones,
Where other worlds encircle other ſuns,
One Mind inhabits, one diffuſive Soul
Wields the large limbs, and mingles with the whole.

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SECT. XXXIX.

OF GENERATION.

Felix, qui cauſas altâ caligine merſas
Pandit, et evolvit tenuiſſima vincula rerum. Anon.

I. *Habits of acting and feeling of individuals attend the ſoul into a future life, and attend the new embryon at the time of its production. The new ſpeck of entity abſorbs nutriment, and receives oxygene. Spreads the terminations of its veſſels on cells, which communicate with the arteries of the uterus; ſometimes with thoſe of the peritoneum. Afterwards it ſwallows the liquor amnii, which it produces by its irritation from the uterus, or peritoneum. Like inſects in the heads of calves and ſheep. Why the white of egg is of two conſiſtencies. Why nothing is found in quadrupeds ſimilar to the yolk, nor in moſt vegetable ſeeds.* II. 1. *Eggs of frogs and fiſh impregnated out of their bodies. Eggs of fowls which are not fecundated, contain only the nutriment for the embryon. The embryon is produced by the male, and the nutriment by the female. Animalcula in ſemine. Profuſion of nature's births.* 2. *Vegetables viviparous. Buds and bulbs have each a father but no mother. Veſſels of the leaf and bud inoſculate. The paternal offspring exactly reſembles the parent.* 3. *Inſects impregnated for ſix generations. Polypus branches like buds. Creeping roots. Viviparous flowers. Tænia, volvox. Eve from Adam's rib. Semen not a ſtimulus to the egg.* III. 1. *Embryons not originally created within other embryons. Organized matter is not ſo minute.* 2. *All the parts of the embryon are*

Section. And as theſe nutritive particles are ſuppoſed to be ſimilar to thoſe, which are formed for her own nutrition, it follows that the fetus ſhould ſo far reſemble the mother.

This explains, why hereditary diſeaſes may be derived either from the male or female parent, as well as the peculiar form of either of their bodies. Some of theſe hereditary diſeaſes are ſimply owing to a deficient activity of a part of the ſyſtem, as of the abſorbent veſſels, which open into the cells or cavities of the body, and thus occaſion dropſies. Others are at the ſame time owing to an increaſe of ſenſation, as in ſcrophula and conſumption; in theſe the obſtruction of the fluids is firſt cauſed by the inirritability of the veſſels, and the inflammation and ulcers which ſucceed, are cauſed by the conſequent increaſe of ſenſation in the obſtructed part. Other hereditary diſeaſes, as the epilepſy, and other convulſions, conſiſt in too great voluntary exertions in conſequence of diſagreeable ſenſation in ſome particular diſeaſed part. Now as the pains, which occaſion theſe convulſions, are owing to defect of the action of the diſeaſed part, as ſhewn in Sect. XXXIV. it is plain, that all theſe hereditary diſeaſes may have their origin either from defective irritability derived from the father, or from deficiency of the ſtimulus of the nutriment derived from the mother. In either caſe the effect would be ſimilar; as a ſcrophulous race is frequently produced among the poor from the deficient ſtimulus of bad diet, or of hunger; and among the rich, by a deficient irritability from their having been long accuſtomed to too great ſtimulus, as of vinous ſpirit.

6. From this account of reproduction it appears, that all animals have a ſimilar origin, viz. from a ſingle living filament; and that the difference of their forms and qualities has ariſen only from the different

different irritabilities and ſenſibilities, or voluntarities, or aſſociabilities, of this original living filament; and perhaps in ſome degree from the different forms of the particles of the fluids, by which it has been at firſt ſtimulated into activity. And that from hence, as Linnæus has conjectured in reſpect to the vegetable world, it is not impoſſible, but the great variety of ſpecies of animals, which now tenant the earth, may have had their origin from the mixture of a few natural orders. And that thoſe animals and vegetable mules, which could continue their ſpecies, have done ſo, and conſtitute the numerous families of animals and vegetables which now exiſt; and that thoſe mules, which were produced with imperfect organs of generation, periſhed without reproduction, according to the obſervation of Ariſtotle; and are the animals, which we now call mules. See Botanic Garden, Part II. Note on Dianthus.

Such a promiſcuous intercourſe of animals is ſaid to exiſt at this day in New South Wales by Captain Hunter. And that not only amongſt the quadrupeds and birds of different kinds, but even amongſt the fiſh, and, as he believes, amongſt the vegetables. He ſpeaks of an animal between the opoſſum and the kangaroo, from the ſize of a ſheep to that of a rat. Many fiſh ſeemed to partake of the ſhark; ſome with a ſkait's head and ſhoulders, and the hind part of a ſhark; others with a ſhark's head and the body of a mullet; and ſome with a ſhark's head and the flat body of a ſting-ray. Many birds partake of the parrot; ſome have the head, neck, and bill of a parrot, with long ſtraight feet and legs; others with legs and feet of a parrot, with head and neck of a ſea-gull. Voyage to South Wales by Captain John Hunter, p. 68.

7. All animals therefore, I contend, have a ſimilar cauſe of their organization, originating from a ſingle

ſingle living filament, endued indeed with different kinds of irritabilities and ſenſibilities, or of animal appetencies; which exiſt in every gland, and in every moving organ of the body, and are as eſſential to living organization as chemical affinities are to certain combinations of inanimate matter.

If I might be indulged to make a ſimile in a philoſophical work, I ſhould ſay, that the animal appetencies are not only perhaps leſs numerous originally than the chemical affinities; but that like theſe latter, they change with every new combination; thus vital air and azote, when combined, produce nitrous acid; which now acquires the property of diſſolving ſilver; ſo with every new additional part to the embryon, as of the throat or lungs, I ſuppoſe a new animal appetency to be produced.

In this early formation of the embryon from the irritabilities, ſenſibilities, and aſſociabilities, and conſequent appetencies, the faculty of volition can ſcarcely be ſuppoſed to have had its birth. For about what can the fetus deliberate, when it has no choice of objects? But in the more advanced ſtate of the fetus, it evidently poſſeſſes volition; as it frequently changes its attitude, though it ſeems to ſleep the greateſt part of its time; and afterwards the power of volition contributes to change or alter many parts of the body during its growth to manhood, by our early modes of exertion in the various departments of life. All theſe faculties then conſtitute the vis fabricatrix, and the vis conſervatrix, as well as the vis medicatrix of nature, ſo much ſpoken of, but ſo little underſtood by philoſophers.

8. When we revolve in our minds, firſt, the great changes, which we ſee naturally produced in animals after their nativity, as in the production of the butterfly with painted wings from the crawling caterpillar; or of the reſpiring frog from the ſubnatant tadpole; from the feminine boy to the bearded

ed man, and from the infant girl to the lacteſcent woman; both which changes may be prevented by certain mutilations of the glands neceſſary to reproduction.

Secondly, when we think over the great changes introduced into various animals by artificial or accidental cultivation, as in horſes, which we have exerciſed for the different purpoſes of ſtrength or ſwiftneſs, in carrying burthens or in running races; or in dogs, which have been cultivated for ſtrength and courage, as the bull-dogs; or for acuteneſs of his ſenſe of ſmell, as the hound and ſpaniel; or for the ſwiftneſs of his foot, as the greyhound; or for his ſwimming in the water, or for drawing ſnow-ſledges, as the rough-haired dogs of the north; or laſtly, as a play-dog for children, as the lap-dog; with the changes of the forms of the cattle, which have been domeſticated from the greateſt antiquity, as camels, and ſheep; which have undergone ſo total a transformation, that we are now ignorant from what ſpecies of wild animals they had their origin. Add to theſe the great changes of ſhape and colour, which we daily ſee produced in ſmaller animals from our domeſtication of them, as rabbits, or pidgeons; or from the difference of climates and even of ſeaſons; thus the ſheep of warm climates are covered with hair inſtead of wool; and the hares and partridges of the latitudes, which are long buried in ſnow, become white during the winter months; add to theſe the various changes produced in the forms of mankind, by their early modes of exertion; or by the diſeaſes, occaſioned by their habits of life; both of which became hereditary, and that through many generations. Thoſe who labour at the anvil, the oar, or the loom, as well as thoſe who carry ſedan-chairs, or who have been educated to dance upon the rope, are diſtinguiſhable by the ſhape of their limbs; and the diſeaſes occaſioned

occaſioned by intoxication deform the countenance with leprous eruptions, or the body with tumid viſcera, or the joints with knots and diſtortions.

Thirdly, when we enumerate the great changes produced in the ſpecies of animals before their nativity; theſe are ſuch as reſemble the form or colour of their parents, which have been altered by the cultivation or accidents above related, and are thus continued to their poſterity. Or they are changes produced by the mixture of ſpecies as in mules; or changes produced probably by the exuberance of nouriſhment ſupplied to the fetus, as in monſtrous births with additional limbs; many of theſe enormities of ſhape are propagated, and continued as a variety at leaſt, if not as a new ſpecies of animal. I have ſeen a breed of cats with an additional claw on every foot; of poultry alſo with an additional claw, and with wings to their feet; and of others without rumps. Mr. Buffon mentions a breed of dogs without tails, which are common at Rome and at Naples, which he ſuppoſes to have been produced by a cuſtom long eſtabliſhed of cutting their tails cloſe off. There are many kinds of pidgeons, admired for their peculiarities, which are monſters thus produced and propagated. And to theſe muſt be added, the changes produced by the imagination of the male parent, as will be treated of more at large in No. VI. of this Section.

When we conſider all theſe changes of animal form, and innumerable others, which may be collected from the books of natural hiſtory; we cannot but be convinced, that the fetus or embryon is formed by appoſition of new parts, and not by the diſtention of a primordial neſt of germs, included one within another, like the cups of a conjurer.

Fourthly, when we revolve in our minds the great ſimilarity of ſtructure, which obtains in all the warm-blooded animals, as well quadrupeds, birds,

birds, and amphibious animals, as in mankind; from the mouſe and bat to the elephant and whale; one is led to conclude, that they have alike been produced from a ſimilar living filament. In ſome this filament in its advance to maturity has acquired hands and fingers, with a fine ſenſe of touch, as in mankind. In others it has acquired claws or talons, as in tygers and eagles. In others, toes with an intervening web, or membrane, as in ſeals and geeſe. In others it has acquired cloven hoofs, as in cows and ſwine; and whole hoofs in others, as in the horſe. While in the bird kind this original living filament has put forth wings inſtead of arms or legs, and feathers inſtead of hair. In ſome it has protruded horns on the forehead inſtead of teeth in the fore part of the upper jaw; in others tuſhes inſtead of horns; and in others beaks inſtead of either. And all this exactly as is daily ſeen in the tranſmutations of the tadpole, which acquires legs and lungs, when he wants them; and loſes his tail, when it is no longer of ſervice to him.

Fifthly, from their firſt rudiment, or primordium, to the termination of their lives, all animals undergo perpetual transformations; which are in part produced by their own exertions in conſequence of their deſires and averſions, of their pleaſures and their pains, or of irritations, or of aſſociations; and many of theſe acquired forms or propenſities are tranſmitted to their poſterity. See Sect. XXXI. 1.

As air and water are ſupplied to animals in ſufficient profuſion, the three great objects of deſire, which have changed the forms of many animals by their exertions to gratify them, are thoſe of luſt, hunger, and ſecurity. A great want of one part of the animal world has conſiſted in the deſire of the excluſive poſſeſſion of the females; and theſe have acquired weapons to combat each other for this purpoſe, as the very thick, ſhield-like, horny ſkin on the ſhoulder of the boar is a defence only againſt animals

animals of his own ſpecies, who ſtrike obliquely upwards, nor are his tuſhes for other purpoſes, except to defend himſelf, as he is not naturally a carnivorous animal. So the horns of the ſtag are ſharp to offend his adverſary, but are branched for the purpoſe of parrying or receiving the thruſts of horns ſimilar to his own, and have therefore been formed for the purpoſe of combating other ſtags for the excluſive poſſeſſion of the females; who are obſerved, like the ladies in the times of chivalry, to attend the car of the victor.

The birds, which do not carry food to their young, and do not therefore marry, are armed with ſpurs for the purpoſe of fighting for the excluſive poſſeſſion of the females, as cocks and quails. It is certain that theſe weapons are not provided for their defence againſt other adverſaries, becauſe the females of theſe ſpecies are without this armour. The final cauſe of this conteſt amongſt the males ſeems to be, that the ſtrongeſt and moſt active animal ſhould propagate the ſpecies, which ſhould thence become improved.

Another great want conſiſts in the means of procuring food, which has diverſified the forms of all ſpecies of animals. Thus the noſe of the ſwine has become hard for the purpoſe of turning up the ſoil in of ſearch inſects and of roots. The trunk of the elephant is an elongation of the noſe for the purpoſe of pulling down the branches of trees for his food, and for taking up water without bending his knees. Beaſts of prey have acquired ſtrong jaws or talons. Cattle have acquired a rough tongue and a rough palate to pull off the blades of graſs, as cows and ſheep. Some birds have acquired harder beaks to crack nuts, as the parrot. Others have acquired beaks adapted to break the harder ſeeds, as ſparrows. Others for the ſofter ſeeds of flowers, or the buds of trees, as the finches. Other birds have

have acquired long beaks to penetrate the moiſter ſoils in ſearch of inſects or roots, as woodcocks; and others broad ones to filtrate the water of lakes, and to retain aquatic inſects. All which ſeem to have been gradually produced during many generations by the perpetual endeavour of the creatures to ſupply the want of food, and to have been delivered to their poſterity with conſtant improvement of them for the purpoſes required.

The third great want amongſt animals is that of ſecurity, which ſeems much to have diverſified the forms of their bodies and the colour of them; theſe conſiſt in the means of eſcaping other animals more powerful than themſelves. Hence ſome animals have acquired wings inſtead of legs, as the ſmaller birds, for the purpoſe of eſcape. Others great length of fin, or of membrane, as the flying fiſh, and the bat. Others great ſwiftneſs of foot, as the hare. Others have acquired hard or armed ſhells, as the tortoiſe and the echinus marinus.

The contrivances for the purpoſes of ſecurity extend even to vegetables, as is ſeen in the wonderful and various means of their concealing or defending their honey from inſects, and their ſeeds from birds. On the other hand ſwiftneſs of wing has been acquired by hawks and ſwallows to purſue their prey; and a proboſcis of admirable ſtructure has been acquired by the bee, the moth, and the humming bird, for the purpoſe of plundering the nectaries of flowers. All which ſeem to have been formed by the original living filament, excited into action by the neceſſities of the creatures, which poſſeſs them, and on which their exiſtence depends.

From thus meditating on the great ſimilarity of the ſtructure of the warm-blooded animals, and at the ſame time of the great changes they undergo both before and after their nativity; and by conſidering

dering in how minute a portion of time many of the changes of animals above deſcribed have been produced; would it be too bold to imagine, that in the great length of time, ſince the earth began to exiſt, perhaps millions of ages before the commencement of the hiſtory of mankind, would it be too bold to imagine, that all warm-blooded animals have ariſen from one living filament, which THE GREAT FIRST CAUSE endued with animality, with the power of acquiring new parts, attended with new propenſities, directed by irritations, ſenſations, volitions, and aſſociations; and thus poſſeſſing the faculty of continuing to improve by its own inherent activity, and of delivering down thoſe improvements by generation to its poſterity, world without end!

Sixthly, The cold-blooded animals, as the fiſh-tribes, which are furniſhed with but one ventricle of the heart, and with gills inſtead of lungs, and with fins inſtead of feet or wings, bear a great ſimilarity to each other; but they differ, nevertheleſs, ſo much in their general ſtructure from the warm-blooded animals, that it may not ſeem probable at firſt view, that the ſame living filament could have given origin to this kingdom of animals, as to the former. Yet are there ſome creatures, which unite or partake of both theſe orders of animation, as the whales and ſeals; and more particularly the frog, who changes from an aquatic animal furniſhed with gills to an aerial one furniſhed with lungs.

The numerous tribes of inſects without wings, from the ſpider to the ſcorpion, from the flea to the lobſter; or with wings, from the gnat and the ant to the waſp and the dragon-fly, differ ſo totally from each other, and from the red-blooded claſſes above deſcribed, both in the forms of their bodies, and their modes of life; beſides the organ of ſenſe, which

which they ſeem to poſſeſs in their antennæ or horns, to which it has been thought by ſome naturaliſts, that other creatures have nothing ſimilar; that it can ſcarcely be ſuppoſed that this nation of animals could have been produced by the ſame kind of living filament, as the red-blooded claſſes above mentioned. And yet the changes which many of them undergo in their early ſtate to that of their maturity, are as different, as one animal can be from another. As thoſe of the gnat, which paſſes his early ſtate in water, and then ſtretching out his new wings, and expanding his new lungs, riſes in the air; as of the caterpillar, and bee-nymph, which feed on vegetable leaves or farina, and at length burſting from their ſelf-formed graves, become beautiful winged inhabitants of the ſkies, journeying from flower to flower, and nouriſhed by the ambroſial food of honey.

There is ſtill another claſs of animals, which are termed vermes by Linnæus, which are without feet, or brain, and are hermaphrodites, as worms, leeches, ſnails, ſhell-fiſh, coralline inſects, and ſponges; which poſſeſs the ſimpleſt ſtructure of all animals, and appear totally different from thoſe already deſcribed. The ſimplicity of their ſtructure, however, can afford no argument againſt their having been produced from a living filament as above contended.

Laſt of all the various tribes of vegetables are to be enumerated amongſt the inferior orders of animals. Of theſe the anthers and ſtigmas have already been ſhewn to poſſeſs ſome organs of ſenſe, to be nouriſhed by honey, and to have the power of generation like inſects, and have thence been announced amongſt the animal kingdom in Sect. XIII. and to theſe muſt be added the buds and bulbs which conſtitute the viviparous offspring of vegetation. The former I ſuppoſe to be beholden

to

to a ſingle living filament for their ſeminal or amatorial procreation; and the latter to the ſame cauſe for their lateral or branching generation, which they poſſeſs in common with the polypus, tænia, and volvox; and the ſimplicity of which is an argument in favour of the ſimilarity of its cauſe.

Linnæus ſuppoſes, in the Introduction to his Natural Orders, that very few vegetables were at firſt created, and that their numbers were increaſed by their intermarriages, and adds, ſuadent hæc Creatoris leges a ſimplicibus ad compoſita. Many other changes ſeem to have ariſen in them by their perpetual conteſt for light and air above ground, and for food or moiſture beneath the ſoil. As noted in Botanic Garden, Part II. Note on Cuſcuta. Other changes of vegetables from climate, or other cauſes, are remarked in the Note on Curcuma in the ſame work. From theſe one might be led to imagine, that each plant at firſt conſiſted of a ſingle bulb or flower to each root, as the gentianella and daiſy; and that in the conteſt for air and light new buds grew on the old decaying flower ſtem, ſhooting down their elongated roots to the ground, and that in proceſs of ages tall trees were thus formed, and an individual bulb became a ſwarm of vegetables. Other plants, which in this conteſt for light and air were too ſlender to riſe by their own ſtrength, learned by degrees to adhere to their neighbours, either by putting forth roots like the ivy, or by tendrils like the vine, or by ſpiral contortions like the honey-ſuckle; or by growing upon them like the miſleto, and taking nouriſhment from their barks; or by only lodging or adhering on them, and deriving nouriſhment from the air; as tillandſia.

Shall we then ſay that the vegetable living filament was originally different from that of each tribe of animals above deſcribed? And that the produc-

tive living filament of each of thoſe tribes was different originally from the other? Or, as the earth and ocean were probably peopled with vegetable productions long before the exiſtence of animals; and many families of theſe animals long before other families of them, ſhall we conjecture, that one and the ſame kind of living filaments is and has been the cauſe of all organic life?

This idea of the gradual formation and improvement of the animal world accords with the obſervations of ſome modern philoſophers, who have ſuppoſed that the continent of America has been raiſed out of the ocean at a later period of time than the other three quarters of the globe, which they deduce from the greater comparative heights of its mountains, and the conſequent greater coldneſs of its reſpective climates, and from the leſs ſize and ſtrength of its animals, as the tygers and allegators compared with thoſe of Aſia or Africa. And laſtly, from the leſs progreſs in the improvements of the mind of its inhabitants in reſpect to voluntary exertions.

This idea of the gradual formation and improvement of the animal world ſeems not to have been unknown to the ancient philoſophers. Plato having probably obſerved the reciprocal generation of inferior animals, as ſnails and worms, was of opinion, that mankind with all other animals were originally hermaphrodites during the infancy of the world, and were in proceſs of time ſeparated into male and female. The breaſts and teats of all male quadrupeds, to which no uſe can be now aſſigned, adds perhaps ſome ſhadow of probability to this opinion. [s] Linnæus excepts the horſe from the male quadrupeds, who have teats; which might have ſhewn the earlier origin of his exiſtence; but Mr. T. Hunter aſſerts, that he has diſcovered the veſtiges of them on his ſheath, and has at the ſame time

time enriched natural hiſtory with a very curious fact concerning the male pidgeon; at the time of hatching the eggs both the male and female pidgeon undergo a great change in their crops; which thicken and become corrugated, and ſecrete a kind of milky fluid, which coagulates, and with which alone they for a few days feed their young, and afterwards feed them with this coagulated fluid mixed with other food. How this reſembles the breaſts of female quadrupeds after the production of their young! and how extraordinary, that the male ſhould at this time give milk as well as the female! See Botanic Garden, Part II. Note on Curcuma.

The late Mr. David Hume, in his poſthumous works, places the powers of generation much above thoſe of our boaſted reaſon; and adds, that reaſon can only make a machine, as a clock or a ſhip, but the power of generation makes the maker of the machine; and probably from having obſerved, that the greateſt part of the earth has been formed out of organic recrements; as the immenſe beds of limeſtone, chalk, marble, from the ſhells of fiſh; and the extenſive provinces of clay, ſandſtone, ironſtone, coals, from decompoſed vegetables; all which have been firſt produced by generation, or by the ſecretions of organic life; he concludes, that the world itſelf might have been generated, rather than created; that is, it might have been gradually produced from very ſmall beginnings, increaſing by the activity of its inherent principles, rather than by a ſudden evolution of the whole by the Almighty fiat.—What a magnificent idea of the infinite power of THE GREAT ARCHITECT! THE CAUSE OF CAUSES! PARENT OF PARENTS! ENS ENTIUM!

For if we may compare infinities, it would ſeem to require a greater infinity of power to cauſe the

cauſes of effects, than to cauſe the effects themſelves. This idea is analogous to the improving excellence obſervable in every part of the creation; ſuch as in the progreſſive increaſe of the ſolid or habitable parts of the earth from water; and in the progreſſive increaſe of the wiſdom and happineſs of its inhabitants; and is conſonant to the idea of our preſent ſituation being a ſtate of probation, which by our exertions we may improve, and are conſequently reſponſible for our actions.

V. 1. The efficient cauſe of the various colours of the eggs of birds, and of the hair and feathers of animals, is a ſubject ſo curious, that I ſhall beg to introduce it in this place. The colours of many animals ſeem adapted to their purpoſes of concealing themſelves either to avoid danger, or to ſpring upon their prey. Thus the ſnake and wild cat, and leopard, are ſo coloured as to reſemble dark leaves and their lighter interſtices; birds reſemble the colour of the brown ground, or the green hedges, which they frequent; and moths and butterflies are coloured like the flowers which they rob of their honey. Many inſtances are mentioned of this kind in Botanic Garden, p. 2. Note on Rubia.

Theſe colours have, however, in ſome inſtances another uſe, as the black diverging area from the eyes of the ſwan; which, as his eyes are placed leſs prominent than thoſe of other birds, for the convenience of putting down his head under water, prevents the rays of light from being reflected into his eye, and thus dazzling his ſight, both in air and beneath the water; which muſt have happened, if that ſurface had been white like the reſt of his feathers.

There is a ſtill more wonderful thing concerning theſe colours adapted to the purpoſe of concealment; which is, that the eggs of birds are ſo coloured