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VITAL DYNAMICS

THE HUNTERIAN ORATION BEFORE THE ROYAL COLLEGE OF SURGEONS IN LONDON

14TH FEBRUARY 1840

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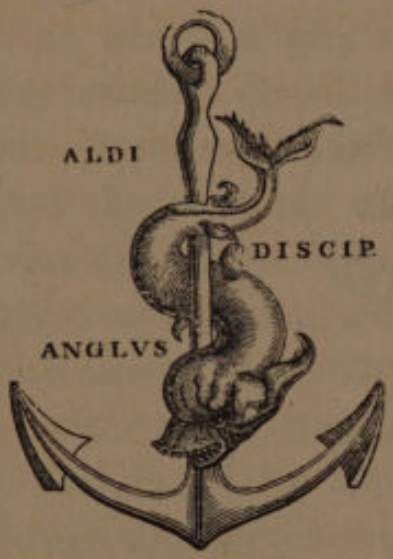
14TH FEBRUARY 1840

BY JOSEPH HENRY GREEN F. R. S.

LATE PROFESSOR OF ANATOMY AND SURGERY TO THE COLLEGE: PROFESSOR OF ANATOMY TO THE ROYAL ACADEMY: ONE OF THE SURGEONS TO ST. THOMAS'S HOSPITAL



LONDON

WILLIAM PICKERING

1840

C. WHITTINGHAM, TOOKS COURT, CHANCERY LANE.

PREFACE.

NOTWITHSTANDING the favourable testimony of friends, on whose judgment I rely, to the success of the Oration which I now offer to the candid and impartial criticism of those engaged in scientific pursuits, I shall neither be surprised nor offended, if it should appear that some of my auditors deemed it unsuited to the occasion on which it was delivered, or, that many of my readers consider it unsuited to any occasion. I cannot conceal from myself the fact, that the students of philosophy, to whom I address myself, are few in number; and that in this country men, even of apparently high cultivation, turn with scorn or indifference from what are called metaphysical pursuits. And if indeed, by the term metaphysics, we designate unmeaning subtleties, vague fancies, and, in general, speculations which properly transcend the human faculties, we might well be content to turn from them as a mere waste of time and abuse of the mind. But if by this term we mean (as in all reason we should) that which, in contradistinction to sensuous facts and appearances, is therefore

supersensuous, because it can be no object of the senses, and necessarily includes the principles which legitimately give to the results of sensuous experience their connexion and intelligibility,—the demand will scarcely appear extravagant, if we ask the students of natural science to examine the philosophical grounds of the postulates and *data* from which they proceed; and to subject to philosophical criticism the reasonings necessary to their inferences and conclusions, nay, the very language in and by which they convey and record the results of their experience.

The aim of this address is avowedly to aid the student in this requisite inquiry, and, I do not hesitate to add, in the indispensable duty of this προπαιδεία and preparatory discipline of science. That the attempt to penetrate, for this purpose, into a region of thought, little, alas! frequented by the English reader, will expose me to the charge of obscurity, almost inseparable from the nature of the undertaking, I have as little ground to doubt as disposition to avoid; and should it proceed merely from the mental indolence which too often induces the many to reject truth, because it is irreconcilable with their prejudices and previous habits of thinking, I shall be ready to bear the imputation without attempting either defence or apology. I am not, indeed, vain

enough to imagine that, had the limits of the Address permitted it, my powers would have enabled me to set forth the truths, which I proposed to vindicate, in the clear and convincing manner to which they are entitled. Any obscurity arising from defects of my own I should be ready at all times to confess: and no less, should the charge of perplexity and obscurity be substantiated by the exposure of error or ignorance, of erroneous statements or inconclusive reasonings, will the same love of truth, which inspired the courage to avow my conviction, prompt me to admit, without hesitation, their falsehood or imperfections.

If, however, after a more careful investigation of the grounds of natural science, it should, on the other hand, appear that the charge of obscurity may be more fitly retorted on a philosophy, tacitly, if not openly, adopted as the guide of observation and experiment, which, if I am not grossly deceived, has retarded the progress of science by fictions, fancies, and arbitrary assumptions, it will not be an unfounded hope, that the prejudices will be dismissed which have hitherto prevented the admission of the Dynamic Principles here inculcated. The limits of a preface forbid the attempt to expose the inconsistencies and contradictions that perplex and bewilder the mind, in the futile endeavours to construct a scheme

of the facts and phænomena of nature from merely sensuous *data*; though it would not be difficult to shew, that the pretended appeal to the senses is, in many instances, merely the substitution of the sensuous fancy for experience, and of pictures and figments for sensuous realities. What other name, for instance, than that of a figment can we give to the so called "matter" of physical reasoners? For the notion of a *materia prima*,—of a substance, standing *sub apparentibus*,—of a *noumenon* in contradistinction to its *phænomenon*,—supposes something beyond the qualities and forces with which it may have been endowed, and by means of which only it can act upon us, or become thereby a possible object of sensuous experience: and what possible object, conceptual or sensible, can remain after the abstraction of all and every property? How can we imagine even this *residuum*, except by mistaking the effort of straining the fancy for the notion it strives to realize? Has the natural philosopher satisfied himself that he derives any advantage in behoof of physics from the assumption of a material *substratum?* Will not some doubt mingle with his belief in examining this question, when he considers that our great Newton could admit that the particles of matter are infinitely small in proportion to the distances between them; and that

others have thought it no objection to the doctrine, that the material universe might be compressed within the compass of a nutshell? Will he find any authority or support for the opinion in the speculations of the materialist, Priestley, who leaves us in doubt whether the question between matter and spirit be not a mere verbal dispute? Let me entreat him, lastly, to weigh, whether the investigations of physics are not ever really and truly directed to the powers and forces with which matter is endowed, rather than to this imagined *substratum*, which the modern science of physics at least is content to keep out of view, as far as its doubtful nature renders it desirable, and to waive the boast of Ralpho, who

> " profest
> He had First Matter seen undrest:
> He took her naked, all alone,
> Before one rag of form was on."

It is very true that the metaphysical question of the nature of the matter is one which has been lost sight of, or banished, by modern physics, and that the experimental school has been content to take matter as a *datum* unexplained, or not requiring elucidation. It is, however, more than a question, whether the inherent difficulties of a sensuous and essentially mechanical philosophy of nature have been removed, by substituting or giving prominence to the *Atomic Doctrine*.

The modern experimentalist assumes or believes that the material constitution of the universe essentially consists in an original number of physical atoms, each distinguished by its specific properties; that these are so aggregated as to constitute bodies; that the physical atoms are so disposed, arranged and connected, as to produce the differences of solid, with all the modifications of density, of liquid and aëriform, and that in all instances they are disposed segregately with interstices, which permit the permeation of the body by other material molecules, and allow of separation, division, or reconjunction, without change or destruction of the individual molecules. Now it is very true that the supposed nature and arrangement of the atoms answer two very important purposes, and offer a sensuous intuition on the one hand, of the porosity, permeability and separability, and on the other, of the solidity, impenetrability, and continuity of bodily existence; and the condition under which such phænomena are possible, is undoubtedly a necessary postulate of the human mind. But it by no means follows that the atomic constitution of matter is the condition which justifies and necessitates its assumption. In order to conceive a body, its composition and decomposition, it is necessary to contemplate it as a possible partible and *continuum*.

But what, after all, is this but to say, that an extended whole or body must be conceived as separable or divisible into parts, and that, viewing the whole as an aggregate of parts, that which we predicate of all must be predicated of each? Does the atomic doctrine bring us one whit nearer to a solution of the remarkable fact of the interpenetration of aëriform bodies, of their rapid diffusion through each other's masses, so that there is no limit to their incorporation;—"one gas," as Dalton expresses it, "acting as a *vacuum* with respect to another?" Does it add any insight into the nature of the quantitative *minima* in the combining ingredients of chemical compounds, which the law of definite proportions has disclosed? It may be convenient for the natural philosopher to call these parts elementary molecules or atoms, but he should never forget that these physical atoms are contrivances of the sensuous imagination, for the purpose of presenting the constitution and changes of bodies as an image; or, if he forget it, he must be reminded that, so far from explaining the material constitution of bodies, they are, in truth, themselves little bodies, of which the parts just as much require explanation as those of larger; and that the difficulty would be the same in respect of a mote dancing in the sunbeam, as of the solar system itself. If, how-

ever, the atomic doctrine pretends to be more than a language, the naturalist will find that he has only exchanged the inconvenient speculation regarding matter for the no less intractable problem which body offers, and which the assumption of physical atoms renders nowise intelligible; an exchange, oppressed with similar difficulties, and which must ever beset a natural philosophy appealing to the senses for facts that cannot be matters of experience, referring to the authority of the senses for *data* that are beyond the capability of the senses to determine, and—not the least of the difficulties,—endowing these molecules with forces that render the physical atoms themselves the superfluous accessories of a natural philosophy too lazy to investigate its primary *data* and postulates, and to render them consistent with each other.

If it should be objected that the experimentalist finds no necessity for troubling himself with metaphysical questions, which he assumes to lie beyond the sphere within which he limits his exertions, and that he adopts the atomic, or other theory, only as a convenient hypothesis, or serviceable language, for conveying or recording a knowledge of the facts which he observes, or has the good fortune to discover,—that, in short, they answer a logical purpose, which it would be difficult otherwise

to supply, in contemplating the constitution and changes of Nature ; let him bear in mind that he is adopting a picture language, which, like the paintings on the walls of Egyptian tombs, or like Mr. Bowles' Bibles, may have the advantage of vividly affecting the senses, but is incapable of expressing more or other than what affects the senses ; and therefore (if our views be correct) calculated to withdraw the mind from the true objects of physical inquiry, namely, powers, forces, causes, laws the attempt to express which adequately in a language of the senses cannot but be a failure, attended with the disadvantage of misleading the mind from the true aims of inductive science. Shall we not, however, rather say that hypotheses, as founded upon arbitrary or insufficient *data*, are positive causes of error, and by the false semblance of knowledge, retard the progress of science. Opinions necessarily influence the statement of facts, and may keep us in ignorance of the truth, and perpetuate error, unless they have been previously subjected to philosophical criticism. It is scarcely necessary to remind the reader of the mischief of hypothetical reasoning, and how much farther its influence may extend beyond a mere logical mode of connecting facts, in the instances of the protracted authority of the Ptolemaic system of astronomy,

of the doctrine of the elements and humors in medicine, and of the mechanical physiology of the school of Boerhaave;—and equivalent examples are not wanting in modern times, of which the acidifying principle of Lavoisier's Chemistry is a notable instance. It may be said, indeed, that the errors here adduced were corrected by a further and more searching appeal to sensuous experience; but were I bound to grant the objection, I might still ask; —Whence did the errors originate, except in the too exclusive authority of the senses, and of the faculty judging according to sense; and what is to guard us in future against similar errors, except a philosophy which, in determining the grounds and aims of natural science, shall render the human mind consistent with itself, as the proof of its coincidence with universal and permanent truth.

This then was the primary object of this Address, to recommend the study of Nature, in the light of a dynamic philosophy, as a scheme of Causes and Laws in the unity and with the connections of reason. And in aid of this purpose, I flatter myself that I have rendered an acceptable service to the student of natural science, in drawing his attention to the all important distinction of the Reason and Understanding, which has been so ably and fully elucidated by the philosophic acumen of Cole-

ridge, and which, though recognized by our elder writers, and adopted by the philosophers of Germany, has been lost sight of or neglected by the more recent cultivators of intellectual philosophy in our country. And in order to this dynamic method, we have urged the student to penetrate deeper than the mere surfaces offered to his senses; and to unsensualize his mind, by contemplating the powers working in and to the *phænomena*, which are their signs and results; and we earnestly exhort him not to take the mere *data* of sensuous intuition as the only legitimate objects of knowledge, and cognitions, extrinsic and sensuous, as the limits beyond which it would be idle to push his inquiries. But if these views claim the serious attention of all those who are engaged in pursuits which have the operations and changes of nature for their object, most especially are they forced on the consideration of those who, in the study of living agents and of organic being, are perpetually reminded that the realities which they seek are not the immediate objects of the senses. What is it that constitutes the reality of our body, or of any organ of the body, say the eye? Is it to be sought in the materials of which it is composed? "Nothing," says Coleridge, "would be more easy than so to construct the paper, ink, painted

capitals, and the like, of a printed disquisition on the eye, or the muscles and cellular texture (that is, the flesh) of the human body, as to bring together every one of the sensible and ponderable stuffs or elements, that are sensuously perceived in the eye itself, or in the flesh itself. Carbon and nitrogen, oxygen and hydrogen, sulphur, phosphorus, and one or two metals and metallic bases, constitute the whole. It cannot be these, therefore, that we mean by an eye, by our body. But perhaps it may be a particular combination of these? But here comes a question: In this term do you or do you not include the principle, the operating cause, of the combination? If not, then detach this eye from the body. Look steadily at it—as it might lie on the marble slab of a dissecting room. Say it were the eye of a murderer, a Bellingham: or the eye of a murdered patriot, a Sidney!—Behold it, handle it, with its various accompaniments or constituent parts, of tendon, ligament, membrane, blood-vessel, gland, humors; its nerves of sense, of sensation, and of motion. Alas! all these names, like that of the organ itself, are so many anachronisms, figures of speech, to express that which has been: as when the guide points with his finger to a heap of stones, and tells the traveller, 'That is Babylon, or Persepolis.'—Is this cold jelly 'the light of

the body?' Is this the *micranthropos* in the marvellous microcosm? Is this what you mean when you well define the eye as the telescope and the mirror of the soul, the seat and agent of an almost magical power?

"Pursue the same inquisition with every other part of the body, whether integral or simply ingredient; and let a Berzelius or a Hatchett be your interpreter, and demonstrate to you what it is that in each actually meets your senses. And when you have heard the scanty catalogue, ask yourself if these are indeed the living flesh, the blood of life? Or not far rather—I speak of what, as a man of common sense, you really do, not what, as a philosopher, you ought to believe—is it not, I say, far rather the distinct and individualized agency that by the given combinations utters and bespeaks its presence? Justly and with strictest propriety of language may I say, speaks. It is to the coarseness of our senses, or rather to the defect and limitation of our percipient faculty, that the visible object appears the same even for a moment. The characters which I am now shaping on this paper abide. Not only the forms remain the same, but the particles of the coloring stuff are fixed, and, for an indefinite period at least, remain the same. But the particles that constitute the size, the visibility, of an organic structure

are in perpetual flux. They are to the combining and constitutive power as the pulses of air to the voice of a discourser; or of one who sings a roundelay. The same words may be repeated; but in each second of time the articulated air hath passed away, and each act of articulation appropriates and gives momentary form to a new and other portion. As the column of blue smoke from a cottage chimney in the breathless summer noon, or the stedfast-seeming cloud on the edge-point of a hill in the driving air-current, which momently condensed and recomposed is the common phantom of a thousand successors;—such is the flesh which our bodily eyes transmit to us; which our palates taste; which our hands touch.

"But perhaps the material particles possess this combining power by inherent reciprocal attractions, repulsions, and elective affinities; and are themselves the joint artists of their own combinations? I will not reply, though well I might, that this would be to solve one problem by another, and merely to shift the mystery. It will be sufficient to remind the thoughtful querist, that even herein consists the essential difference, the contradistinction, of an organ from a machine; that not only the characteristic shape is evolved from the invisible central power, but the material mass

itself is acquired by assimilation. The germinal power of the plant transmutes the fixed air and the elementary base of water into grass or leaves; and on these the organific principle in the ox or the elephant exercises an alchemy still more stupendous. As the unseen agency weaves its magic eddies, the foliage becomes indifferently the bone and its marrow, the pulpy brain, or the solid ivory. That what you see is blood, is flesh, is itself the work, or shall I say, the translucence, of the invisible energy, which soon surrenders or abandons them to inferior powers, (for there is no pause nor chasm in the activities of Nature) which repeat a similar metamorphosis according to their kind;—these are not fancies, conjectures, or even hypotheses, but facts; to deny which is impossible, not to reflect on which is ignominious. And we need only reflect on them with a calm and silent spirit to learn the utter emptiness and unmeaningness of the vaunted Mechanico-corpuscular philosophy, with both its twins, Materialism on the one hand, and Idealism, rightlier named subjective Idolism, on the other: the one obtruding on us a world of spectres and apparitions; the other a mazy dream!"

I will not, however, conceal from my readers that I have had an ulterior object in the following address, and—in addition to its purpose,

in connection with the intention of the founders of the Hunterian Oration, of vindicating the original merit of John Hunter as a philosophical physiologist,—that it was composed with a view to the larger design, to which his labors most importantly contributed, of reconciling the study of Nature with the requirements of our moral being, and of connecting science,—which even as the noblest offspring of our intellect is but a fragment of our humanity,—with the philosophy of Coleridge; which, as far as my knowledge extends, pre-eminently, if not alone, gives life and reality to metaphysical pursuits, by showing their birth, growth, and requisite foundation in the whole man, head and heart. It must be reserved, indeed, for a more suitable occasion, to set forth with fuller and clearer evidence the comprehensive scheme and method of its great and good Author, as far as such a supplement may be necessary to his inestimable published writings; and I am not without hope that sufficient will have been done in this address to convince the student of the true import of the doctrine of Ideas, as eternal truths, which are, indeed, actuating powers, in the faith of the correlation of the human mind with the Divine Reason, with that Intelligence whose thoughts are acts, with that Mind which is the identity of truth and reality.

It is in aid of this more vital philosophy, that the doctrine of Ideas has been introduced: and if the word sound strangely to those for whom "Idea" has no other meaning than, "whatsoever is the object of the understanding when a man thinks,"*—the advantage of exchanging it would be equivocal; since this term, or some substitute less authorized by philosophical usage, is imperatively required in dynamic philosophy, in order to designate powers as predetermining and constructive, as intelligential acts, δυνάμεις νοεραὶ καὶ νοηταί, and as *formæ formantes*, or laws. It is however worthy of notice, that the necessity of conveying the meaning here intended has led to the adoption of expressions, the familiar use of which, whilst it renders them less preferable for a technical purpose, happily aids us in explaining the peculiar force of the term "Idea," in accordance with the usage of the Platonic School, in which it first acquired currency. Thus the word "Principle" is sometimes employed as in some respects equivalent to Idea; and it will be admitted that if this term have any appropriate meaning, it is that of a causative first, which predetermines its consequents and results, and therefore potentially contains them,—that is, has the power of

* Locke, Human Understanding, chap. i. §. 8.

producing them, though the power may not have been actually exerted in realizing them. We speak of the "principles" of moral conduct, and assign to the agent a good or bad principle, as that which influences or predetermines his actions. Again, we infer a "principle" of vitality in all living beings, as that which, antecedent in order of operance to any visible product, is the power which builds up the living fabric, and remains as its conservative "principle" or energy: nay, where the term is used *sensu improprio*, as when *morphia* in opium is called its active "principle," still we mean the power which produces and acts in and by the so called material substance. It will be seen then, that the term is used for the purpose of designating the character of a primal causative, which is known by, and presupposed in, the results which it produces and predetermines.

Another example of a term sometimes substituted for Idea, we find in the word "Spirit," as it is not unfrequently employed; for both alike may designate a one power, manifesting itself in a diversity of forms, and in a manifold of changing results. Thus we speak of the "Spirit or Idea of the British Constitution:" and though the Idea has perhaps never been distinctly recognized, or raised into distinct consciousness, if indeed we except in the Idea

of Church and State, by Coleridge; yet, meanwhile the seed, *semen geneticum*, having found an appropriate soil, has grown and evolved itself, as it were, by a blind and silent life; and, notwithstanding the occasional frost-blight, the shock of the blast, and the stroke of the lightning, has reared itself amid faction, invasion, and revolution, into a growth as stately as the native oak of its soil. And I have still faith enough in the English heart of my country to believe, that, as long as its "Spirit" remains national, in that best sense of the word nation, which respects not a particular generation,—not the people at one time existing, but the unity of the generations, the type of our inward humanity in the flux of our outward mortality,—the Constitution will continue to expand, prosper, and perfect itself harmoniously as by an organic life. In like manner, the use of the phrase, the "Spirit of the Scriptures" is accompanied by no fear of being misunderstood: we appeal to the one spirit pervading them as evidence of the inspiration of the writers, and we refer confidently all its recorded events, all its prophetic assurances, promised blessings and awful denunciations, all its precepts, doctrinal and practical, all that elevates hope, enlightens faith, or enlivens charity, in its radiant pages,—we attribute all its varied workings to One Holy Power, re-

vealing Himself as the moral Providence of the world in the redemption of humanity.

Again, the terms, "Type, Pattern, Exemplar, Model, παράδειγμα," have been used as in some degree synonymous with Idea, since they imply that, according to which any result or product is perfected. This may be illustrated by the conception of an artist working according to a pattern, or ideal in his mind; and thus, a Praxiteles in forming a statue embodying all that is lovely in the female form, or a Fra Angelico, in realizing his supposed vision of the beatified Virgin, might be said to have an Idea in his mind, which was the "standard" according to which he judged of female forms; the "pattern" according to which he worked; and the "ultimate end" which he had proposed to himself from the beginning, and had guided his labors throughout. Though we may say to the artist, as well as to the philosopher, in the words of Scripture, *And look that thou make them after their pattern, which was shewed thee in the mount.**—For the demand is here no less than that of giving a living presence to that, of which all the forms within our experience are but approximations; and if, therefore, such ideal types can be *contemplamina* for the human mind, they must be derived from a higher

* *Exodus*, xxv. 40.

source, and more excellent birth-place; and whether we look to the works of nature or to the Ideas, which actuate man in his strivings, and become for him the ultimate aims that guide his endeavors towards perfection in his acts and deeds, we cannot but admit that the end and aim are present, and contained in the intention and design at the commencement, predetermine the means to their attainment, and secure the result. Such then is an Idea; and we may describe it as a causative principle, combining both power and intelligence, containing, predetermining, and producing its actual result in all its manifold relations, in reference to a final purpose; and realized in a whole of parts, in which the Idea, as the constitutive energy, is evolved and set forth in its unity, totality, finality, and permanent efficiency.

In the ensuing discourse, an attempt has been made to determine the import of Ideas, in connexion with the powers of nature, as a scheme of living forces; and the term has been employed to designate those energic acts of Omnipotent wisdom, which, as laws of nature, *formæ formantes*, are at once creative and conservative of a nature, ever changing, and yet ever essentially the same. If we contemplate them as thoughts of the Divine Intelligence, they are Ideas, the archetypes and preexisting

models; if as acts of the Divine Will manifested in nature, they are laws. But the student, in humbly raising his apprehension to the Supreme source of Ideas, must never forget the Divine Unity, nor the identity therein of unerring Intelligence, which transcends choice, and of Omnipotent Will, causative of all reality, in eternal act transcending all pause of deliberation. In surveying the works of nature as the impress of Perfect Wisdom, which is Almighty Power, and whose thoughts are acts; no breach of unity may be conceived in the design and realization, and we can only say that the will of God *is*,—at once actualized, and in one act identifying originative power, final intention, and completed reality, in its highest perfection of being. God does, and then sees that it is good; for that which is done, can be only the reflex of the perfect agent.

Although it would be here out of place to attempt to reconcile the discrepancies of commentators on the Platonic Ideas, enough, it is hoped, has been done, in evolving the essential character of a law of nature, to rescue the speculations of Plato from the opprobrium of extravagance, even of absurdity, which has been too often imputed to them, and to vindicate, as far as sound philosophy may sanction it, his doctrine;—that Ideas, ἰδέαι, are the eter-

nal types, παραδείγματα, in the divine mind, according to which, and the principles, ἀρχαί, by the efficiency of which, all things became; and which Ideas, infused into the human mind, and recognized by a sort of recollection, it is the business of philosophy to bring into distinct consciousness. St. Augustine has with better wisdom, indeed, assigned a more sufficient cause than memory for their presence in the minds of men, in saying: "*Credibilius est quia præsens est eis, quantum id capere possunt, Lumen Rationis æternæ, ubi hæc immutabilia vera conspiciunt, non quod noverant aliquando et obliti sunt, quod Platoni vel talibus visum est.*"* For, in truth, it is a statement of the Christian doctrine, that the Word, by whom all things were made, is essential light and life to his creatures;—πάντα δι' αὐτοῦ ἐγένετο, καὶ χωρὶς αὐτοῦ ἐγένετο οὐδὲ ἕν ὃ γέγονεν. Ἐν αὐτῷ ζωὴ ἦν, καὶ ἡ ζωὴ ἦν τὸ φῶς τῶν ἀνθρώπων. John, ch. i. v. 3, 4. As a farther exposition of the same doctrine, we offer the following definition by Coleridge: "That which contemplated objectively, (that is, as existing externally to the mind,) we call a Law; the same contemplated subjectively, (that is, as existing in a subject or mind,) is an Idea. Hence Plato often names Ideas, laws; and Lord Bacon, the British Plato, describes

* Retract. lib. i. cap. 4.

the laws of the material universe as the Ideas in nature. *Quod in natura naturata lex, in natura naturante idea dicitur.*"* And it is in accordance with this truth that I have endeavored to show in the following Address, that, as all within the sphere of our sensible experience bears the character of the transient and fluxive, it is only by the aid of the Reason, φῶς τὸ ἀλήθινον, that we are enabled to look beyond and deeper, to discover the laws which give permanence and regularity, to discern the eternal Ideas, which are the regulating types and standards of a nature ever tending to lapse into the imperfect and arbitrary, and to raise ourselves to the contemplation of the true causes, the divine acts themselves, which, in our experience of the sensible world, are hidden under the veil of the unreal and perishing representatives of the realities, from which they are derived.

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* Church and State, p. 12. Edited by H. N. Coleridge, 1839. Compare The Statesman's Manual, Appendix E.

And the following comment on the Platonic doctrine, though not unobjectionable in its phraseology, may be acceptable to the reader, as offering a different kind of illustration: "*La théorie Platonicienne est l'unité de l'existence universelle, par conséquent l'harmonie de l'esprit humain et de la nature, des conceptions de l'un et du plan de l'autre, et le double caractère de l'idée, prise au sens de Platon, comme conception générale dans le sujet pensant, et comme loi ou forme générale dans l'objet externe.*" V. Cousin Metaphysique d'Aristote, p. 49.

Lastly, if the Author has succeeded in drawing the attention of the student to the import of Ideas, and in exhibiting their importance in aid of a dynamic method of a philosophy and science of nature, he cannot better conclude this prefatory address, than by a passage from Schelling, in the language of Coleridge: "The highest perfection of natural philosophy would consist in the perfect spiritualization of all the laws of nature into laws of intuition and intellect. The *phænomena* (the material) must wholly disappear, and the laws alone (the formal) must remain. Thence it comes, that in nature itself the more the principle of law breaks forth, the more does the husk drop off, the *phænomena* themselves become more spiritual, and, at length, cease altogether in our consciousness. The optical *phænomena* are but a geometry, the lines of which are drawn by light, and the materiality of this light itself has already become matter of doubt. In the appearances of magnetism, all trace of matter is lost, and of the *phænomena* of gravitation, which not a few among the most illustrious Newtonians have declared no otherwise comprehensible than as an immediate spiritual influence, there remains nothing but its law, the execution of which, on a vast scale, is the mechanism of the heavenly motions. The theory of natural philosophy would

then be completed, when all nature was demonstrated to be identical in essence with that which, in its highest known power, exists in man as intelligence and self-consciousness; when the heavens and the earth shall declare not only the power of their Maker, but the glory and the presence of their God, even as He appeared to the great prophet during the vision of the mount, in the skirts of his divinity."*

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* Biographia Literaria, v. i. p. 257.

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HUNTERIAN ORATION.

MDCCCXL.

Prudentibus hæc satis fore, imprudentibus autem ne plura quidem. BACON, NOVUM ORGANUM.

HUNTERIAN ORATION.

MR. PRESIDENT AND GENTLEMEN.

On this, the twenty-fifth, occasion of our assembling to commemorate the birth of John Hunter, by renewing our acknowledgment of his merits,—an occasion signalized by the presence of a gracious Prince,* whose many personal claims on our loyal affection are enforced by gratitude to the revered Monarch, his excellent and illustrious father, to whom this College owes its existence,—on this the twenty-fifth commemorative occasion, I might claim some indulgence in the performance of the duty entrusted to me, when I remind you of the difficulty which the talents and eloquence of more than twenty predecessors have imposed on the task. But, though I do not hesitate to solicit your forbearance in a comparison, which I fear would prove unfavourable to him who has now the honour of addressing you, I dare not attempt to vindicate my inability to do justice to Hunter's eminent merits by pleading any diminution in the interest, still less any exhaustion of the materials

* H. R. H. the Duke of Cambridge.

of the subject, however frequently set forth and impressively urged. The discoveries of science, the triumphs of genius, the revelation of truth, seem to partake of the permanent being, which is their source; they are perennial, living growths, which ever put forth anew their foliage, blossom, and golden fruit; and we collect from year to year the harvest, that owes its birth to those divine seeds of wisdom, which the gifted individuals of our race have been permitted to plant, which have been watered by the dews of heaven, and have been fostered by the light and genial warmth of a sun, that sheds on them the blessing of Providence.

Among those individuals, to whom have been granted creative genius, power of insight, and the faculty of interpreting the Laws, by which their divine Author works in Nature,—among the foremost of those favoured individuals may be ranked the great man whom we now meet to honour. We claim for him the enlightened approbation of those whose scientific attainments enable them to appreciate his transcendant merits: we claim for him the gratitude of mankind: and, if it be in any proportion to the benefit conferred, they will award to him the name of a benefactor, as having enlarged the boundaries, multiplied the resources, and elevated the aims of a science, eminently calculated for the benefit, and exclusively devoted to remove or alleviate the

ills, of suffering man. If, however, our praise is to be discriminative and appropriate to the occasion, we must essay, in the humble hope of some inspiration of the same power, to scan the genius which animated and directed his bold, original, and profound researches, and to trace, with kindred spirit, the mind of him who conceived, planned, and, in a great measure, constructed (what yet indeed remains to be fully achieved) the mighty work of a philosophy and science of life and living being. The mere personal character of the man has, meanwhile, almost ceased to be a matter of interest; of those who personally knew him, whom we regard with the affectionate reverence due to those who have communed with a gifted seer, there still linger only a few amongst us; and even now it is my painful duty to remind you of the loss of one of these distinguished pupils of Hunter, of one whose memory is hallowed to me by recollections of personal and of family friendship.

Edward Coleman had shown early in his professional career originality and ability in physiological research; and having obtained, at the joint recommendation of Mr. Hunter and of Mr. Cline, the appointment of professor at the Veterinary College, he was thereby enabled at once to follow his favourite pursuits, and to promote the interests of the profession to which he had become attached. And it is not too much to say, that it was eminently,

by the Hunterian Physiology, evinced in his lectures and published works, that the veterinary art, in being based on its proper science, has been elevated in this country into a profession, and that its practitioners have thereby obtained that title to the rank of gentlemen, which mainly, at his instance, was recognized by the Government in granting to veterinary surgeons commissions as officers of cavalry. The charm of Professor Coleman's intellectual character was its freshness, originality, and enthusiasm; he had that instinctive philosophy which consists in the unprepossessed susceptibility to, and love of, truth; and we shall not withhold from him the attribute of genius, if (as has been happily said) its character be that of the "feelings of childhood taken up and matured into the powers of manhood."* In his social intercourse he was playful, unassuming, genial, and amiable. His amenity of manners and kindness of disposition continually engaged new friends, whilst he ever cherished those attachments which he had once formed: and by all those who enjoyed his friendship and knew his worth, his memory will be preserved in that enduring regret, in which grief disguises itself as the fond remembrance of the excellence it laments.

That those of Hunter's pupils whom he has left behind for our respect and affection may

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* Coleridge's Biog. Lit. I. 85.

long continue to cheer us by their presence, be our fervent prayer! But with them the immediate interest in the peculiarities of the private and personal character of the man himself must cease. Henceforward the name of John Hunter will remain as the symbol of a productive power and of a constructive function in the organic development of science: and it is my intention, on the present occasion, in support of this larger and more permanent ground of interest, and in behalf of Hunter's claims as a medical philosopher, to address you on the scientific Idea or aim which guided his physiological investigations, in connexion with the philosophical grounds of natural science:—not unmindful of the lessons of my great teacher and revered friend, Samuel Taylor Coleridge, who long since earned the gratitude of the admirers of Hunter by asserting the dynamic spirit of his views, and who stands pre-eminent in our country in recalling its better minds from that sensual misnamed philosophy, that tendency to empiricism and empirical novelties, unsteadied by science, in which a specious name of Utility usurps the Idea of fontal and abiding Good:

> Yea, oft alone,
> Piercing the long-neglected holy cave,
> The haunt obscure of old Philosophy,
> He bade with lifted torch its starry walls
> Sparkle, as erst they sparkled to the flame
> Of odorous lamps tended by Saint and Sage.
> O framed for calmer times and nobler hearts!

O studious Poet, eloquent for truth!
Philosopher! contemning wealth and death,
Yet docile, childlike, full of Life and Love!"*

And if the contemplation of Nature is to be other and more than a mere description of appearances, a *catalogue raisonné* of facts, or a *memoria technica* of phænomena, formed by generalization and classification; if it aim at connexion and unity, it requires an appeal to philosophy, in order that insight may be superadded to sight.† The business of philosophy, I say, is to discover truths, which, as first principles, are to give intelligibility, and which, therefore, cannot be deduced from the facts of experience, which they are intended to explain, and to which they are to give unity and connexion:—they are truths su-

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* Coleridge's Poet. Works, vol. i. p. 201.

† Intellectual unity is indeed supplied by science; but science can be predicated only of any scheme of knowledge, connected as a chain of necessarily dependent truths, so that any link of the chain being given, any other may be deduced as a necessary consequence of the principle, which determines the relations of all, and which gives to its possessor the power of anticipating and predicting its results in any given case. And if the essential character of science consists in the necessary connection and dependency of the links in any scheme of knowledge, it will be equally evident that, in order to complete and perfect it as truth, the principle which serves as the staple to the chain must itself be established and vindicated. This, however, is the business of philosophy; the object of which is to investigate and determine first principles, and to bring them into the unity of the rational mind and of truth one and universal: principles are the postulates of science and the problems of philosophy.

persensuous. But in referring to truths, which transcend our sensible experience, do I therefore seduce the student to wander,

extra flammantia mœnia mundi,

after an *ignis fatuus* of vain metaphysical speculation? On the contrary, I refer him to facts of his own consciousness, whereon to ground his assurance of the truth and reality of the principles, which the insight of nature requires. We demand, and the rational mind cannot be satisfied with less, that the facts, phænomena, and changes, which form the sphere of our sensible experience, and, collectively, are called Nature, shall be rendered intelligible to, and rationally accounted for by, our mind. This cannot be said to have been accomplished, whilst they are for us phænomena only, mere appearances, or impressions on the senses; nay! they cannot be said to have for us even the dignity of facts, until they have been named, collected, sorted, arranged and classified, or have received some impress of intellectual unity.* But we require more than this. The instincts of reason † lead

* A particular, that is, any specific impression on the senses, becomes a fact for the mind when it has been named, and thereby included in a *genus*, or designated as a generic conception. To think is to generalize, and language is the instrument of the process. Hence all words are, in truth, general terms.

† The phrase "instincts of reason" is intended to imply that men may be actuated by ideas, truths or principles of

us to investigate what the realities are of which the phænomena are the outward signs, and we ask: What the permanent is amid the perplexing variety of change? How, and by what efficiency, the operations offered to our inquiries are wrought! What enables us to anticipate as certain the observed recurrence of events? And why, or for what purpose, the *complexus* of physical actions and reactions is perpetually renewed before us in all the marvellous variety, order, and beauty of nature? In short, we must soon arrive at the conclusion that, in order to any rational insight of the facts of sensible experience, we are to view them, and seek their intelligibility * in their Laws and Causes. And this leads me at once to the consideration of the nature of those Laws, which have been appointed by the Creator, and which it is the aim and humble hope of

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reason, of which they have not conscious possession or insight, and that they may be possessed by such, and their thoughts and acts governed by these powers of truth, though they may not possess them, nor have the capability of legitimating the possession by conscious insight of their truth and reality.

And the Reader is requested to observe, that the weight of the argument here proposed depends mainly upon a distinction, throughout implied in this discourse, and adopted by our elder writers, though, alas! neglected by those of the present day in England, namely, the essential distinction between Reason and the Understanding; this, however, has been so fully and ably established by Coleridge, that I have only to recommend to attentive perusal his Aids to Reflection, 4th Edit. p. 157;—on the difference in kind of Reason and the Understanding.

* See Appendix A.

his rational creatures to discover, in firm reliance on his aid, *συμπράττειν πρὸς διόρθωσιν ἀκριβῆ τοῦ ἐν ἡμῖν λόγου, καὶ ἕνωσιν αὐτοῦ πρὸς τὰ ὄντως ὄντα, διὰ τοῦ τῆς ἀληθείας φωτός.**

It is to our incomparable countryman Bacon that, by the unanimous suffrage of natural philosophers, the merit is conceded of having turned men's minds from the mere logical legerdemain, which, during the period of the School-philosophy, usurped the name of natural science, to observation and experiment, and of having established the principle of Induction as the legitimate process by which we are to arrive at insight of the laws of Nature. Shall we, however, adopt the now generally received opinion, that the inductive process which Lord Bacon recommends, consists entirely of "generalizations, commencing with the most circumstantially stated particulars, and carried up to universal laws and axioms, which comprehend in their statements every subordinate degree of generality;"† and thus, that a law is only a generalization from the facts and phænomena of sensible experience, a mere result of, and belonging to, the human understanding? Assuredly, Lord Bacon's philosophy had a nobler aim, and requires, in order to a science

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* Simplicii Comm. in Epicteti Enchiridion Schweighäuser, Tom. i. p. 526.

† See Preliminary Discourse on the Study of Natural Philosophy, by I. F. W. Herschel, London, 1830. Chap. iii. p. 104; Compare Whewell's History of the Inductive Sciences, Vol. i. p. 6.

of nature, that man should also interpret the facts offered to his senses. If we ask how he attains to this power of Interpretation and of insight, the answer is, by the *lux intellectus*, the *lumen siccum*, the pure and impersonal reason, freed from all the various idols, enumerated by our great legislator of science, the *idola tribus, specus, fori, theatri*,—that is, freed from the limits, the passions, the prejudices, the peculiar habits of the human understanding, natural or acquired; but, above all, from the *idola intellectús*, from the arrogance which leads man to take the forms and mechanism of his own mere reflective faculty as the measure of nature and Deity. For, says Bacon: "*Non leve quiddam interest inter humanæ mentis idola et divinæ mentis Ideas, hoc est, inter placita quædam inania, et veras signaturas atque impressiones factas in creaturis, prout inveniuntur.*"* And thus, if in order to the interpretation of nature, he requires that man should know and apprehend by the light of reason the import of sensuous facts as the signatures and impressions of divine Ideas, we may safely affirm that the Induction, which Lord Bacon proposed, though forming the steps to the needful vantage ground for the "*inqui-*

* Nov. Org. Aph. 23. Compare Essay IX. of Coleridge's Friend, 3rd Edit. in which the argument is more fully stated and carried out. And the reader is earnestly invited to peruse the whole treatise on Methodology in that work, of which Essay IX. forms a part.

sitio formarum, quæ sunt ratione certa et sua lege æternæ et immobiles,"* had in truth, for its final object, the discovery of those Ideas, which as laws of nature, are the impress of the Creator's power and wisdom, and as such, are necessarily somewhat other and more than the mental substantiation of facts under whatever degree of generality.

Again, does the history of the grand discoveries of science offer any sufficient evidence that they were only the result of a laborious collection of facts and observations of particulars. If indeed that great master-piece of the generalizing faculty, the Ptolemaic System of Astronomy, still retained its authority, it might have been held up as a triumphant proof of the success of the method: but, alas! "its cycles and epicycles, orb within orb," have vanished like a summer morning's mist before the piercing glance of him, who, penetrating deeper than appearances, *solem dicere falsum ausus est*,—have vanished before a reason, which can correct experience, and has authority to annul the reports of the senses, and the *dicta* of the faculty judging according to sense.† "What, for instance, could be ap-

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* Nov. Org. lib. ii. Aph. 9.

† "We arrive at conclusions which outrun experience, and describe beforehand what will happen under new combinations, or even correct imperfect experiments, and lead us to a knowledge of facts contrary to received analogies drawn from an experience wrongly interpreted, or overhastily generalized." —*Herschel*, ib. p. 29.

parently more unprofitable than the dry speculations of the ancient geometers on the properties of the conic sections, or than the dreams of Kepler, (as they would naturally appear to his contemporaries) about the numerical harmonies of the universe? Yet, (says Sir John Herschel, from whom I quote,*) these are the steps by which we have risen to a knowledge of the elliptic motions of the planets, and the law of gravitation, with all its splendid theoretical consequences and its inestimable practical results."† The same high authority tells us‡ that "the law of definite proportions (in Chemistry), after the laws of mechanics, perhaps the most important which the study of nature has disclosed, was announced at once by Mr. Dalton in its most general terms, without passing through subordinate stages of painful inductive ascent."§ And a dispassionate inquiry into the origin of the discoveries of science will convince us that, so far from their being in general

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* Herschel, ib. p. 11.

† Condorcet, quoted by Conte, says: "*Le matelot, qu'une exacte observation de la longitude préserve du naufrage, doit la vie à une théorie conçue, deux mille ans auparavant, par des hommes de genie, qui avaient en vue de simples spéculations géométriques.*"—Cours de Philosophie positive, par M. A. Conte, Tome i. p. 65.

‡ Herschel, ib. p. 305.

§ "A remarkable instance of such a relation" (says Sir John Herschel, speaking of the relations among the *data* of physics, which show them to be quantities not *arbitrarily* assumed, but depending on laws and causes, which they may be the means

the offspring of a generalization from particulars, they oftener originate in observations apparently trivial and accidental, in occurrences sudden and unexpected, frequently in the pursuit of fanciful analogies, or in the trial and rejection of arbitrary hypotheses, and are the result of a mind excited to react upon its experience, unsatisfied with the hitherto adopted connexion of facts and their want of unity, and its inventive and originative powers, thereby roused to enlarge its apprehension beyond the perspective which its own mechanism implies: and hence the discovery of any great law of nature has uniformly the character of felicity, and of a revelation, as by a flash of divine light, of the legislative wisdom of the Creator.

This view will acquire additional evidence by further meditation on the nature of Law. The human mind recognizes a law, wherever it attributes unity to a manifold of facts and phænomena, contemplates the connexion of

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of at length disclosing) " a remarkable instance of such a relation is the curious law, which Bode observed to obtain in the progression of the magnitudes of the several planetary orbits. This law was interrupted between Mars and Jupiter, so as to induce him to consider a planet as wanting in that interval;—a deficiency, long afterwards strangely supplied by the discovery of *four* new planets in that very interval, all of whose orbits conform in dimensions to the law in question, within such moderate limits of error as may be due to causes independent of those on which the law itself ultimately rests."—*Herschel*, ib. p. 308.

each and all in relation to the same as necessary, regular, and invariable, and is thereby rendered capable of anticipating and predicting a constant order of succession or of simultaneous co-operation in their recurrence. A glorious instance already adduced, of the establishment of a law, answering to this definition, we owe to our immortal countryman Newton. Not only has it been shown that the movements of the planetary bodies, of which our system consists, are ordered by the law of gravitation, even that the inequalities of the planetary movements may be explained and predetermined by the same; but that the law of gravitation enables the astronomer to demonstrate with predictive insight, the stability and permanence of the system under all the accumulating influence of its perturbations.*

It is in attaining to the knowledge derived from the possession of such laws, that man becomes, as Lord Bacon expresses it, the "Interpreter of nature." But do we not derive this gift of power and prophecy from somewhat far higher than from any mere exercise of the human understanding or faculty judging according to sense? A law not only implies what is, and must be, the result of universal experience according to the essential constitution of human mind, but that more excellent knowledge of an operance, which would be

* Compare Herschel, ib. p. 272.

real and effective whether man contemplate its effects in the works of nature or not, and which is constitutive in nature.* Without the admission of this incontrovertible truth, all sense of an outward, necessary, and efficient connexion would be lost. Instead of a rational and unshaken faith in an invariable order of nature, we could only claim for a patch-work of experience that faintest mode of combination arising from a habit of association in our own mind; and a mere belief in probabilities would usurp the place and name of law, with

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* "Every law is a provision for cases which *may* occur, and has relation to an infinite number of cases that never have occurred and never will. Now it is this provision, *à priori*, for contingencies, this contemplation of possible occurrences, and predisposal of what shall happen, that impresses us with the notion of a *law* and a *cause*. Among all the possible combinations of the fifty or sixty elements which chemistry shows to exist on the earth, it is likely, nay, almost certain, that *some* have never been formed; that some elements, in some proportions, and under some circumstances, have never yet been placed in relation with one another. Yet no chemist can doubt that it is *already fixed* what they will do when the case does occur. They will obey certain laws, of which we know nothing at present, but which must *be* already fixed, or they could not be laws. It is not by habit, or by trial and failure, that they will learn what to do. When the contingency occurs, there will be no hesitation, no consultation;—their course will at once be decided, and will always be the same if it occur ever so often in succession, or in ever so many places at one and the same instant. This is the perfection of a law, that it includes all possible contingencies, and ensures implicit obedience,—and of this kind are the laws of nature."—*Herschel*, ibid. p. 36.

doubt or utter disbelief of all that is beyond or above the senses.

And in the world do we not see everywhere evidences of a unity, which the component parts are so far from explaining, that they necessarily presuppose the unity as the cause and condition of their existing at all? Every whole of parts, be it the minutest crystal, a plant, an animal, the globe which sustains us, the solar system of which it is a part, or the universe itself, in the infinitude of which that system is less than a mote, every whole of parts demands for its intelligibility a cause or principle of each union, a power and unity, antecedent in the order of efficiency, and remaining present, as the sustaining and conservative energy; it implies a legislative act, predetermining the result, compelling implicit obedience, and excluding all contingency;—an act combining the foresight of wisdom and the power of irresistible will as immutable purpose and persistent function; and that (saith the judicious Hooker) "which doth assign unto each thing the kind, that which doth moderate the force and power, that which doth appoint the form and measure of working, the same we term a law."* Reflect on the exquisite harmony of all surrounding things and the coherence of all to the κόσμος, to the order and

* Ecclesiastical Polity, B. I. c. ij. See Coleridge's Note on Hooker, Literary Remains, vol. iii. p. 29. Compare Aids to Reflection, 4th Edit. p. 44.

beauty of the world! How else could a whole, a system of manifold agencies, result in sequence invariable, in connexion necessary, in order permanent, in co-operation harmonious, in government immutable, unless by a will, manifested in acts causative and intelligential, predetermining the final purpose, and providing the means to the ultimate aim, already contemplated in the antecedent unity of the legislative act?

And, if such be the nature of the laws that govern the universe, can it be doubted that man may raise his apprehension to the creative thought and energy, which produces and sustains, and that he is permitted to contemplate the wisdom and power which framed the worlds, in those energic acts, ideas or laws, which constitute the divine operance? Will it be denied that the ultimate aim of man's knowledge can be no other than the first principles, call them truths or powers, which by Bacon and Plato were called Ideas of the divine mind?

But shall we say that man, by any faculties that he dare call his own, can comprehend, or apprehend, the infinite power and wisdom of Deity? I shrink from the temerity and rashness of such an assertion. My position is this:—Man finds, in examining the facts of his consciousness, and as the essential character of his rationality, the capability of apprehending truths universal, necessary, absolute; the grounds of which being underived from, must

be antecedent, and presupposed in order, to experience:—man finds in himself the capability of inferring the reality of that which transcends his sensuous experience, and of contemplating causality, efficiency, permanent being, law, order, finality, unity:—man finds in himself the capability of apprehending, in a world of relations, the supra-relative; in a world of dependencies, the unconditional; in a world of flux and change, the immutable; in a world of imperfections, the perfect:—man recognizes in himself, as the privilege and need of a rational mind, the capability of enlarging his thoughts to the universe, infinite as the omnipresence of God, "upholding all things by the word of his power;" the capability of raising his mind to the Supreme, as the Absolute Will, causative of all reality in the eternal plenitude of being. And it is in meditating on the conditions and cause of this capability that man becomes conscious of an operance in and on his own mind, of the downshine of a light from above, which is the power of Living Truth, and which, in irradiating and actuating the human mind, becomes for it Reason;*—yea!

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* The Reader will bear in mind that the object of the Author is limited to a description of the relations of human science to eternal truth; but that his meaning fully and adequately expressed, is no less than the sublime doctrine revealed by St. John, that the reason is the light and spiritual presence of the Logos, τὸ φῶς τὸ ἀληθινὸν, ὃ φωτίζει πάντα ἄνθρωπον ἐρχόμενον εἰς τὸν κόσμον. John, chap. i. v. 9.

which is the revelation of those divine acts, at once causative and intelligential, which he recognizes as first principles, ultimate truths, as ideas for the human mind, and constitutive laws in nature. It is by virtue of this Reason, that we hear the voice and legislative words of the Creator, sounding through the universe; and it is in the sabbath stillness of our intellectual being, when the busy hum of the world is hushed, that the strains of this divine music penetrate the soul attuned by meditation to move responsive to its harmony!

If, then, a science of nature exist at all, I do not hesitate to avow my conviction that it must be under the informing light of Ideas. And it may be safely asserted from the premisses, that the method of the science must be dynamic; that is, by contemplating nature as a scheme of causes and laws with the connections, and in the unity, of reason.

Difficult, no doubt, will it be for the student, who desires to enter on this attractive field of thought, to discipline his mind thereto; but aid, encouragement, and example will not be found wanting, if he seriously incline his attention to the proofs of the evident dynamic tendency of physical science, especially under the auspices of its recent and present cultivators. Witness the advancement and revolution of the science of Astronomy after the promulgation of the great ideas of Kepler,

and the perfecting of these by the sublime geometry of Newton. Trace the progress of Chemistry: to blind empiricism succeeded experiment, guided by scientific aims, till at length, in Dalton's announcement of the law of definite proportions, Chemistry has been raised into the conditions of a science, and its combinations have been shown to be regulated by laws of quantity,* which arm the inquirer with foresight and anticipative certainty. Within a short period, however, a new light has been thrown upon this interesting department of knowledge; and our illustrious countryman Faraday, following the path of his great predecessor Davy, even now is lifting the veil, which, under the vague and empirical phrase, "elective affinity," has hitherto hidden the nature and operation of chemical forces, and has already shown that "bodies are held together

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* "*Optime autem cedit inquisitio naturalis, quando physicum terminatur in mathematico.*" *Nov. Org.* Lib. ii. Aph. 8.

"And (says Herschel, ibid. p. 123.) it is a character of all the higher laws of nature to assume the form of precise quantitative statement." Nor shall we wonder that man has acquired insight into nature and her laws, in proportion as he has been enabled to reduce them to distinct quantitative statement, and has brought them within the mental constructions of mathematical science, if, as in the instance before us, "the observed relations among the data of physics show them to be quantities not arbitrarily assumed, but depending on laws and causes, which they may be the means of disclosing." Need we remind the reader of the speculations of the Pythagorean School, or of the sublime saying, *Numero, pondere, et mensura generantur cæli et terra?*

by a definite power, which, when it ceases to discharge that office, may be thrown into the condition of an electric current."† And if he has succeeded in thus establishing the identity of electrical and chemical action, how greatly augmented, and how rapidly extending, is our knowledge of this power, and with it of all those agents, which, refusing to be evoked by any other name than that which reserves to them their dynamic character, are called even by the empirical inquirer "imponderable." The age of man might almost suffice to recall to our recollection the time when electricity was little better than a scientific plaything; but the discoveries of Oerstedt, of Faraday, and of their noble compeers, whilst they have shown us that in electricity, Voltaic action, magnetism and chemical attraction, the same power is at work under different conditions of operance, have only left us in doubt how few of the phænomena and changes of nature may be left by future investigation unexplained by its agency. Meanwhile we see that as science advances it more and more penetrates beyond the mere objects of sense, and, in order to obtain the intelligibility of their causes, directs its inquiries to the powers and forces, of which the sensuous phænomena are only the signs, and to the laws, under which the powers are manifested in their results.

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† Faraday's Researches, Phil. Trans. Art. 855.

Now if this position admit of verification in the sciences strictly physical, it will obtain evidence more full and striking,—though from the nature of the subject the scientific idea must longer await its perfected form,—in those which have for their object the problem of life and organization. It was the peculiar and eminent merit of John Hunter, that he had raised his mind to the apprehension of life as a law, in aid of a science of vital dynamics, and as the means of giving scientific unity to the facts of living nature. In what other sense can we understand either his assertion that "life is a principle independent of organization," or the purport of the magnificent commentary on his system, the Hunterian Museum?* The incalculable advantage of philosophizing in this spirit is plain, if we consider that Hunter at once got rid of all hypotheses, fictions, and arbitrary assumptions. By contemplating life, as Newton had taught the mechanic philosophers to contemplate gravitation, not as a thing, nor as a spirit, neither as a subtle fluid, nor as an intelligent soul, but as a law, he laid the foundation of scientific physiology; and in that very conception of a law taught us that life is a power anterior in the order of thought to the organization, which it animates, sustains and repairs,—a power originative and construc-

* Compare Coleridge's Friend, vol. iii. p. 173.

tive of the organization, in which it continues to manifest itself in all the forms and functions of animated being. This great Idea never ceased to work in him as his genius and governing spirit; and if in his printed works the one directing thought seems occasionally to elude his grasp, yet in the astonishing preparations for his Museum we find him constructing it for scientific apprehension out of the "unspoken alphabet of nature," and exhibiting the legislative idea in the "mode and measure of its working," by bringing together the significant forms and types of life and organic existence. A better comment on the aim of Hunter we cannot offer than in the words of the celebrated Cuvier: "*Celui, qui posséderait rationnellement les lois de l'économie organique pourrait réfaire tout l'animal.*"* For what else does he here assert, than that in the light of a law, according to which the animated being was originally constructed, we obtain insight into the forms and relations of organic

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* Cuvier *Révolutions du Globe*, p. 99. It was the perception of a Law that enabled Cuvier to say, that it is "*le principe de la corrélation des formes dans les êtres organisés, au moyen duquel chaque sorte d'être pourrait, à la rigueur, être reconnue par chaque fragment de chacune de ses parties.*"

"*Tout être organisé forme un ensemble, un systême unique et clos, dont les parties se correspondent mutuellement, et concourent à la même action définitive par une réaction réciproque. Aucune de ses parties ne peut changer sans que les autres changent aussi; et par conséquent chacune d'elles, prise séparément, indique et donne toutes les autres.*"—Cuvier, ibid. p. 95.

structure, and of their necessary interdependency?†

For proofs of the pregnancy of the idea, which animated Hunter's labors, turn to the magnificent assemblage of facts contained in the Museum, which by the munificence of Parliament is now deposited within these walls, and which by the liberality of this College, mindful of its sacred trust, aided by the taste and judgment of the architect, Mr. Barry, has been provided with an abode worthy of the means employed and of the object in view. In speaking of the Museum you would, however, justly deem it an omission did I not notice the excellent preservation and admirable order of its contents, which we owe to the zeal and ability of the Conservators: and it would be un-

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† A no less instructive illustration might be offered in the idea, in the light of which the law of the metamorphosis of plants rose up before the mind of the poet Goethe; nor needed he to have felt any irritation when Schiller, to whom he was expounding it, "shook his head and said, That is not experience, that is an idea." See the anecdote in Whewell's Hist. of the Inductive Sciences, vol. iii. p. 435; for the idea is the mental possession of the law under which the results are realized which are the object of experience. And if the germ which Goethe planted, became in the hands of Decandolle and others one of the most important elements of physiological botany, in giving intelligibility to growth and development, which are the essential character of vegetable life, it has mainly contributed to raise Botany into the rank of a dynamic science, and to give scientific connection to the accumulative labours of Linnæus, of Jussieu, and others, to whom we are indebted for the indispensable work of classification and generalization.

grateful were I not to express the deep sense, which in common with the profession I must ever feel, of the singular merits of Mr. Clift, to whose affectionate devotion of a life under many former privations we are indebted for its jealous guardianship, and in whom as the *genius loci* each preparation lives, and the soul of all is as it were impersonated in a living individuality, the substantiated echo of Hunter's self. It is impossible in taking a cursory view of this storehouse of physiological wealth to repress our admiration of the founder himself, who at the sacrifice of fortune and of present enjoyment to the cause of science, labored with undaunted perseverance amid the sneers of his contemporaries * in the execution of this great work; it is impossible in a more leisurely survey of its treasures not to appreciate the judgment he displayed in culling that which is choicest in illustrative fact; it is impossible in examining his preparatory labors for the description and explanation of the collection, now in the course of publication with the catalogue, to withhold our unqualified praise of the genius, which thus brought together this epitome of animated nature in the unity of a scientific idea!

It is in this Museum that we find the pledge

* It is reported that a surgeon of no inconsiderable repute at the time ventured to say—that Mr. Hunter's preparations were just as valuable as so many pig's petty toes. And I can state on good authority that it was thought even discreditable to attend Mr. Hunter's lectures.

and proof of John Hunter's pre-eminent and original merit, that of having first presented the facts of comparative anatomy in and as a connected scheme of graduated development, the connexion supplied and the aim anticipated in the antecedent unity of the causative law of life. He has thus furnished the grounds of a new science, the science of Comparative or Universal Physiology, and with it the well founded and not unconfirmed hope of making every part of the organized creation give intelligibility to every other part, and all to the crown and consummation of all, the human frame.

It would be worse than idle to say that his great predecessors from Aristotle and Galen down to Haller, Daubenton, and Pallas, and amongst whom we proudly point to our immortal Harvey, had not collected many and most valuable materials, or had not been guided by the instincts of science in the direction of its true aim; but it would require other boldness than that of truth to aver that hitherto any induction of law had given connexion and scientific unity to the facts of comparative anatomy and physiology. It would be alike base and purposeless to deny the well earned merits of his contemporaries and successors; and without any invidious attempt to detract from the fair fame of the illustrious Cuvier, as the great lexicographer of comparative anatomy, or to lessen the high character of his

distinguished fellow-laborers, French, Italian and German, especially the last in their rare combination of the minutest accuracy with the boldest speculation,—and certainly without any desire to obscure the reputation of our own countrymen,—we may justly claim for Hunter the praise of originality and of priority in the scientific development of comparative physiology; even though it may be true, that by the aid of subsequent inquirers we see more clearly than he himself did the final aim implied in his researches, and approach nearer to the goal toward which he led the way. That however he had also more largely contributed to the wealth of facts, that form the capital of the science, than has been hitherto admitted,—nay that he had anticipated much of recent discovery,—can scarcely now be doubted, though it will be unnecessary for me to enter into details, unsuited to the present occasion, as this College has best provided for establishing his claims by the foundation of the Hunterian chair, which, filled by its present and first professor, Richard Owen,* the able vindicator of Hunter's fame, is calculated to form a glorious epoch in the annals of science, reflecting honor alike on this College and on

* Palmer's edition of Hunter's works, vol. vi. *Observations on certain parts of the animal economy, with preface and notes by Richard Owen.* An invaluable commentary on Hunter, in connection with the descriptive catalogue of the physiological series of comparative anatomy in the Hunterian Museum.

the country. Sufficient for my present purpose, if I am permitted to sketch briefly the scope, tendency and main result of Hunter's principles.

We gather from Hunter's researches, that even in "animal substances devoid of apparent organization," such as a germ, a seed or an egg, there is what Hunter calls a "simple principle of life;" and we learn from these instances that, though the force of vitality be latent, in all life existence must begin from itself,—(I do not say caused by itself,)—and depends upon an appetence to be, or to fill a pre-determined sphere; in other words, living existence implies a subject or power which, actuated and directed by the law or idea, becomes a causative agency formative and productive, and this under the condition of being excited to act, and at the same time of resisting the excitant, as long as it remains an alien power, either by repelling or appropriating the same. The living germ is excited by the surrounding heat, light, air and moisture, under circumstances in which these alien agents form an appropriate element; and whilst therein the materials are acquired from without by assimilation, the form is evolved by a shaping energy from within, and the living subject, like a blind artist working after an invisible pattern, constructs the organization in which it dwells.

This is the first character of all life, Pro-

ductivity, and this so eminently that we cannot, except by abstraction, conceive of life otherwise than as manifested inseparably in a product. But the living thing, though beginning from itself, would exist but imperfectly did it not exist likewise for itself; but this it cannot do except for another, and in and by an outward world. This relation to an outward world is indeed attained in growth; but as we see throughout the vegetable kingdom, of which growth is the essential character, the result is imperfect: the whole living energy is productivity, and exhausts itself in outward products; but the plant has no inward reflex on itself, and remains to and for itself an alien and unintelligible thing. In order to that potentiation of living existence, which we name animated, or to any grade of being in that scale, which culminates in, and is throughout rendered intelligible by, mind and will, the living subject must at least so far know as to find or feel its own state. Sensibility is the predominant, say rather the essential, characteristic of animated being; sensation is indeed an imperfect reflex, but yet is the nascent consciousness of a self, though again of a self, which as life we dare not call other or more than the craving, which arises from want and the appetence of being. But in whatever degree this want is disclosed, and the craving awakened, that which the self or subject does not, and cannot, find in itself, it is impelled to go out of itself to seek and to

procure; and to this going forth the living subject is roused by the multiform excitants of the outward world, attracted by that which it desires, repelled by the alien, and in the seizure or resistance compelled to adapt its own state to its manifold exigences inward or outward. Here then rise upon us the powers and functions of Irritability and muscular action, of free-motion, of adaptive agencies, and of instinctive contrivance, as the necessary correspondents of Sensibility by which, under the influence of pleasure and of pain, occasioned by needs, allurements and resistances, which attract the subject from, or repell it to, its centre, the living being feels its own state, and though imperfectly finds a self.

Growth, motion and feeling,—such are the universal characters, under which animated being is alone conceivable. And it is in contemplating these functions as forces of one subject or power that we learn the aim and purpose of the actuating idea, in the development of an organism, as intending a living body, that is, a sphere of act and existence, as the indispensable medium and condition of the manifestation and working of that which in and of itself is essentially supersensuous —a living subject or power. But if growth, motion and feeling, constitute the universal characters of animated beings, and must therefore be predicated of the lowest, we shall find, in bringing before our minds the different

orders of creatures and ranks of animals, that these are differenced by a relative subordination of these forces. If in the germ the living subject exist in and from itself; if in a higher form of development, first of growth, and then of growth with instinctive motion, it exist for others; and if in the form of sensibility it exist for itself;—by comparing, I say, the various groups of the animal kingdom, we shall find that they may be ranged in an ascending scale, of which the degrees are marked by a relative balance and proportion of the vital forces, and in which the ascent is determined by the evolution of life into Sensibility, and by the superordination of sensibility as the highest force and most essential form of living existence.

In the lowest forms of life, which seem almost exhaustless in the *Protozoa*, nature may be said to measure space, and in realizing its dimensions to take possession of and fill it with an experimental variety of living shapes. And thus are presented to us forms, which remind us, first of lifeless nature, the disc, the star, the globe, the cylinder, animated as it were into living being; and which next rise into shapes, imitative of the lowest form of vitality in vegetation, the vase, the bell, and the various flowerlike forms of the inhabitants of the corals, and their housings.*

* Here the shaping energy is predominantly active, and it is worthy of notice, as significant of its operation through the

But while life is thus busy in multiplying shapes, its inward activity is at work in securing the conditions of organic function and of the self renewal of existence, by building up the organs instrumental to the reproduction of the animal and to its relations with the outward world. And if in the lower orders of the Invertebrated Series this inward activity is subordinated to that which manifests itself in outward shape, it is in the higher order of the same, namely in the insects and molluscous animals, that the vital striving in both direc-

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whole ascent of formation, that as Carus has sagaciously observed, "the most simple and primary form of all organization is the spherical, and that whilst the flattening of the sphere into shapes, bounded by plane surfaces, denotes elanguescence of an idio-centric or vital action, as in crystals, the expansion of the sphere, its elongation into the ellipse, its protrusions, or the multiplication of its centre or periphery, express an increase of vital energy and exhibit the formation of living bodies." See *Grundzüge der vergleichenden Anatomie und Physiologie*, p. 12. Compare his work *Von den Urtheilen des Knochengerüsts*. In this evolution of the animated globe or sphere, we must not however forget, that in the constructive act the straight line, as the radius, is equally a coefficient with the curvilineal, and claims a place in the order and perfection of nature, as the form of motion radiant or extroitive and as the symbol of act and function. This primary form of evolution, of which the spherical is the ground, we notice in the germ and egg, the globules of the blood, and globular *infusoria;* and in the radiated order of animals, this as a character of the formative law of life is still preserved in the equal development and symmetrical arrangement about a central axis, as if the shaping energy were still bound by, and could not altogether free itself from, the limits imposed by the scheme of equal development from a centre.

tions becomes more apparent, energetic and significant. In *Insecta* the life is thrown outward, not in order to shape, but to perfect the relations of the animal to the outward world, in organizing it for free motion, for instinctive and adaptive actions, for the eminently outward existence, which is the main character of the whole class: hence in connexion with it the multiplicity and variety of locomotive and instrumental organs, so that the animal in many instances is a whole workshop of tools; hence, the perfecting especially of the respiratory apparatus, and the aëriform structure of the whole body; hence its metamorphoses, or outwardly exhibited embryogeny; hence its defect of inward unity and the exhibition of a life relatively persisting in sections, as in the familiar example of a divided wasp. The insect is indeed the representative of irritability, of a life excited to outward reaction; and hence in the insects we find Instinct fully developed, and therewith one of the great purposes of animated existence disclosed, as that of acquiring a sphere of action by the adaptation of means to mediate ends; a character equally applicable to the human understanding in the absence of ultimate aims under the abeyance of the reason.*

In the *Mollusca*, on the other hand, the

* See Aids to Reflection; 4th edition, p. 157. On the difference in kind of Reason and the Understanding, and on the connexion of Instinct with the latter.

energy of life is drawn inward, and we are presented with what by a bold metaphor we may call, the tentative experiments of nature in perfecting the internal organs. Witness especially the progressive complication and advancing perfection of the digestive, respiratory and circulating organs: but this not so much in reference to the animal itself as to prepare those organic relations, which in the next stage of the ascent are necessary for the development of the apparatus of sensibility. And if, when we compare the *Mollusca* with the insects, there is an apparent sinking back, it is in order as it were to draw inward and concentrate the organific energies for the higher and more complete ascent of which they are the promise.

In the Invertebrated Series of animals, we trace already a structure fitted in a higher stage to become typical of an inward and central unity, namely the nervous system and brain. But the development and perfecting of these is the main character of those animals, which in connexion with it are provided with a skeleton, hence called Vertebrated, and in which, though attained by grades and successive steps, the process is completed of the evolution of life into sensibility; that is, when the power of sensibility becomes central and predominant, and is manifested in its appropriate structure of Nervous System and Brain. This process, as one of experimenting the

different proportions and harmonies of the three powers of life under various relations, we trace in the fishes, reptiles and birds, and finally in the *Mammalia*, in whom the superordination of the Sensibility is ultimately accomplished.*

It is in the light of this scientific Idea, as supplying unity and connexion to the facts of organic structure exhibited in Hunter's Museum, that we contemplate nature as a Physiogony or genetic process; and if it be possible to convey in one sentence the sort and degree of interest, which the final aim of such a history of nature is calculated to inspire, I might say, that the object is, to exhibit every order of living beings, from the "rudimental chaos of life" to the *Mammalia*, as so many embryonic

* These views formed the basis, and explain the purport, of the Lectures on comparative anatomy, which the Author had the honor of delivering, when Professor of anatomy and surgery, at the Royal College of Surgeons. The publication of these Lectures has been rendered unnecessary by various works, which offer to the student the means of more extensive information on this important branch of knowledge, than they claimed to possess; but he hopes at no distant period to set forth more at large the principles here enunciated, and which those lectures were intended to vindicate in connection with Hunter's labors. In the meanwhile he refers the Reader to the Catalogue, descriptive and illustrative of the physiological series of comparative anatomy, for illustrations of his views; and he especially entreats his attention to the third volume, and its admirable preface, in corroboration of their accordance with the spirit of Hunter's researches. A lecture containing a brief recapitulation of the above mentioned course will be found at the end of the volume.

states of an Organism, to which nature from the beginning had tended; to exhibit nature as labouring in birth with man, and her living products as so many significant types of the great process, which she is ever tending to complete in the evolution of the organic realm.* And in recognizing by the light of this idea man as the ultimate aim and consummation of nature, we shall see in each stage of the ascending scale, with evidence increasing directly as the ascent, at once the opposition and harmony

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* A similar view is taken by the German philosopher Schelling, whose speculations produced a revolution in the minds of his countrymen, not less remarkable than that effected by his predecessor Kant, and which, whatever may be thought otherwise of their worth, cannot but be admitted to have had an invigorating influence on the progress of natural science; witness, as more or less intimately connected with his school, the names of Steffens, Ritter, Oerstedt, Oken, Carus, Kieser, Willbrand, Link, Marcus, Reil, Walther, Döllinger, Sprengel, &c.

He says, "*Der Anatom begreife das Symbolische aller Gestalten, und dass auch in dem Besondern immer eine allgemeine Form, wie in dem Äussern ein innerer Typus ausgedrückt ist. Beständig sey in ihm die Idee von der Einheit und inneren Verwandtschaft aller Organisationen, der Abstammung von einem Urbild, dessen Objectives allein veränderlich, das Subjective aber unveränderlich ist: und jene darzustellen, halte er für sein einziges wahres Geschäft.*" The philosophical anatomist should strive to apprehend the symbolical character of all organic forms, and learn that in every particular form a universal form, and in every outward an inward type, is revealed. The idea should be constantly present to his mind of the unity and inward alliance of all organisms, and of their derivation from one prototype, objectively only changeable, but subjectively, or as a subject, invariable; and to exhibit this idea should be his aim, and is his true vocation.—*Schelling Academisches Studium*, p. 300.

of two great tendencies;—on the one hand that of nature to integrate all into one comprehensive whole, and consequently retaining each part;—and on the other hand, the tendency to integration in the parts, or that by which each more and more secures the privilege of being in, from, and for itself, as the anticipated type of its final achievement in the Individuality of man.

And in further support of the truth of this principle of advancing Integration, I confidently refer you to the researches of Wolff, Meckel and others in embryology. They have successfully established the law, already anticipated by Hunter,* that the progressive phases of the embryo correspond to the abiding forms, which are preserved in the total organism of animated nature, as typical of its gradative evolution; and that as the embryo of each higher animal passes rapidly through the forms of the animals inferior to it, in order to attain its maturity and specific rank of

* "If we were capable of following the progress of increase of the number of the parts of the most perfect animal, as they first formed in succession, from the very first, to its state of full perfection, we should probably be able to compare it with some one of the incomplete animals themselves, of every order of animals in the creation, being at no stage different from some of those inferior orders; or, in other words, if we were to take a series of animals from the more imperfect to the perfect, we should probably find an imperfect animal corresponding with some stage of the most perfect." *Hunterian* MSS. *See Preface to the Physiological Catalogue,* vol. i. p. iv.

being, that of man is transitively the compendium of all; not indeed without a difference,—since in each instance the changing form of the embryo bears the impress of its transitional and incomplete character, while it ever preserves the promise and prophecy of the being into which it is to be finally evolved. And it did not escape Hunter, as a consequence of the same law, that Congenital Defects, hitherto comprehended under the vague designation of monstrosity, are to be explained by the development of the embryo being interrupted and arrested at some early stage of its regular evolution, and that the defective form, which is the result, is analogous to the form and structure of an inferior class. And thus if in the human embryo these defective forms constitute a series of transient epochs, which are repetitions of the types, that denote the grades of the ascending scale of animated being, in like manner all the lower forms in relation to the highest may be regarded as abortions, by anticipation of nature's mature work, the human frame.*

Again, in meditating further on the increasing perfection of being, as measured by its adequateness to the principle of Integration and Totality in each part, which nature aims at in the whole, we acknowledge, in the evidence offered throughout the ascending scale of animated existence the following points:†

* See Appendix B. † See Appendix C.

1st. That every organic whole, from the polype up to man, indicates a higher and more effective principle of unity, and therefore of more perfect individuality, in proportion as the parts are more numerous, yet at the same time more various, each having a several end; while yet the interdependence of each on the other, the subordination of the lower to the higher, and the intimate union of all shall be perfected in an equal proportion:—

2dly. That, as every organic whole is the result of an antecedent principle or power, which, considered as power, is exclusive of parts, another mark of advancing perfection will be when the partless and indivisible unity is itself represented by some visible and central product, to which all the various parts converge as the bond, medium and condition of the communion and interdependence of all in their constitution to one. Such is the Brain, which represents in respect of power that unity which the total shape or exterior exhibits in respect of sight or sense:—

And, 3rdly. If the aim of animated being be the achievement of sensibility, and of the subordination of the inferior powers thereto, by which the animal exists from itself, in itself, and though imperfectly for itself, in order to the full presentation of this ultimate end, nature must not only feel,—she must know—her own being, that is, Mind must be superadded to life.

If then we take these as the characters of the advancing perfection of nature towards Individuality, as the final purpose of divine law, it is plain that we alone find them fully realized in that being, whom we dare no longer consider merely as a part of nature, over which he is destined to "have dominion," but rather as its crown and epitome. In man, we find the organic structure completed, and the total organization exhibiting the most perfect attainment of corporeal existence, as the medium and condition of the operance and self-potentiation of soul, spirit or power:—in man alone the organic frame is so constituted that no one part is predominantly or disproportionately developed, and therefore permits, and requires beyond that of any other animal the adjustment of all the living powers and faculties to a balance, in the control of which we recognize the condition, mark, and privilege of his free agency; in all the animated beings below man the body may be said to constitute the animal, in him it is the organ and instrument of mind; in short, the organization of man is no longer the mere perfecting, but the *apotheosis*, of the animal structure.* In him alone the *analoga* of rational mind and of will,—and more we cannot attribute to the most intelligent animals,—cease to be mere *analoga*;

* See Appendix D, on the characteristics of the human frame.

and in each of these twin factors are we to look for the consummation of the great aim towards which nature tends from the beginning. In the sphere of the intellect, individuality appears consummated in Genius; in the sphere of the will, Individuality has its acme in integrity,—moral worth. It is in man finally that individuality becomes Personality; that is, the capability of self-affirmation in the image of the invisible Supreme, implying the command that he should unite his powers of intellect and of act to perfect himself according to that divine pattern and Idea in order to his high destiny.

The physiologist must indeed here reverentially pause, as having reached the limits of his science, yet his researches would want the light of their final aim should he pass unnoticed their common end, in which is disclosed to us the object of the history of nature as preface and portion of the history of man, the knowledge of nature as a branch of self-knowledge and the outwardly realized history of our own consciousness and conscious being. It was to this as its goal that John Hunter's labors undoubtedly tended, and it is not too much to say, that in presenting the facts of comparative anatomy, as a connected scheme of graduated development in the unity of predetermining law, he justly claims our homage as the founder of the science of Com-

parative or Universal Physiology, in which every part of the creation derives its intelligibility from the final purpose revealed in earth's noblest creature,—as aspiring heavenward—Man.

And if Hunter left the physiological part of his great work incomplete, it was only because in obedience to the more pressing exigencies of the profession to which he belonged, he projected a revolution in Pathology, by carrying into the obscure recesses of disease the torch of the same philosophy, by which he had already successfully shed a light upon the hitherto mysterious agencies of vitality. We may date from his original views the rise of scientific surgery: but invaluable as his researches were, and most happy as their effects have been, in the especial improvement and increased light, power, and courage of surgery, may we not rather say, that he achieved the more important service of bringing the whole art of healing into an immediate connexion with the sciences, which have nature for their object, by exhibiting its requisite foundation on an enlightened physiology? And if the attribute of inventive genius be his, who unequivocally establishes a principle, as including, anticipating, and explaining all, and even its possible and yet unknown results, we venture to claim this distinction for Hunter, in extending to pathology the same principle which had

happily guided his physiological researches, by treating disease as a problem of vital dynamics, and by seeking its intelligibility in the unity of the law of life.* The limits of this address compel me indeed, though reluctantly, to relinquish as hopeless the attempt to elucidate the philosophical tendency of his pathological labors: but I do not hesitate to affirm that one of the main aids in constructing a science of pathology will be by adopting as its ground the principle throughout implied in Hunter's researches; that is, by recognizing in life a power as of an agent at once contrariant to, and coerced by, the law, which actuates and directs it; and by treating disease as a problem, the solution of which is to be sought in the great laws of life, as perturbations indeed of the order, which these laws maintain, derived from the imperfection of the subject, but perturbations to be explained by laws, which, like those of the solar system, at once permit and correct the deviations. And if after witnessing the vain strivings of this contrariant agency, betrayed in disorder, deformity, degeneracy and disease, the medical philosopher meditates, on the laws which produce the order, permanence, regularity and beauty of organic life, he will feel as if, after the toils, vexations, and annoyances of the day, he had withdrawn with the astronomer

* See Appendix E.

to his observatory, and in the hushed stillness of some balmy night, directing his delighted gaze to the serene spectacle of the star-lit sky, contemplated the mystic planetary dance, which reveals more sensibly, though not more certainly than animated being, the eternal and unchangeable laws impressed on nature by nature's Architect and Creator. Thence turning back on his own pursuits, he will accord to Hunter the high merit of being at least the Kepler of his science, which only awaits its Newton in order to complete the scientific unity, already instinctively anticipated by Hunter's genius!

Finally; the aim of this address has been to exhibit to you John Hunter as a medical philosopher, by vindicating the philosophical tendency and spirit of his labors; and its purport will need no apology to those who love and honor the Profession, and are ambitious that it should possess that honor and dignity in the estimation of society at large, which nothing but its scientific character, as a branch from the common trunk of universal truth, can confer; that rank which it first acquired, and which it can only retain by its intimate connexion with the liberal arts and sciences, the possession and application of which constitute and continue the civilization of a country. And as such, and because they all contain as a necessary element a

knowledge, which is its own reward, and needs no higher or accidental benefit as a motive for its cultivation, they acquire and merit the name of liberal; and without which, we might still have most useful trades with ingenious and well informed tradesmen, operatives, and artizans, but no professions, and no claim from the profession to the name of gentlemen.

The relative wants and afflictions of man constitute the necessity of the healing art; and its application in detail to the removal or alleviation of the mishaps and ailments, that "flesh is heir to," forms its marketable value. In every particular calling there is a particular kind or *quantum* of skill and technical knowledge, arising out of the specific wants or desires of our fellow creatures, which every member of the calling, be it what it may, is under a virtual contract to possess. If this be the case generally, most especially must it be so with the members of the medical and surgical profession; and as far as this sort and quantity of professional skill and knowledge are concerned, ignorance and incompetence are worse than disreputable,—they are dishonest. But for this very reason, the possession of these alone can confer no honor. It never can be a distinction to possess what it would be ignominy to want. Consequently in whatever calling this is all, where the calling neither requires nor admits of more,—however

great and evident its utility may be, however indisputable for mankind its services,—it never did, it never can, obtain or deserve the rank or character of a liberal profession.

There was a period even in Christendom, when the art of medicine, made up of superstition and the crudest empiricism, left wise men in doubt, whether it were better than an art of cheating and poisoning. Nevertheless it was connected with what at that time passed for philosophy, science, and the liberal arts, and in consequence of this connexion physicians enjoyed at all times a high rank and consideration as members of society. On the other hand, there never was a time, or ever could be, when Surgery, even in its rudest form, could have been otherwise than most useful, nay, necessary for mankind; under all circumstances it was and must have been a blessing. But it was mere chirurgery, that is, hand-craft, handy-work. It was not engrafted on the great trunk of universal science, of which all particular knowledges are but so many diverging branches, not yet ennobled by being permeated as it were by those general truths, of which the rules and maxims of medicine and surgery are but so many specific applications and embodyings. The connexion in which the name stood in the privileged Guild or Company of Surgeons, explains and instances the consequence: our unphilosophic, unspeculative predecessors carried on the trade of Barber-surgeons.

If on the one hand, every profession has a deep interest in the character of its professors; —for as the artists generally, such will be the general estimation of the art; and a profession will soon sink into the predicament of a trade, where the majority of its professors derive their motives from, and confine their attainments to, the demands and interests of their own shop, and study only the good opinion of their customers:—so, on the other hand, has every professional man a deep interest in the general estimation and accredited rank of his profession.* But knowledge and skill, exclusively practical and empirical, did not raise our art into, and never can maintain it in, the

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* A liberal profession may be defined as "the application of science, by the actual possessors of the same, to the needs and commodities of social man; that is, by a learned class, among whom, as far as the boundaries of existing knowledge extend, skill is grounded on, or accompanied by, insight." And we may add, that the cultivation of science for its own sake, as the predominant aim, must ever constitute the essential difference between a profession and a trade; for as in the latter the art is rightfully considered exclusively as the means of gain, so the former must inevitably be degraded into a trade, whenever mercenary and sordid motives supersede the scientific aim. Nor can it be deemed of slight importance in the formation of a professional class, such as we have ventured to describe it, that those destined for the medical profession should partake of that education which is required in common for the liberal professions, as an integral part of the gentry of the country, with the sense and habit of a common training in their duties, moral and religious, in their obligations as citizens, and in their sentiments of professional honour as gentlemen.

dignity of a liberal profession. This I repeat; and I call the name of John Hunter to witness, that the present rank possessed by all the members of our profession, as such, was achieved by the union therewith of comparative anatomy and physiology, the science of which is, by the essential nature of the pursuit, philosophy. And had Hunter performed no other service than that of thus bringing the whole art of healing, medical and chirurgical, into an immediate connexion with the speculative sciences of nature, which, without reference to their immediate practical application, are cultivated by the first and noblest minds for their own worth;—if he had done no more than connect the medical profession with all-ennobling science by a bond of alliance, which never, without ignominy to the profession, and forfeiture of its best and most legitimate claim to that title, can henceforward be dissolved or broken;—John Hunter would rightfully take his place among the most eminent benefactors of mankind, and have left a name which every naturalist must hear with reverence, and which no physician or surgeon can pronounce without gratitude and filial awe.

APPENDIX.

A.

EVOLUTION OF THE IDEA OF POWER.

If Causes and Laws be rightly assigned as the legitimate objects of inquiry in order to natural science; if the determination of these require somewhat other and more than the mental substantiation of sensuous facts, under whatever degree of generality, by the understanding or faculty judging according to sense; if they imply the apprehension of permanent being, of efficiency, of necessity, of finality, of unity, which, if they exist in nature, cannot be derived from, but must be presupposed in order to, sensible experience; and if these, as principles of reasoning on nature, and of explaining its changes, be the result, and constitute essentially the character, of rational mind; then it will not be denied that physical science is grounded on truths supersensuous and metaphysical, which we obtain by meditation on our own powers in and by the light of reason.

This position cannot be better illustrated than by investigating the origin of our notion of cause and efficiency; for the thought, which the term power designates, is one, which is neither derived nor deduced from our sensible experience.

The presentations to the senses are the effects and supposed manifestations of the powers adequate to produce them, but of the powers themselves we are thereby no wise cognizant: we see an apple, detached from the branch on which it hung, fall to the ground, and we say that the fall is produced by the power of gravity; we see the change, the motion, but the cause or power producing the *phænomenon* is wholly beyond the limits of the senses. But neither can we in strictness deduce the existence of power from any change in outward nature, or from the corresponding impression on our senses; for the knowledge afforded by the senses can convey no notion of that which is beyond and above all sensible experience. If therefore the notion of causative power be a legitimate assumption, occasioned indeed by the presentation to the senses, though not obtained by them, it must be inferred, brought in, made use of, by the mind for its own purposes, namely for explaining or giving intelligibility to the *phænomena*. It is then in the human mind that we seek the ground and origin of the assumption of power, cause, efficiency; and this ground we readily trace in the mind as that ultimate fact of the consciousness, which we call Will, as the power essentially of origination. Of this fact we can offer no proof, we can adduce no evidence beyond that of referring the inquirer to the facts of his own consciousness; beyond this we cannot ascend, since it is an ultimate fact, and this so eminently that if we suppose any antecedent the term loses its meaning and contradicts itself. It is

indeed true that the conscious will, of which we are now speaking, is mind, and is indissolubly connected in our thoughts with intelligence, though at the same time we have no difficulty in distinguishing the will (as the originative and causative) from the intellect, which directs and guides it; and hence indeed arises our capability of considering the will abstractedly from intelligence, but in so doing it ceases to be all that which we mean by the term will, we give it a different name, and in this manner form to ourselves the notion of power, and as soon as this power manifests itself sensibly, of force.

If however such be the true ground of our notion of power, it cannot be denied that, in attributing powers to outward nature, and in ascribing its changes to these as causes, the human mind silently transfers its own constitution to the outward, and assumes that the subjective ground of nature is in kind one with man's inward being. But how should this be otherwise? Man can acquire no knowledge except under the conditions of his own consciousness, and nothing can be intelligible to him except by virtue of his own intelligence; he cannot conceive of any power or mode of action, of which he has not the *analogon* in his own powers and in the modes of agency of which he is conscious. He knows that his will is influenced, urged, nay, sometimes compelled by outward powers and agencies, and this experience, whilst it is for him the very ground of his belief in the reality of an outward world, convinces him that the influence, of which he

is conscious being the same as that of his own will, the cause must be of the same kind. "We are conscious," (says Herschel*, "of a power to move our limbs, and by their intervention other bodies; and that this effect is the result of a certain inexplicable process which we are aware of, but can in no way describe in words, by which we exert force." And he adds: "Though it may seem strange that matter should be capable of exerting on matter the same kind of effort, which judging alone from this consciousness, we might be led to regard as a mental one; yet we cannot refuse the evidence of our senses, which show us that when we keep a spring stretched with one hand we feel an effort opposed exactly in the same way, as if we had ourselves opposed it with the other hand, or as it would be by that of another person."

It must be recollected, however, that, if as we believe, the notion of power have no other origin than that of will as disclosed by our own consciousness, it has no other meaning when attributed to outward nature than that of will with the abstraction of intelligence. But though it would be manifestly absurd to attribute to the powers of nature any conscious design, yet by the constitution of our own mind we are constrained to admit that their agencies so far partake of intelligence that they are adaptations to relative ends, in the unity of some final aim or purpose. Hence it is that we distinguish the power or agent from the mind that

* Intr. to Nat. Phil. p. 86.

directs it, and we say that the powers of nature, in and of themselves blind, brute, and unintelligent, act under Laws, by which we express the constraint and forced subjection of a power or agent to an intelligence guiding and governing it as an alien and subject.

And if by the examination of the facts of his consciousness, man comes unavoidably to the conviction that the powers of nature are of the same kind in their essential ground as his own will, it will be scarcely possible for him, in meditating further on the mysterious agency at work in nature, not to consider it as part of the same moral operance, which his conscience reveals to him; and whilst his moral being bears involuntary testimony to the fact of the moral order and governance of the universe, recognized in the laws appointed by the wisdom of the Creator, he cannot but be convinced of the existence in nature of a contrariant and alien agency striving, though vainly striving, against the beauty, order and harmony of the world. If, I say, in the light of our moral being we may rightly interpret the character of the physical world, and if in all the forms of nature the pravity of the subject is betrayed by evidences of the impermanent, the unsufficing, the arbitrary,—of weakness, degeneracy and imperfection,—are we not bound to assume as a principle, for the purposes of physical science, and in behoof of that unity of the mind, which truth implies, the contrariety of the agent or subject in nature, and of the divine laws, by which it is at once actuated, coerced, and directed?

At all events the assumption of a perfect law, coercing an imperfect subject, offers a solution of the difficulties, which must arise from denying the imperfections in nature: nor need we apprehend any well founded religious objection to a view, which, in admitting the existence and influence of evil no less in the physical than in the moral world, at the same time asserts its uniform conversion to good, by the benevolent all-might of the divine Legislator, whilst it offers the means and condition of reconciling physical science with the stedfast faith of Christianity.

APPENDIX B.

TRANSCENDENTAL ANATOMY.

This parallel scale of evolution in the transient forms of embryonic life, and in the relatively abiding forms, which are constituent parts of nature's totality, has been tested by the accurate anatomical investigations of Meckel, Tiedemann, Müller and others, in the development of every organ and system. They have most successfully vindicated this department of knowledge from the censure of the "*mira indiligentia hominum*," expressed by Lord Bacon, who could hardly have anticipated the splendid achievements of embryogeny, by which the student of nature is privileged to enter the workshop, and "*præsens esse*

cum artifex operatur et opus suum promovet."* By the aid of comparative anatomy the process itself of the construction of organs has been unfolded to the armed eye of science, and therein the ground laid of a science, which, under the recently admitted name of transcendental anatomy, aims at establishing the law of organic genesis by substituting the certainty of a scientific idea for the results of empirical observation, and at discovering the pattern and pre-existing model, according to which, and the genetic process itself by which, organic forms are constructed. In adopting, however, this idea, which had its origin in the genial mind of the great poet Goethe, and which has been expanded by Oken, Spix, Carus, and others into the principle that all the varied organic forms are but modifications of one simple primary form, and that for instance, the osseous system in every part, and in its most complicated total result, is but the repetition of a simple vertebra, —in adopting, I say, the principle of organic modifiability and unity of composition, we must

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* "*Mira enim est hominum circa hanc rem indiligentia. Contemplantur siquidem naturam tantummodo desultorie et per periodos, et postquam corpora fuerint absoluta ac completa, et non in operatione sua. Quod si artificis alicujus ingenia et industriam explorare et contemplari quis cuperet, is non tantum materias rudes artis, atque deinde opera perfecta, conspicere desideraret; sed potius præsens esse cum artifex operatur et opus suum promovet. Atque simile quiddam circa naturam faciendum est.*" *Nov. Org.* Lib. ii. p. 355, Vol. iv. 4to edit.

never forget that insight of the law, to any useful purpose of science, must be completed by a knowledge of the conditions which determine the variation and differences of form and structure.*

APPENDIX C.

GRADATION OF ANIMAL LIFE.

The marks of advancing perfection may be thus more fully stated:

1st. The necessity of grades. The resistance of a contrariant subject in nature is throughout implied; and if the process be that of converting resistance into willing subjection and cooperation, it cannot, from the imperfection of the subject, be effected otherwise than gradatively. The divine law can only compel and coerce the brute and unintelligent powers of nature;—in infusing light and life on the same, as in the bee and elephant, it may induce and guide, and finally on rational man it acts by obligation and conviction.

2nd. As nature tends to integrate all organic forms into one comprehensive whole, in like manner every type of organic being is the expression and measure of its tendency to represent, and to integrate itself as, the whole of which it is a part; and the grades in the ascending scale of integra-

* A useful summary of these views for the English reader will be found in Anderson on the Comparative Anatomy of the Nervous System, London, 1837.

tion, which are retained and exhibited at once in the total organism of nature, each organic being has to pass through successively, in a series of which, each transient form is superseded by another of greater perfection, until it has attained its specific rank in the scale of individuality.

3rd. Every organic whole, from the polyp up to man, indicates a higher and more effective power of unity, and, therefore, of more perfect individuality in proportion as the parts are more numerous, yet at the same time more various, each having a several end; while yet the interdependence of each on the other, the subordination of the lower to the higher, and the intimate union of all to the constitution of One, shall be perfected in an equal proportion.

4th. As every organic whole is the result of an antecedent principle, which, as power, is exclusive of parts, another mark of advancing perfection will be when the partless and indivisible unity is itself represented by some visible and central product, to which all the various parts converge, as the bond, medium and condition of the union and communion, and of the interdependence of all in their constitution to One. Such is the brain, which represents, in respect of power, that unity which the total shape or exterior exhibits in respect of sight or sense.

5th. As every finite creature has external relations, the comparative perfection will consist in the emancipation and independence of the creature from the alien external powers, and its comparative superiority over them and power of com-

manding them, with the facility of adapting itself to its external relations in the greatest variety, and under the greatest change of these relations. And when we add to this the power of using external nature as an alien, of using what it neither assimilates nor admits, it is more than independence, it is sovereignty.

6th. If the aim of animated being be the achievement of sensibility, and of the subordination of the inferior powers thereto, by which the animal exists from itself, in itself, and, though imperfectly, for itself, in order to the full presentation of this ultimate end, nature must not only feel, she must know her own being; that is, mind must be superadded to life.

APPENDIX D.

CHARACTERISTICS OF MAN'S BODILY FRAME.

In a comparison of the frame and capabilities of man with those of the inferior animals, if we take the human frame as the ideal standard of form, it will be found that all others present so many declensions from the Idea, by exaggeration or defect: and it will be found from this survey, that man is unquestionably endowed with that structure, the perfection of which is revealed in such a balanced relation of the parts to a whole as may best fit it for a being exercising intelligent choice, and destined for moral freedom. It is not,

therefore, an absolute perfection of the constituents singly, but the proportional development of all, and their harmonious constitution to One, for which we contend;—a constitution which implies, in a far higher degree than in any other animal, a balanced relation of the living powers and faculties, and which requires, therefore, in man pre-eminently the endowment of rational will as necessary for the control and adjustment of the balance. Man has not the quick hearing of the timid herbivorous animals, but it was not intended that he should catch the sound of distant danger and be governed by his fears; he has not the piercing sight of the eagle, nor the keen scent of the beast of prey, but neither was man intended to be the fellow of the tiger, or a denizen of the forest. Hence the departure from the perfect proportion of man, which we observe in the inferior animals, may be regarded as Deformities by exaggeration or defect, dependent upon a preponderance of a part that necessitates a particular use, or the absence of a part that deprives the animal of a power, and in both instances alike abrogates that freedom, for which provision is made in the balanced relation of the constituents of the human fabric, which permits the free choice of means, and the adaptation to any purpose determined by an intelligent free-will. Dilate the head, and you have a symptom of disease: protrude the jaws, you have a voracious animal: lengthen the ears, timidity is expressed: let the nose project, and the animal is governed by its scent: enlarge the belly, and you

are reminded of the animal appetites: long arms may fit him for an inhabitant of the trees, and a fit companion for the ape; and predominant length of legs are infallibly associated with the habits of the wading or leaping animals. In all, regarding man's form with reference to his destination as the ideal standard, the means become ends, deformity prevails, and becomes the badge of unintelligent slavery to the mere animal nature.

This may be further illustrated by a general and brief comparison of the components of the skeleton in the vertebrated animals with that of man.* In considering the skull, it will be found, that man, of all animals, has the largest and roundest cranium; from the ape to the fish, the brain case decreases in capacity, in correspondence with a proportionably diminishing development. But in the same ratio, the parts allotted to the senses, and the parts merely subservient to the preparation of the food, increase in size. In looking at the head of the horse and the dog, it will be readily observed how much the cranium recedes, and the jaws protrude; but in birds, reptiles, and fish, the proportions are so altered by the diminution of the cranium, that the whole head appears almost to consist of the jaws;—witness the mandibles of the stork and pelican, and the enormous jaws of the crocodile and shark. And we may add, that man is the only animal that has a prominent chin.

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* The Author gladly embraces this opportunity of acknowledging his obligation to that distinguished cultivator of physiological science, Tiedemann. See his *Zoologie* 1ter *Band.*

This distinguishing character of the human skull, found in the proportion of the brain case to the jaws when compared with the same in the inferior animals, the ingenious Camper devised the method of more accurately determining, by means of what has been called the Facial Angle. It consists in drawing one line from the most prominent part of the forehead, to the sockets of the upper incisor teeth and a second, which describes the ground plane of the cranium, through the external *meatus* of the ear, and lower edge of the nose, and which, cutting the first on the upper jaw, forms with it a determinate angle: and it is evident that this angle will be greater in proportion to the development of the forehead and recession of the superior *maxilla*, less or more acute in proportion to the projection of the upper jaw and recession of the forehead.* According to this mode of relative admeasurement, it appears that the facial angle in the European, exceeds that in the Negro; and, it is worthy of notice, that the Greek sculptors, who were careful to mark strongly, or even exaggerate those circumstances which peculiarly mark the human character, have often exceeded the right angle in the ideal anatomy of their deities, though at the same time with the discriminative taste, which prevented them from exceeding the limit, beyond which the

* See Camper's Treatise *Uber den natürlichen Unterschied der Gesichtszüge im Menschen.* Compare Cuvier on the view of the profile and tranverse section of the cranium: *Leçons d'Anatomie Comparée*, Tom. ii. p. 9. and Blumenbach's view from above, or bird's-eye view of the cranium: *De generis humani varietate nativa.*

form would have become a symptom of disease. It follows then, that the size of the brain case in man, proportionate to the development of the brain, indicates the predominance of this organ over those of the senses, which may be regarded as the measure of the subserviency of the animal to the outward excitants, and over the organs for the preparation of the food, the preponderance of which mark the subjugation of the creature to the mere animal needs,—that the predominant development of the cranium, I say, is the mark, symbol and condition of man's characteristic excellence, as pre-eminently gifted with mind.

In order, however, to prevent any misconception with regard to the meaning of the above position, the reader is requested not to confound it with the attempt which has been made to found a physiognomical system on the form of the cranium; and without pretending to give an opinion on the value and merits of that system, it will not be out of place to draw the attention of its supporters to a question, which, sooner or later, must claim their serious consideration. It is well known that Drs. Gall and Spurzheim, from numerous observations, have been led to determine that there are certain regions or parts of the skull which are more or less developed in different individuals. They believe that, where these parts are peculiarly prominent, it is the indication of a greater development of the brain at that spot; and that such being uniformly connected with the manifestation of certain dispositions or faculties, they infer that the portion of brain at that part is

the organ of that faculty, intellectual activity, or moral sentiment. Hence, in their opinion, the relative prominence of the different cranial regions may be used as the measure, or serve as the indication, of the predominant propensities, feelings, or mental endowments of the individual.

It has been generally admitted that there is a mutual relation and interdependence between the brain and the manifestation of the intellectual powers, and that the greater size of the brain in man is in some connexion with his higher mental endowments. The admission, however, involves a far more difficult question respecting the nature of this connexion: and we may here inquire, whether the views of Gall and Spurzheim tend in any degree to solve this difficulty; and whether their system is adequate to its proposed object,—that of determining the condition of the reciprocal relation between the brain and our moral and intellectual nature, and of forming a physiognomical scheme, whereby the configuration and development of the brain shall be shown to be a safe index of our propensities and faculties.

They tell us that the brain is composed of a plurality of organs, each of which has its appropriate functions. Now, what are we to understand by the word Organ, of which they have given us no definite meaning or explanation? In some sense or other, an organ must be instrumental or conditional, however, laxly we employ the term. It may be as in a musical instrument, where the sound or utterance is given by the player; and in which all that is expressed belongs to the

performer, and might be accomplished by the aid of various instruments indifferently. It may be again as in a machine, wherein, by the contrivance and adjustment of the mechanism, the power and its results reside wholly in the instrument. Or it may be as in the animal body, where there is indeed a mechanism, but which is at the same time, the product of a vital power; and thus becomes the organ in and by which the vital power continues to manifest itself as the appropriate function of the same. If a cerebral organ exist at all, it must be of the latter kind. In this we have three things which especially are to be noted, as fulfilling the conception of an organ;—namely, 1. the power which sets the organ in motion, the principle of its activity and action;—2. the structure in and by which this principle is manifested or becomes an act;—and, lastly, the product of that act. Perhaps the best illustration, in the present instance, is that of an organ for motion, a muscle: this consists of a bundle of fibres, with the property of contractility, attached at the extremities to one or more moveable parts, and to which a nerve proceeds for the purpose of conveying the influence producing the contraction. In this instance we have that which is incorporeal, manifesting itself in and by a corporeal organ: in consequence of some mental operation, volition determines the contraction of the muscular fibres, and the part to which they are attached is moved according to its mechanical condition. Thus an organ, in its product, its mode of action or application, has uniformly reference to the forms of sensuous intuition.

But how is it with the cerebral organs, described by Gall and Spurzheim, with the organs of secretiveness, approbation, or ideality? What is the function of that particular packet of medullary fibres, entitled the organ of Self-esteem? Is self-esteem some particular motion of these fibres; and if so, what sort of motion? Is self-esteem the product or the cause of that motion? If it be the cause of the motion, what end or purpose does the motion answer? If it be a product, what evidence can be brought to the senses that it is so?

It will be said, perhaps, that this mode of questioning is unfair, and that a kind of evidence is required, which is not only not demanded, but is not applicable to the subject in question; and that although the mode of activity cannot be demonstrated, yet that the conception of the brain or its parts being a condition of thought or feeling is not invalidated. It will be said, perhaps, that we have abundant proof of the exercise of the intellect being rendered impossible, or its operations disturbed, by causes manifestly referable solely to the condition of the brain,—and therefore, that the brain is that part upon which the exercise and operations of the intellect depend; and if attributable to the whole mass, we may assign, upon proper evidence, particular functions to particular parts.

But if we admit the premises, is the conclusion legitimate? If we grant that thinking is suspended or disturbed because the brain is injured or injuriously affected, are we therefore to conclude that thinking is the function of the brain?

Are we, in other words, to believe that thought is effected by, or is the result of, any operation or mode of action of the brain? This, surely, does not follow from the *data*, and if asserted, it would be perfectly fair to ask what intelligible conception could be formed of a process in which no conceivable mode of cerebral action could produce the result? For, imagine any possible sort of material operation in the bundles of medullary fibres,—conceive them to be analogous to muscles, to glands, to an electrical or galvanic machine;—what is the common mark in the operation of all these as material agents? This;—that the result is a *phænomenon*, that it is, or might be, presented to the senses: whereas thought, being in its very nature and conception that which can never become the object of the senses, wants that common mark, which would characterize it as the possible result of a material agency. The assumption, in fact, of an organ of thinking, is the confounding of things which are essentially disparate, and of different kinds.

It might still be supposed, that there was some lurking power in the term "condition," where we have admitted that the exercise of the intellect may be disturbed or altered by causes referable to the state of the brain, and that, therefore, the brain influences the intellectual process, or that the latter is, in some sense, dependent upon the brain. But the utmost that can be legitimately inferred, is, that the brain is the condition of the corporeal manifestation of mind, of the mind as far as it has relation to the body. To go

further would be to confound condition with efficient cause, and we should be no more justified in stating the brain to be the efficient and operative source of mind, than in stating the stomach to be so, because it is the condition of the continued bodily existence of an intelligent being.

Passing on to the consideration of the other components of the skeleton, we may next examine the Trunk; and it is evident that in man we have mainly to regard the Spine in relation to its purposes as a central column of support, in aid of his erect position. Now this, the vertebral column, consists of a pile of bones, named *vertebræ*, distinguished as those of the neck, of the back, and of the loins, and the pillar rests below upon the wedge-shaped *sacrum*, having the *coccyx* as an appendage, which forms the tail in inferior animals. And in the human spine, characterized especially by its serpentine bend, the various regions thus named are proportionately and harmoniously developed; but in the inferior orders of animals, each region acquires some peculiar prominence, in obvious relation to some necessitating purpose, influencive of the character and habits of the agent. In birds, the region of the neck is peculiarly long, serving as a balancing pole in flight, or as in the aquatic birds answering the purpose of a fishing-rod; whilst the region of the back is very short, and that of the loins is wanting altogether. In the *Mammalia*, various proportions are observed: in the *Cetacea*, the neck is so short that it appears to be wanting; in the giraffe, it is

as remarkably long, serving to lift the head of the animal as a browsing apparatus; and in many, the tail is extraordinarily developed, answering the purpose of a "prehensile hand to the monkey, a trowel to the beaver, a rudder to the whale, and a leaping-pole to the kangaroo." Of the *pelvis*, we need observe no more, than that in man it is the most complete; for its breadth and development form a necessary part of the adaptation of his frame to the erect posture. In looking to the chest, we find in man a structure peculiarly appropriate to respiration, and this in connexion with speech and with the expression of feelings and emotions, as characteristic of a life raised into intimate union with mind: whilst in the inferior animals it has subsidiary offices, which bring it in closer relation to the organs of locomotion; in some quadrupeds, by a greater number of *vertebræ* and ribs; in birds, by an expansion of the *sternum;* in serpents, by a multiplicity of ribs, which serve the purpose of feet; or it bears the traces of imperfect development, as in the frogs; and fish cannot be said to have a *thorax* at all.

If we compare the lower limbs of man with the hinder extremities of quadrupeds, we again find the peculiar character and perfection of the former in their adaptation and appropriation to maintain the balance of the body in the erect posture. In some, indeed, the hinder limbs are so formed as to permit the creature to obtain, for a time, the free use of the fore extremities; but the endowment serves but to mark, as in the monkey, that it was

intended for a climbing animal; and the extraordinary length and strength of the legs of the kangaroo show only its aptitude to leap. And if, in birds, the support of the body is effected by two legs, it leaves the anterior extremities free only for the purpose of aiding in, and of executing, a different mode of locomotion. In man alone the lower extremities, providing wholly the means of support and progression, leave the upper limbs as instruments, the use of which is entirely at the choice of the agent.

And in aid of this purpose, we find in man the most perfect upper extremity. From the ape to the fish, the different components diminish in number, development, and variety of motion. This is especially noticeable in the hand; which, in consequence of the length of the fingers, the number of articulations, and the multiplicity of their movements, especially in consequence of the capability of opposing the thumb to the fingers, becomes an instrument fitted for the most delicate and varied operations directed by the skill and intellect of man. Compare, in this respect, this flexile and modifiable apparatus with the single digit of the extremity of the horse, on the horny tip of which the weight of the animal (by an admirable mechanism indeed) is supported and carried; or with the abortive hand of the whale, sufficiently like the human to be so called, but retracted, enveloped in skin, and degenerated into a fin, that merely serves as an oar in propelling the animal through the water. It might be said, perhaps, that the hand of the monkey claims the

praise of as great perfection as that of man, but the dwindled thumb marks its imperfection for handling and for touch; and the arms even of the anthropoeid oran otan, lengthened to deformity, irresistibly prove their use to be little else than for grasping and climbing.

In the contemplation of the human skeleton, its most striking characteristic, however, and that which contradistinguishes it from the bony fabric of all other animals, is its adaptation to the erect position; an attribute not only peculiar to man, but without which, his structure could not correspond to his spiritual endowments, since it is at once the need and symbol of a being raised above the servile condition of the mere animal nature.

Thus the skull is poised, with only a slight preponderance anteriorly, at the top of the vertebral column; and a plumb line, dropped from the point of its support, falls through the centre of gravity between the feet, which present the base of support to the whole towering fabric. We remark, however, that the supporting parts do not range with this line. The spine is bent like an italic *S;* it recedes at the chest, in order to give room to its cavity, and at the same time is harmoniously inflected forwards at the loins and neck, in order to facilitate its balance over the points of support; and it cannot be doubted that these curves contribute to the capability of bending and changing the position of the trunk, without endangering the loss of balance. But the balance

of the body is also greatly aided by the breadth of the human pelvis, which, supplying a broad base of support, permits the inclinations of the trunk without the necessity of altering the position of the lower limbs. The lateral breadth of the pelvis, however, throws the heads of the thigh bones, upon which the weight of the body is transmitted, to some distance on each side of the line, that falls through the centre of gravity; and in order to provide a compensating adjustment, the thigh bones are placed obliquely, inclining towards each other, so that in the upright posture with the feet together, they touch at the knees, and the weight is then received upon the heads of the leg bones or *tibiæ*, which stand perpendicularly under the centre of gravity. And these again are planted upon the arch of the foot or instep, on which the whole weight of the body securely rests. Then, in order to secure in the foot the requisite firmness in standing, we find that it is articulated with the leg at right angles, so that both the heel and toes touch the ground; and the joint is placed nearer the posterior than the anterior part of the foot, so as to increase the base of support in that direction towards which the body tends most to fall; besides which, the weight is here received on the inner side of the foot, where it is most arched, thereby offering not only the advantage of a strong support, but one which is highly elastic, yielding without injury in alighting upon the feet, and acting as a spring in progression.

Thus the majestic column of the human form

is raised and built up upon its pedestal, and the living pillar, readily maintaining its equipoise, bears aloft its capital, whilst the upper limbs are left free to adlibitive motion. Thus the place of the head, as the corporeal representative of that which perceives and wills, the disposition of the senses therein as the *media* of intelligence, and of the organs of speech as the interpreters of thought, and the arrangement of the upper limbs as instruments of volition, no longer subservient to mere animal needs,—all impress us with the conviction that even the skeleton cannot be intelligible to us, without admitting that the human bodily frame was designed for the instrument and dwelling of a being contradistinguished from and elevated above all other animals :—

> A creature, who, not prone,
> And brute as other creatures, but endued
> With sanctity of reason, might erect
> His stature, and upright, with front serene,
> Govern the rest, self knowing.

Man alone is erect. It is to this posture that the body of man owes the character, impressed on the whole frame, of its emancipation from subserviency to the mere animal needs, and becomes expressive of mind and of free and intelligent action. It will be seen that the lower limbs, answering the purposes of support and locomotion, have alone any obvious or necessitated utility ; while the upper extremities are, in consequence, left at liberty as the ready and facile instruments of his will. Hence too the senses are best freed from their servitude to the bodily wants,

and the countenance is raised as the expressive exponent of thoughts and feelings, which the mouth declares and interprets by words. And thus as the stem bears the corolla, the head is carried on high, as the most noble part of the frame, which it surmounts; all the rest of the body seems as if intended to carry it; and when considered in its fitness for expression, it may be said to be representative of the whole man.

If principally connected with erect posture the body is admirable and acquires its human character, we shall no less find, in directing our attention to the organs of motion in man, the aptitude and capabilities of a being designed for intelligent freedom. We find in man the organic structure adapted for the greatest variety of motion. It is true, indeed, that many of the *mammalia* are so constituted, as greatly to excel man in particular kinds of locomotion; but we shall in vain look for the same combination and mastery of his powers, which the erect posture implies. The monkey climbs and jumps with a facility truly extraordinary; but it is with difficulty, or only for a short time, that he raises himself into the erect position. Dogs, horses, deer, excel man in swiftness, but they cannot climb nor walk erect. The otter, the beaver, and the seal, swim well, but it is their only boast above creatures of their own kind. And whales or other cetaceous animals, though admirably adapted for swimming, have no other mode of locomotion. Man, on the other hand, stands and walks erect, runs, jumps, climbs, swims,—

man alone, can so modify his frame, that it is in his power to waive the high privilege of the harmony and balance of his faculties; and by concentering his volition to any one property or perfection, we have reason to believe that he might equal or excel the beast, most characterized by that perfection,—outrun the deer, outwrestle the bear, climb with the monkey. In short, man has the most modifiable organs of motion, and is most capable of subjugating them to his will, and of rendering them the instruments of his varied purposes.

The capability of varied motion in man depends greatly upon the facility with which the different parts of the body, especially the limbs, move at the same time in opposite directions; a power, which not only permits variety of movement, and confers an aptitude of expressive action, but likewise gives preeminently a character of suppleness, ease, and freedom to the total motion. But it is the equipoise of his body in connection with the erect position, which gives the unity to any totality of movement, and determines the attitude or carriage necessary to preserve its balance. In order to balance the body, whether at rest or in motion, it is necessary that man should exert an incomparably greater number of muscles than the inferior animals; and for the same reason a far greater effort of his volition is required for adjusting the proportional action of each, and for combining and harmonizing the actions of all; in short, of all animals man must be most the master of his own body.

It is further deserving of notice that the inflec-

tions of the trunk, the motions of the limbs, and the play of the several joints, all tend to the circular and curvilineal in their movements, a circumstance which mainly tends to confer on human motion the character of Beauty. And it may be safely affirmed that, under all the varieties of expressive movement, the very structure and mechanism of the body tend to reduce its motions to the form of the beautiful, or resolve them into grace; a fact of which we may convince ourselves in watching the sinuous movements of the dance, wherein, aided by the totality of motion in the dancer, they present a harmony by continuity, a problem of grace which is ever solving and ever beginning anew.

Beauty of attitude, and grace of carriage, are, however, intimately connected with the maintenance of the balance and equipoise of the body. No attitude can be beautiful in which the idea of rest is not conveyed by that permanence and security, which results from a perfectly felt balance. "Grace of carriage, requires not only a perfect freedom of motion, but also a firmness of step, arising from a constant bearing of the centre of gravity over the base of support;"* it includes ease and security. And in both, whether it be motion becoming fixed as attitude, or attitudes presenting themselves in the shaping flow of motion, beauty and grace reveal themselves in self-command and in freedom made manifest by self-control. In short, look at the body in any position or attitude, in any of the incidental or casual forms

* Arnott's Physics, p. 128.

arising out of the free and unconstrained movements of man healthy in frame and unshackled by conventional usages, and the truth will force itself on your conviction. Pass in review the ponderous strength of the Hercules, the agile Mercury, the graceful ease of the Antinous, the reclining Ilyssus, all the animated forms of the frieze of the Parthenon,—whatever Greek art has signalized or modern genius has realized,—witness the sports of children, or go even to the wild denizens of the American forest,—and proof will no longer be needed that grace and beauty are inherent in, not accidents of, the human body, as the fit instrument of human freedom and intelligence, and the translucent medium, as it were, of man's proper and spiritual being.

I conclude with the profound observation of Rudolphi: "*Es ist eine grosse Kluft zwischen dem Menschen und den Thieren, die durch nichts ausgefüllt wird.*" There is a chasm between man and animals which no ingenuity can fill up or overbridge.* And we pause with wondering awe, when the refined researches of anatomy bring us suddenly back with startling evidence to that record of primeval wisdom, which marks emphatically the distinctive epoch of creation: *God created man in his own image.*

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* Physiologie 1ter Band, p. 37.

APPENDIX E.

HUNTER'S PATHOLOGY.

In tracing the revival of Medicine in the middle ages from the Alchemists to the morning twilight of the Helmonts, and thence to Sydenham, Boerhaave, Hoffmann, and Stahl,—the main feature of its history is the obstinate struggle of the Rational or Galenic Schools, with the daring half-enlightened empirics of the Chemical sect. But what hope of science could Medicine lay claim to in the hasty generalizations and the mistaken theory of the elements, humors, and qualities, advanced by the Rationalists, Galenists, or by those under whatever other name who governed the profession with the leaden sceptre of a pedantic routine during the reign of the so called Aristotelian Logic? What approach to the certainty of science could medicine boast under the audacious and blundering quackery of their rivals the chemical sect? What advance in truth could be expected even from the great mind of Boerhaave, whilst trammelled by the errors of the Iatro-chemical school, of which he was the founder? Or what progress in knowledge could be anticipated from his no less illustrious contemporary Stahl, who confounded life with the conscious soul?

It was a great step in the advancement of our profession, and a blessing to it in this country,

when Sydenham, following the example of the Father of medicine, united with science common sense, observation, and experience. It was a great improvement in the study of disease when morbid anatomy began to be cultivated, and the appearances after death were studied in connexion with the peculiar symptoms and sufferings during life, as has been done by Morgagni, Portal, and Baillie. And it is not without a feeling of congratulation, that we find men's minds turned from the merely logical methods of system and nosological arrangement, and the study of names exchanged for that of diseases, our knowledge of which is at present too imperfect to permit successful generalization and classification; though, in avoiding the error of our predecessors, who forgot that their systems of Nosology were only provisional, we are perhaps too much disposed to overlook the advantage of these as needful aids in the study of medicine. But the source from which we must expect the great light in constructing the science of Pathology, is the investigation of the latent processes (as Bacon named them*) by which disease is produced, or rather in which it essentially consists, and which correspond to what have been technically and less happily called proximate causes. If we are not to blunder on empirically, we must begin with

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* "*Inventio, in omni generatione et motu, latentis processus continuati ab efficiente manifesto et materia manifesta usque ad forman inditam.*" Nov. Org. Lib. Aph. i. Bacon uses the term *forma*, as *forma formans*, *natura naturans*, *fons emanationis*, and equivalent to law.

Disease, not as a *datum*, but as a problem to be solved; and in order to its solution, the phænomena of disordered functions must be studied, as signs of the decrement of vital energy by excess or defect, and by altered balance or changed predominance, of the vital forces.

It was alone from a philosophical physiology, like that of Hunter, that such a study of disease in behoof of a scientific pathology could originate, and it was upon this basis that he prosecuted his pathological researches. The appeal to philosophical principles in Hunter's works was indeed the cause of their being a closed volume to his less enlightened contemporaries: but, though the principles implied or expressed subjected them to the scorn and neglect of those less embued with the spirit of philosophy, the results of those principles, verified as they were by facts, have gradually and insensibly forced themselves on the conviction of the Profession; and though adopted silently, and without acknowledgment, as if the authors themselves had forgotten or were ignorant from whence they were derived, they now form the very groundwork of all books, treatises, and lectures on professional subjects.

In his pathology Hunter, by contemplating life as an agency working under the control of law, remained true to the principle already established in his physiology. And one of the first fruits of this pregnant principle was the clear perception of the unity of the living body as a Constitution, by virtue of which it forms a system of interdependent parts, and a constitution of balanced forces mutually

reacting and combining to one end. This is the very meaning of the term "Constitution," as applied to the animal economy; and it may not be amiss here to remind the Reader that hence we obtain, likewise, the meaning of the term "Health," as that state, which consists in the balance of the powers constituting the life of an animated body, and an accordant state of the structures and organs, in and by means of which the functions of these powers are exercised and directed. But these powers may and do exist in various degrees of intensity and of relative subordination in different individuals; the result is what we call the individual's constitution, and all diseases and disorders referable to any disturbance of this specific harmony are Constitutional Diseases.

Hunter saw, however, that, in order to the satisfactory solution of the problem of disease in accordance with the laws of Vital Dynamics, the conditions of its origin and progress required a more searching inquiry than had hitherto been attempted. In his account of Susceptibility we may note not only the important observations on the specific susceptibility of particular parts, and of particularly constituted individuals to special causes of morbid action; but in connecting it with the universal law of Excitability and Resistance, we see the scientific ground on which was placed his distinction of Power and Action. He saw too the necessity of assuming a Disposition or proneness in the individual to this or that form of disease, as to gout or scrofula; and with this was connected his philosophical view of Hereditary ten-

dencies, announced in the just observation that the term "hereditary," should be applied not to the disease, which becomes the heir-loom, but to the predisposition in which it originates. A pregnant subject not only unexhausted, but scarcely opened, farther insight into which might not only aid us in the discovery of the law of the propagation, and transmission by descent, of malformation, of disease, and of insanity, but might throw a light on the obscure problem of the variety of the human races, of degeneracy, and of the awful mystery of a life admitting, and becoming permanently possessed by, an alien and hostile power.*

But the principles thus obtained would have been incomplete without bringing the various perturbations and disorders of function, which constitute the phænomena of disease, under the law of the unity of life. And so fully was Hunter impressed with the importance of this subject, that we find him frequently recurring, and devoting a considerable portion of his lectures, to a consideration of Sympathy, the term being intended to express the community, and, as it were, consent of feeling and action, which preserves the bond of

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* Some further explanation may be deemed requisite for the elucidation of the latter part of this paragraph; the Reader, however, is requested to accept provisionally, in lieu of a more detailed comment, a statement of the Author's view that the various forms of Degeneracy form part of the problem, and admit of satisfactory explanation from the principle of evil renitency, indicated in a former note on the evolution of the idea of Power.

interdependence in all the parts and actions of a living body, in their constitution to one organic whole. He saw that it was from a knowledge of Morbid Sympathy that we are enabled to anticipate and discriminate the immediate and remote effects of injury, or to understand the means by which a removal of the injurious cause, or a restoration from its effects may be accomplished; and that in the conditions of sympathy we are to study the nature and end of Constitutional Irritation.

It was probably during this study of the relations and nature of disordered functions that Hunter framed for himself a language, which, if it exposes him to the charge of minting terms, objectionable from their novelty and obscurity, ought not in candour to be condemned without weighing the counterbalancing advantages they may possess of philosophical accuracy. We are at first startled with such phrases, as the "stimulus of necessity," the "stimulus of death;" but the perplexity will be greatly removed, if the student reflect that, as all appetence implies want, and as therefore the living subject may be excited by the absence of what it needs, so likewise that the sense of deprivation may become no less a stimulus than that which acts as a positive excitant. Again, by the term "action," which has called forth much severe criticism, he seems to have intended what, in the received phraseology of the Schools, is called a proximate cause. But instead of being a fanciful assumption, like Boerhaave's or Cullen's hypothesis of the proximate cause of inflammation,

he confines the designation to the morbid act or process in which the disease may be supposed essentially to consist, as far only as it is made sensible, or may be legitimately inferred by an induction from facts, without admitting aught that the facts do not warrant or require. And thus, if we look to his investigation of the nature of the inflammatory process, can we enough admire the almost wearisome collation of facts by which he removes, point by point, all the intervening obscurity which separates, in our view, the morbid from the natural action of vessels, and brings them into luminous and intelligible connexion? An instance of the boldest use of the term, and which well illustrates that use, is that of calling mortification an "act of death;" but the accuracy of the apparent paradox will be acknowledged, if we contrast with the immediate and direct destruction of a part, by fire or caustic, a process of mortification, which consists of living actions throughout, and of which the last act is that of excluding a part from participating in the conditions of vitality which it is no longer capable of maintaining, and of throwing off, as a slough, that which can have no community with life and living existence.

And lastly, if this unity of life, which ever tends to preserve the bond of living action, be evinced in that interdependence of the parts which is exhibited in sympathy, it is no less revealed in the ever present tendency to Integration, which it is evidently the purpose of many of the actions excited by sympathy to effect in the natural processes which lead to the repair of local injuries

and to the cure of many diseases. This power of restoration, under certain limits, has scarcely been denied by any, and most pathologists have been content to admit that the phænomena of disease must be explained in part by disturbing forces, and in part by a reacting and restorative power, under the name of a *vis medicatrix naturæ;* but the latter, under this or whatever other appellation, will be but an unexplained and mysterious agency, a mere *facultas occulta*, unless we apprehend it in the light of an antecedent unity, or law of integrity, which in all life having produced a whole, ever tends to preserve and restore that which it had produced; though as the subject or agent is imperfect—that is, a mere spontaneity actuated into an instinctive adaptivity—and tends to lapse from the law which actuates and directs it, its power of restoration is limited, the actions by which it is intended to be accomplished may be excessive or defective, and thus its ends frustrated. And here the province of the healing art commences; to the principles of which Mr. Hunter so largely contributed in teaching us where we are not to interfere with the ordinary course of events, and where, neither trusting too much nor too little to the powers of nature, the Practitioner is to incite where they are defective, is to restrain and allay where they are excessive; that, guided by a knowledge of the laws of life, he may conduct the disease to a successful termination by restoring the balance in which health consists.

If it were necessary to enter more at large into

the detail of Hunter's labours, I might refer you to his work on the Fundamental Principles of Inflammation, as to one of the most masterly performances of inductive investigation, and unprecedented in the science to which it is a contribution. But since my already exceeded limits only permit me to select one or two instances in further illustration of the merits of a work, which first deserved the title of an investigation of the Principles of inflammation, let me remind you that, if in his researches on Ulceration, in connexion with the functions of the absorbent vessels, we find him creating a new branch of science, it was by his elucidation of the process of Adhesion that he principally conferred on surgery a scientific character. The knowledge of this mode of union in wounds has eminently contributed to rescue surgery from the opprobrium of unsuccessful operations, and to simplify and give success to their after-treatment; and has been no less influential in raising surgery from a rude and mechanical art to the dignity of a science.

Recollect too, that in tracing the nature and results of inflammatory action, Hunter has elucidated the principles by which we obtain insight into the largest and most important class of diseases, which the physician no less than the surgeon has to treat, and to the knowledge of which, his successful, because scientific treatment is, alas! almost exclusively confined. We are too apt to forget what we owe to Hunter's industry, sagacity, and genius; but the value of his pathological labors may be estimated by contrasting the in-

creased power, insight, and security of medical science, since these latent processes have been understood, with the feebleness, indecision, and timidity of a "*médecine expectante*," or with the ignorance and blundering rashness of our predecessors.

APPENDIX F.

INSTINCT.

THE following remarks on the import of instinct are those to which Coleridge refers in the Aids to Reflection, (p. 177, last edit.) as in accordance with his view of the understanding, differing in degree from instinct, and in kind from reason; and whatever merit they possess must have been derived from his instructive conversation. They are here inserted, in the hope that they may interest the reader in connexion both with the passages of the preceding discourse, and with the writings of Coleridge, on this important subject.

What is Instinct? As I am not quite of Bonnet's opinion, "that philosophers will in vain torment themselves to define instinct, until they have spent some time in the head of the animal, without actually being that animal," I shall endeavour to explain the use of the term. I shall not think it necessary to controvert the opinions which have been offered on this subject, whether the ancient doctrine of Descartes, who supposed

that animals were mere machines; or the modern one of Lamarck, who attributes instincts to habits impressed upon the organs of animals, by the constant efflux of the nervous fluid to these organs, to which it has been determined in their efforts to perform certain actions, to which their necessities have given birth. And it will be here premature, to offer any refutation of the opinions of those who contend for the identity of this faculty with reason, and maintain that all the actions of animals are the result of invention and experience; an opinion maintained with considerable plausibility by Dr. Darwin.

Perhaps the most ready and certain mode of coming to a conclusion in this intricate enquiry, will be by the apparently circuitous route of determining, first, what we do not mean by the word. Now we certainly do not mean, in the use of the term, any act of the vital power in the production or maintenance of an organ: nobody thinks of saying that the teeth grow by instinct, or that when the muscles are increased in vigour and size in consequence of exercise, it is from such a cause or principle. Neither do we attribute instinct to the direct functions of the organs in providing for the continuance and sustentation of the whole co-organized body. No one talks of the liver secreting bile, or of the heart acting for the propulsion of the blood, by instinct. Some, indeed, have maintained that breathing, even voiding the excrement and urine are instinctive operations; but surely these, as well as the former, are automatic, or at least are the necessary result of the organization

of the parts in and by which the actions are produced. These instances seem to be, if I may so say, below instinct. But again, we do not attribute instinct to any actions preceded by a will conscious of its whole purpose, calculating its effects, and predetermining its consequences, nor to any exercise of the intellectual powers, of which the whole scope, aim, and end are intellectual. In other terms, no man, who values his words, will talk of the instinct of a Howard, or of the instinctive operations of a Newton or Leibnitz in those sublime efforts, which ennoble and cast a lustre, not less on the individuals than on the whole human race.

To what kind or mode of action shall we then look for the legitimate application of the term? In answer to this query, we may, I think, without fear of the consequences, put the following cases, as exemplifying and justifying the use of the term Instinct in an appropriate sense. First: when there appears an action, not included either in the mere functions of life acting within the sphere of its own organismus; nor yet an action attributable to the intelligent will or reason; yet, at the same time, not referable to any particular organ,—we then declare the presence of an Instinct. We might illustrate this in the instance of a bull-calf butting before he has horns, in which the action can have no reference to its internal œconomy, to the presence of a particular organ, or to an intelligent will. Secondly, likewise (if it be not indeed included in the first) we attribute Instinct, where the organ is present; if only the act is equally anterior to all

possible experience on the part of the individual agent, as for instance, when the beaver employs its tail for the construction of its dwelling, the tailor-bird its bill for the formation of its pensile habitation, the spider its spinning organ for fabricating its artfully woven nets, or the viper its poison fang for its defence. And lastly, generally where there is an act of the whole body as one animal, not referable to a will conscious of its purpose, nor to its mechanism, or to a habit derived from experience, or previous frequent use. Here with most satisfaction, and without doubt of the propriety of the word, we declare an Instinct; as examples of which, we may adduce the migratory habits of birds; the social instincts of the bees, the construction of their habitations composed of cells formed with geometrical precision, adapted in capacity to different orders of the society, and forming storehouses for containing a supply of provisions,—not to mention similar instances in wasps, ants, termites; and the endless contrivances for protecting the future progeny.

But if it be admitted that we have rightly stated the application of the term, what we may ask is contained in the examples adduced, or what inferences are we to make as to the nature of Instinct itself, as a source and principle of action? We shall perhaps best aid ourselves in the enquiry by an example, and let us take a very familiar one of a caterpillar taking its food. The caterpillar seeks at once the plant, which furnishes the appropriate aliment, and this even as soon as it creeps from the ovum; and the food being taken into the

stomach, the nutritious part is separated from the innutritious, and is disposed of for the support of the animal. The question then is, what is contained in this instance of instinct? In the first place, what does the vital power in the stomach do, if we generalize the account of the process, or express it in its most general terms? Manifestly it selects and applies appropriate means to an immediate end prescribed by the constitution—first, of the particular organ, and then of the whole body or organismus. This we have admitted is not instinct. But what does the caterpillar do? Does it not also select and apply appropriate means to an immediate end, prescribed by its particular organization and constitution? But there is something more, it does this according to circumstances;—and this we call Instinct. But may there not be still something more involved? What shall we say of Hüber's Humble-bees? A dozen of these were put under a bell glass along with a comb, of about ten silken coccoons, so unequal in height as not to be capable of standing steadily. To remedy this, two or three of the humble bees got upon the comb, stretched themselves over its edge, and with their heads downwards, fixed their fore feet on the table on which the comb stood, and so with their hind feet kept the comb from falling. When these were weary others took their places. In this constrained and painful posture, fresh bees relieving their comrades at intervals, and each working in its turn, did these affectionate little insects support the comb for nearly three days; at the end of which time they had prepared

sufficient wax to build pillars with it. And what is still further curious, the first pillars having got displaced, the bees had again recourse to the same manœuvre. What then is involved in this case? Evidently the same selection and appropriation of means to an immediate end as before; but, observe! according to varying circumstances.

And here we are puzzled;—for this becomes understanding. At least no naturalist, however predetermined to contrast and oppose instinct to understanding, but ends at last in facts, in which he himself can make out no difference. But are we hence to conclude that the instinct is the same, and identical with the human understanding?—Certainly not;—though the difference is not in the essential of the definition, but in an addition to, or modification of, that which is essentially the same in both. In those cases namely, as that which we have last adduced, in which instinct assumes the semblance of understanding, the act indicative of instinct is not clearly prescribed by the constitution or laws of the animal's peculiar organization, but arises out of the constitution and previous circumstances of the animal, and those habits, wants, and that predetermined sphere of action and operation which belong to the Race, and beyond the limits of which it does not pass. If this be the case, I may venture to assert that I have determined an appropriate sense for Instinct:—namely, that it is a Power of selecting and applying appropriate means to an immediate end, according to circumstances, and the changes of circumstances, these being

variable and varying; but yet so as to be referable to the general habits, arising out of the constitution and previous circumstances of the animal, considered not as an individual, but as a Race.

We may here, perhaps, most fitly explain the error of those who contend for the identity of Reason and Instinct, and believe that the actions of animals are the result of invention and experience. They have no doubt been deceived in their investigation of instinct, by an efficient cause simulating a final cause; and the defect in their reasoning has arisen, in consequence of observing in the instinctive operations of animals the adaptation of means to a relative end, from the assumption of a deliberate purpose. To this freedom or choice in action and purpose, instinct, in any appropriate sense of the word, cannot apply, and to justify and explain its introduction, we must have recourse to other and higher faculties than any manifested in the operations of instinct. It is evident, namely, in turning our attention to the distinguishing character of human actions, that there is, as in the inferior animals, a selection and appropriation of means to ends—but it is (not only according to circumstances, not only according to varying circumstances, but it is) according to varying Purposes. But this is an attribute of the intelligent will, and no longer even mere understanding.

And here let me observe that the difficulty and delicacy of this investigation are greatly increased by our not considering the understanding (even our own) in itself, and as it would be were it not

accompanied with, and modified by, the cooperation of the will, the moral feeling, and that faculty, perhaps best distinguished by the name of Reason, of determining that which is universal and necessary, of fixing laws and principles whether speculative or practical, and of contemplating a final purpose or end. This intelligent will,—having a self-conscious purpose, under the guidance and light of the reason, by which its acts are made to bear as a whole upon some end in and for itself, and to which the understanding is subservient as an organ or the faculty of selecting and appropriating the means—seems best to account for that progressiveness of the human race, which so evidently marks an insurmountable distinction and impassable barrier between man and the inferior animals; but which would be inexplicable were there no other difference than in the degree of their intellectual faculties.

Man doubtless has his instincts, even in common with the inferior animals, and many of these are the germs of some of the best feelings of his nature. What, amongst many, might I present as a better illustration, or more beautiful instance, than the storgè or maternal instinct? But man's instincts are elevated and ennobled by the moral ends and purposes of his being. He is not destined to be the slave of blind impulses, a vessel purpose-less, unmeant. He is constituted, by his moral and intelligent will, to be the first freed being, the master-work and the end, of nature; but this freedom and high office can only co-exist with fealty and devotion, to the service of truth

and virtue. And though we may even be permitted to use the term Instinct, in order to designate those high impulses, which in the minority of man's rational being shape his acts unconsciously to ultimate ends, and which in constituting the very character and impress of the humanity reveal the guidance of Providence; yet the convenience of the phrase, and the want of any other distinctive appellation for an influence *de supra* working unconsciously in and on the whole human race, should not induce us to forget that the term Instinct is only strictly applicable to the Adaptive Power, as the faculty, even in its highest proper form, of selecting and adapting appropriate means to proximate ends according to varying circumstances,—a faculty which however only differs from human understanding, in consequence of the latter being enlightened by reason,—and that the principles, which actuate man as ultimate ends, and are designed for his conscious possession and guidance, are best and most properly named Ideas.

RECAPITULATORY LECTURE.

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Life as a Law.—Division of natural science into Physiography, Physiology, and Physiogony.—Import of Physiogony as History of Nature. Types, as significant forms of Organization, and as a language of Nature.—Scheme of the ascent of animal Life.—Organic Types of Zoophyta: Articulata: Mollusca: Pisces: Aves: Reptilia: Mammalia. —Gradative perfection and final aim of animated being.—Principle of the multiplication of forms.—Intermediate state of life and mind in the Passions.—Concluding observations.

"It is with sciences as with trees. If it be your purpose to make some particular use of the tree, you need not concern yourself about the roots. But if you wish to transfer it into another soil, it is then safer to employ the roots than the scions. Thus the mode of teaching, most common at present, exhibits clearly enough the trunks, as it were, of the sciences, and those too of handsome growth; but, nevertheless, without the roots, valuable and convenient as they undoubtedly are to the carpenter, they are useless to the planter. But if you have at heart the advancement of education, as that which proposes to itself the general discipline of the mind for its end and aim, be less anxious concerning the trunks, and let it be your care that the roots should be extracted entire, even though a small portion of the soil should adhere to them: so that, at all events, you may be able, by this means, both to review your own scientific acquirements, remeasuring as it were the steps of your knowledge for your own satisfaction, and at the same time transplant it into the minds of others, just as it grew in your own."

BACON.

RECAPITULATORY LECTURE.

In the course of lectures of this year, I now proceed to the concluding portion of the arduous undertaking of explaining to an enlightened audience the structure and economy of the animal creation at large;—an undertaking from which I should have shrunk except from a sense of duty and of what I owed to my character, and to the promotion of the objects of our College, in the cultivation of science, and the advancement of our own profession. I will add, too, that I have been encouraged by the hope that I might excite in the minds of my junior auditors a love and an enthusiasm for the cultivation of natural science, not merely for the phænomena, and particular facts which it presents, however interesting in themselves, but as they are the workings and manifestations of Laws, and the revelations of Reason and of Will.

Besides, without the observation and study of nature, our thoughts want an external reality which the mind of itself cannot afford. As (according to our immortal Shakspeare),

> the eye sees not itself
> But by reflection, by some outward thing,

so external nature serves as a mirror, in and by which our inward being is reflected and made intelligible. At the same time, in the calm and disinterested pursuit of truth afforded by nature, we may fortify our minds against the allurements of the world, and find consolation under its disappointments and afflictions.

If I have in any degree succeeded in what I conceived to be the legitimate design of these Lectures, I shall have contributed to rescue Hunter's character from the charge of ill founded and visionary opinions, and to maintain his peculiar and almost exclusive merit, in laying the foundation and in fixing the principles of scientific physiology, by banishing hypotheses, fictions, and arbitrary assumptions, and by considering Life as a Law—assigning to it a perpetual antecedence to all the sensible phænomena of animation,—and as a measure common to all its agencies and particular manifestations; and, in that very conception of a Law, implying that it is a power anterior (in the order of thought) to organization, which yet it animates, sustains, and repairs,—a power originative, and constructive of an organization, in which it continues to manifest itself in all the forms and actions of animated beings.

This idea, which led Hunter, step by step, for its illustration to the formation of the great assemblage of significant facts contained within these walls, cheered and emboldened

me in the difficult task of presenting to you, in a scientific form, the facts disclosed by the organic and animated world. Under the light of this Idea, and with a view to its intelligible development, allow me to remind you that the three great divisions into one or other of which all natural science resolves itself are :

Physiography, or Description of Nature ;
Physiology, or Theory of Nature; and, lastly,
Physiogony, or History of Nature.

The office of the first, or Physiography, is to enumerate and delineate the effects and products of nature as they appear. Its sphere is that of sensible experience, of appearances, in contradistinction from truths drawn from immediate facts by inference. The subject matter is not unhappily entitled by elder naturalists *Natura naturata*, or nature considered passively ; and the result may be compared to an immense family piece, the figures of which are all portraits.

The office of the second, or of Physiology, is, first, to deduce by inference the rules or principles by which the innumerable facts of physiography may be reduced into manageable order, either in reference to the convenience of our faculties, which is the principle of all artificial classification, or in relation to the objects themselves, which (should it ever be realized) will be the ground of a natural classification. Secondly, it is the office of physio-

logy likewise to ascertain the powers, which must be inferred from the phænomena, and the laws under which they act; in other words, to ascertain the idea of life and its constituent forces as far as it is common to all living bodies.

The third, or Physiogony, regards the facts and appearances of the natural world as a series of actions, and Nature itself as an agent, acting under the analogy of a will and the pursuit of a purpose;—in what sense, and whether by a necessary fiction of science, or with some more substantial ground, we leave here undetermined. Physiogony too, no less than physiology, investigates the principles of life; but this again principally in reference to the original construction of living bodies, and to the productive powers, or their formative principle. The distinctive aim, then, of physiogony is to present a History of Nature, and, as in all other history, to discover in the past the solution of the present, and in both the anticipation of the future. If it be possible in one sentence to convey the sort and degree of interest, which the object of physiogony or the history of Nature is calculated to inspire, I might say, that its object is to exhibit every order of living beings, from the *polypi* to the *mammalia*, as so many embryonic states of an organism, to which nature from the beginning had tended, but which Nature alone could not realize—to exhibit Nature as labouring in

birth with man. It was this Idea which enabled me, in former lectures, to present to you Nature's living products, as so many significant Types of the great process which she is ever tending to complete in the evolution of the organic realm. In each stage of the ascending scale of living beings we see, with evidence increasing directly as the ascent, at once the opposition and the harmony of the two great tendencies which must be regarded as the main factors or constitutive agents in this great work of Nature, namely—that of Nature tending to integrate all into one comprehensive whole, and, consequently, retaining each part, and, as in vegetation, building upon herself; and on the other hand, the tendency to individuality in the parts, and for this purpose the *nisus* in each to detach itself from the preceding or to supersede them, now by building the new edifice out of the materials of its more rude predecessor, and now by destruction, as one who, by the force of the vault, should crush the platform from which he had taken the spring. Hence the states, which the individual passes through in all the epochs of its embryonic being, and which having been disappear, are preserved in Nature, and maintain the rank of external and abiding forms. And thus the aim of physiogony is to present the history of Nature as preface and portion of the history of man, the knowledge of Nature as a branch of self-knowledge.

Such were the motives that incited me, and the prospects that encouraged me, to introduce the physiographic details, which form the main body of these Lectures, with an attempt to decypher the forms and characters impressed thereon. Not that I could expect to exhibit a system of natural history, or was rash enough to attempt it; but, endeavouring to follow the steps of the immortal Hunter, that I might map out the bounds and limits of the science, and attempt to demonstrate the principles upon which such a science might be constructed, and the main operative powers into which the agency of nature must distinguish itself. And if attempts of this kind may be regarded, like certain geometrical curves, as endless approximations without the possibility of attainment or coincidence; yet, be it remembered, that approximations may be made, and that every step is one of ascent, widening both the retrospect and prospect, and giving us power and insight for the further discovery of truth.

I have not indeed hidden from myself the difficulties and discouragements of my undertaking. Under the training, and with the discipline and habits of mind general in this country, and from causes in the main highly honorable to our character, an almost exclusive value has been given to pursuits and inventions of immediate and palpable utility. Our highest aim is to be men of sense: and this is as it should be, were it not that too often the

man of the senses, who resolutely confines his knowledge to the impressions on his senses, is mistaken for the man of sense;—so often, indeed, that it is not unfrequently expedient to remind a disputant, that the most certain, and hitherto the most important of all sciences, the Mathematics I mean, is grounded on the intuitions of the sense, in contradistinction from, and exclusive of, the impressions on the senses. It is well that we should be men of sense, but not, even in the highest import of the term, men of sense exclusively; and I venture to assert, that the man who acknowledges no truth and no reality in any subject, which he cannot reduce, in imagination at least, to weight, measure, or colour, lives in the eclipse of the better half of his intellectual being. He may be a tolerable mathematician, a philosopher he cannot be. With the diagrams of abstraction he may be conversant and even familiar, but not with that sublimer geometry and universal arithmetic, the real constructions of which form the history of nature. To the diagrams, such as preserved beneath this roof formed the study, and fixed and guided the inward constructions of Hunter,—which demonstrate in succession that individuality and integration to a whole are the great polar forces of organic nature, that every the minutest living creature and every integral part thereof acts by a life of its own, and yet that all are permeated and sustained by a

common life,—to these he must for ever remain a stranger, and too probably will become an enemy. The philosopher, who dissatisfied with lifeless abstract science seeks after real knowledge, and will not confine his inquiry to the impressions received through his senses and generalized under the name of facts, with now and then a theological make weight, a few religious phrases introduced as substitutes for the ideas that constitute Religion, or inevitably lead to it,—he must consent to remain unintelligible for the many, and to be represented by the many as a man who has sunk out of the light of common day, and out of the view of common sense.

And such, above all, must be the case of every man who undertakes the department of natural history, under the full and distinct conception of the words—Nature, History. For History has for its subject actions, and the results and products of powers in action: but actions imply or suppose a Will, a Purpose, and must be interpreted by desires, motives, tendencies, by a something at least analogous to purpose, will, desire, and which can only be rendered intelligible by a reference to these as known in ourselves. But Physiogony, or the History of Nature, has for its peculiar subject the activity of productive powers, or the sum and series of those actions of which the facts and phænomena of Physiography are the product—under the rule that

the product of every given power is to be received as the measure of its force and the index of its direction. If Natural History, then, be not a misnomer, an erratum in the nomenclature of science, it must be either the history of nature assumed as an agent, or the history of a plurality of productive powers considered severally as agents, but which taken collectively are called Nature, in the active sense of the term; just as the collective products and results are called Nature, passively understood. The same reasoning applies to the immediate subject of these remarks—the investigation of the significant forms of organization, contemplated as so many Types or characters impressed on animal bodies, or into which they are as it were cast. Now Types and characters, variously yet significantly combined, form a visual language. The Types of nature are a natural language, a language of nature. But a language is as little conceivable without reference to an intelligence, if not immediately yet ultimately, than a series of determinate actions can be imagined without reference to a Will; and a consistent and connected language no less supposes intelligence for its existence than it requires an intelligence for its actual intelligibility. And though the language should not, like conventional language, stand in opposition to the things intended, but be one with them, this would prove nothing more than that it was

not a language only. And this, I scarcely need say, forms but one among very many objects which we recognize in nature, and the number of which acknowledges no other bound but the sphere which comprehends life, enjoyment, protection, and perpetuation.

I have judged it right thus once again to offer to your notice the grounds that led me to adopt the scheme upon which the several courses of Lectures have been conducted; and I will now complete this introduction to the present course by a brief recapitulation of the facts that have formed the physiographical part of the Lectures, and may serve to justify the arrangement of organic beings as a series of evolutions from the lowest to the highest. Not, allow me to remind you, in supposing that there is any power in the lower to become, or to assume the rank and privileges of, the higher, upon any such fanciful scheme as that proposed for the invertebrated animals by that laborious and otherwise meritorious naturalist, Lamarck,—a scheme in which the ground and cause is everywhere meaner and feebler than the effect, and in which blindness is made the source of sight, and ignorance would be the parent of mind and thought;—but in assuming that the ascent is the indication of a law, and the manifestation of a higher power acting in and by nature.

Proceeding upon these principles, I adopted, as the most convenient, the divisions of Cu-

vier's *Règne animal*, and I presented to you a scheme of the ascent of animal life, as indicative of the law regulating the series of developments of organic beings,—of a law, which may be discovered in all the manifold varieties, diversities, and richness of the productions of nature; in all preserving a unity in diversity, a plan and method in the seeming irregularities and even sports of this productive fertility. The resulting forms of animal life present not a plan which we can consider as the effect of any arbitrary combination, or of a regularity imposed upon nature by the human fancy or understanding;—it is neither a scale, nor a ladder, nor a network; it is neither like the combination of a kaleidoscope, nor the pattern of a patchwork; it is no process by increase or superaddition:—but it is, as in all nature's acts, a growth, and the symmetry, proportion, and plan, arise out of an internal organizing principle. This gradation and evolution of animated nature is not simple and uniform; nature is ever rich, fertile, and varied in act and product:—and we might perhaps venture to symbolize the system of the animal creation as some monarch of the forest, whose roots, firmly planted in a vivifying soil, spread beyond our ken; whose trunk, proudly erected, points its summit to a region of purer light, and whose wide-spreading branches, twigs, sprays, and leaflets, infinitely diversified, manifest the energy of the life within. In the great

march of nature nothing is left behind, and every former step contains the promise and prophecy of that which is to follow, even as the oak exists potentially in the acorn; and if nature seems at any part to recede, it is only as it were to gather strength for a higher and more determined ascent.

Without at all presuming to have traced adequately in all its parts and proportions this evolution of the forms of animal life, I now proceed to give a brief outline of the main facts of the preceding Lectures in the genetic order, which, at the outset, I proposed.

In the first great division of the animal kingdom, or the invertebrated series, the great variety, both of external form and internal structure, presents us rather with the tentative experiments and preparations for the formation and construction of living beings, than with such fixed types as are manifested in the vertebrated classes of animals.

Of the ZOOPHYTES, we found in the *Infusoria* or *animalcula* of infusions, as the lowest, only a body of a uniform gelatinous consistence, at first without special organization; and then as the first attempt, the hollowing out of a cavity, which, in its functions, combined the office of stomach, heart, and sexual organ.*

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* It is right to apprize the Reader that this Lecture was delivered in the year 1828; the first course having been given in the year 1824. The author is indebted to Professor Owen,

This cavity we found again more distinctly evolved in the *Polypi* of the group of radiated animals, as in the *hydra* or water polype for instance, or in the *acalephæ*, of which the *actinia* or sea anemone may serve as an example. But around the central cavity, as the first organic part, we saw the other organic structures develope themselves, namely, around this centre radiated *tentacula*, feelers, or arms, and a special organ for reproduction. And here, namely, in the first distinctive stage of

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to whom he offers his grateful acknowledgment, for the following valuable note on the curious additions, which our knowledge of the infusory *animalcula* has since that time received.

"The researches of Professor Ehrenberg, and their confirmation in most points by subsequent observers, have established the fact that the Infusories possess an organization of a strictly animal grade, of a moderate degree of complication even in the minutest monads, with a mutual dependence of the different systems, and a general subserviency to the well-being of the whole. An alimentary cavity or canal complicated with many digestive sacs characterizes all the lower Infusories, hence called *Polygastria:* these have also an extensive reticulated ovarium, a large spermatic gland, and two or more extremely irritable and contractile spermatic reservoirs. The *Polygastria* manifest such modifications of their outward form and inward structure, that they can be divided into twenty-two families, of which eleven are naked, and eleven are covered by a siliceous case. Most, if not all, the species possess locomotive vibratile cilia: many have a maxillary apparatus of sharp teeth. In forty-eight species, referable to twenty-one distinct genera, Ehrenberg has discovered *ocelli*, or coloured eye-specks; beneath which, in *Amblyophis* and *Englena*, nervous ganglia are discernible. The Infusories are very tenacious of life; and possess astonishing powers of propagation by spontaneous fission, gemmation, and fertile ova."

the organific process, we might expect the first appearance of a nervous system: and accordingly, we found around the central cavity a nervous ring, which henceforth in all the invertebrated animals forms the principal constituent of a nervous system. We pointed out this in the *actinia*, and in one of the lowest kinds, in which we found it distinct, the *asterias;* the nervous ring surrounds the alimentary cavity, and sends two threads to each of the five rays of its star-shaped body.

Then in the worm-like animals, the *Entozoa* and *Vermes*, we found that the organic structures become more separate in structure and distinct in function. The alimentary canal and skin, as the first representatives of the digestive and respiratory systems, a vascular system as the link between both, and a more distinct nervous system became manifest. In the lowest of the *Vermes* the alimentary canal, though still without subsidiary organs, extends itself through the lengthened body, and instead of a single aperture, we found distinct apertures for mouth, *anus*, and sexual organs. The nervous ring, with which the nervous system begins, here appears throughout around the *æsophagus* or entrance of the alimentary canal; but in addition, double or single threads extend along the sides of this canal, and we have the first approach to centrality of the nervous system in the formation of *ganglia* or central points.

Again, in the *Insecta* and *Crustacea*, forming a link with the *Vermes*, and a diverging branch of development, we were presented with the especial perfecting of the respiratory system, and of the locomotive and instrumental organs, as if nature seemed here to perfect the relations of the animal with the external world. In these, the skin becomes a hard tegument, ceases to be itself the organ of respiration, and the respiratory organs are separated and evolved as gills in the *Crustacea*, or as *stigmata* and *tracheæ* in the Insects. The firm horny tegument is divided into moveable segments, and the soft uniform feelers of the lower orders are evolved into jointed *antennæ*, *maxillæ*, feet, and the various instrumental organs. The muscles are distinct, numerous, and their arrangement complex; and the organs of the senses become distinct, and acquire a perfection which we do not find even in the immediately higher forms of animal life. But with this perfection of the external organs, the digestive and the vascular systems seem scarcely to advance. With respect to the nervous system in these, in correspondence with the articulated type or form of the organism, the nervous collar becomes repeated in each segment of the body, and with the longitudinal disposition of the last becomes further perfected. In the first joint, or head, there is a complete nervous ring, the upper part of which enlarges into a two-lobed *ganglion*, from which

proceed the nerves of the *antennæ* and eyes, and below forms a second *ganglion*, from which the principal nervous cord of the body goes forth as two nerves, which in the next articulation are again united into a *ganglion*, and from this two cords again issue, again to be united at another joint, and so repeated throughout the body.

In the next type of organization, the organs of growth and reproduction become more evolved; and in the *Mollusca*, we are presented with a perfecting of the internal organs, which is to prepare for, and to be more fully developed in the higher animals. There is a sinking back as it were, in order to draw inward, and concentrate the organific energies for a higher and more complete ascent. In the *Mollusca*, namely, and first in the *Mollusca acephala*, as the oyster and muscle, the organic structure is characterized by the more perfect evolution of the respiratory, digestive, and circulating organs, and with a correspondent development of the nervous system. We find the same nervous collar about the *æsophagus;* but the *ganglia* are enlarged, especially the inferior: there are then two nervous cords that extend along the body: and, lastly, as especially noticeable, we discovered a posterior *ganglion*, which becomes intelligible as a correspondent to the heart, situated at the posterior extremity. Again, in the *Gasteropoda*, we found the vascular system more complex, the nervous sys-

tem more perfect, and the sexual organs more evolved in the distinction of the sexes, although still in one individual. But, both in the *Acephala*, and *Gasteropoda*, the organs of sense and locomotion, as marking the relation of the animal to the external world, are imperfect or scarcely appear, and only in the latter we find a more perfect organ of touch, and that of vision indicated only in the same part.

In the *Cephalopoda* the organic structure attains a higher degree of development. This is observed, in an especial degree, in the nervous system and senses. In the former we find what reminds us even of the brain of the higher animals, and in the organs of sense we find the eyes partake of this perfection, and even an organ of hearing becomes manifest, though in a rudimental form. The organs of generation become more evolved, and the sexes are separated in different individuals. Even the rudiment of a skeleton is observed in the cartilage, which surrounds the brain, and thus first appears as a defence to the noblest organ.

Such are the steps and gradual advancement of the development of organic structure in the lower classes of animals; of those, namely, that form the great division of the *Invertebrata*. And thus, in contemplating the series, we are presented with the great preparations for individuality and integration, which we have described as the aim and tendency of nature's productivity in the construction

of organic beings:—and we trace already a structure, fitted in a higher stage, to become typical of an inward and central unity, namely, the nervous system and brain, the development and perfecting of which is the main characteristic of the vertebrated series of animals.

In this second great division of the animal kingdom, or of those possessing a skeleton, comprising fishes, reptiles, birds, and *mammalia*, the total organism becomes more completely evolved, and in man finds that most perfect evolution of the different organs, which is in accordance with the most perfect balance of all, and a resulting harmony of the whole. The nervous system here again becomes the representative in its modifications of the more and more increasing centrality and unity. The first and most significant modification is that the central masses of the nervous system, which we have seen in the lower classes uniformly on the lower or ventral surface, here uniformly and throughout take their station on the upper surface. Here too we find that the separated centres, and chain of *ganglia*, are fused (as it were) into one continuous mass and form, the spinal cord, whilst the former arrangement is only repeated or retained in the ganglionic system. But both are to be subjected to a brain, evolved from the spinal cord, and repeating in its highest form the medullary

collar, and thus producing the more or less perfected unity of the nervous system.

But this perfection is only attained by grades and successive steps of evolution, and we are still reminded, even in the higher classes, of the lower types of organization. Thus as in the first and lowest, the whole organific power was concentrated in the production of a central cavity, as the rudimental representation of *viscera*, the organs of motion were scarcely yet evolved, and of senses and nervous system scarcely a trace was as yet discovered: so in fish,—as the lowest of the vertebrated series, distinguished by having a nervous central mass extending along the dorsal or upper surface,—we find the cavity for the reception of the alimentary and sexual organs, the abdominal cavity, namely, the most important; the organs of motion imperfectly evolved, the flesh itself gelatinous, the vertebral column answering chiefly the purpose of a locomotive organ in the tail, whilst the fins but imperfectly represent the extremities of the higher animals; and the evolution of the respiratory system (which holds equal pace with the motive) presents itself only as scarcely enclosed gills. In the nervous system the higher type of formation is indeed presented, but still only indicated: the first great counterparts, the brain and spinal cord, as the centres for sensation and motion, are scarcely sepa-

rated; the spinal marrow, which in the highest is subordinated to the brain, here predominates in mass and extent, the ganglionic system is present, but its branches minute and without distinct *ganglia*, and the brain itself is scarcely more than a series of *ganglia*, and a prolongation of the spinal cord. The more perfect evolution of the organs of sense here but begins: the organ of hearing is still imperfect, the organ of smelling stands in no communication with the respiratory apparatus, and the only faint resemblance to an organ of touch is in the feelers about the mouth of some kinds.

Again, as we next found in the lower classes, especially in the *mollusca*, the perfecting of the respiratory apparatus and its dependent organs, so in the next higher class of the *vertebrata*, Reptiles, we found the imperfect gills converted into a true lung: external organs of locomotion become developed, and the bony *compages* becomes a more complex and pliant frame-work, adapted to the varying form and moving of frog, of tortoise, serpent, or lizard. The senses are variously perfected: the eye approaches in structure to that of birds; the organ of hearing acquires an external orifice; the olfactory organ becomes the external opening of the air passages; and the nervous system, especially in the more connected and united structure of the brain, manifests its more perfect arrangement and structure.

In the next higher class, that of Birds, we

found the same process repeated which we have noted in the insects, the evolution of the respiratory and locomotive apparatus. The most important characteristic of birds is that which is derived from the important relation between their economy and the atmospheric air, observed in their respiration, circulation, muscular energy, hearing, and voice. Their respiratory apparatus is extensive; the lungs consist of minute cells, and communicate with cavities and air cells, which extend through the chest and abdomen, and are connected with the cells of the hollow bones;—in short, the body is permeated by the atmospheric air. Their blood is warmer, and circulates more quickly than in any other animal. In the organs of locomotion we found the muscles endowed with heightened irritability and energy; the skeleton, light to facilitate motion, and the anterior extremities especially developed and adapted to flight. We found the vocal apparatus perfected, and the animal gifted with voice and song. The senses also are farther developed, especially the ear and eye. And the nervous system no less marks their higher rank; the mass of brain exceeds that of the spinal cord, and is distinguished by its breadth and rounded form, and by the more intimate connexion of the cerebral divisions.

In the fourth and last division of the higher classes, that of the *Mammalia*, so named from their having *mammæ*, and suckling their young,

we find still farther grounds in the manifold and more perfected organization for adopting a graduated scale and series of evolutions. In their structure they closely resemble man; and the differences between the organization of these animals and that of man, consist generally in the want of harmonious combination of the component parts of the former to a whole, rather than in the presence or absence of particular organs. In all, there are the same organs as in man, but the relative development of these varies considerably in the different kinds, and with the perfection of one organ or system of organs, there is a proportionate defect of other organic constituents. The organs for the circulation and aëration of the blood have a less predominant influence on the economy of the *mammalia* than in birds; but they are warm-blooded, have a heart with four cavities, and consequently a double circulation; and they breathe by means of complex lungs, with minute and multitudinous air cells. In the organs of locomotion, we notice an adaptation to a far greater variety of free motion than in birds. The symmetry of the skeleton is more perfect than in any other class of animals; and the collocation and mechanism of its parts, together with the subservient muscular apparatus, enable these animals, according to their needs, habits, and modes of life, to run, spring, climb, burrow, swim, or even fly. But the perfecting of these

organs is especially evidenced in the formation of a Hand; and in its evolution we trace a series from the *Rodentia*, most of which have a clavicle, and indications at least of a power of pronation and supination of the fore-arm, through the squirrels to the *Quadrumana*, in whom it bears the closest resemblance to the human organ, as the most complete instrument for varied handling and delicate touch. All have five senses, though it will be unnecessary to enter into details, which tend to show that the organs are more perfected than in the preceding classes; and we may safely affirm that, in the whole organic development of the *Mammalia*, as the highest class, there is a manifest tendency to the most varied organization, with increasing centrality and unity of the parts. This is, however, most clearly evinced in the type of the nervous system: the brain predominates in size, becomes more distinct in its parts, and more united as a whole; and whilst some of its components are more developed, others are superadded; the spinal chord is more subordinated, and in the ganglionic system we have even a central focus in the semilunar ganglion and solar plexus. Thus, in comparing the brain of the *mammalia* with its immature form in the inferior classes of the *Vertebrata*, we find that the *ganglia*, which, in the fish, are rudiments only of the hemispheres, have been expanded into the now greatly preponderating masses of the cere-

brum, and their shape completed by the winding convolutions of the surface; we observe that the large ganglia, which correspond to the quadrigeminous bodies, have become relatively diminished in size, and hidden by the development of the cerebral hemispheres,—that the cerebellum, with its various appendages and offsets, has acquired magnitude and characteristic form,—and that the connecting structures or commissures, especially the *fornix* and *corpus callosum*, hitherto wanting, have been superadded,—in short, that by expansion and addition, by concentration and change of proportion, the brain in the mammalia has attained its completed form.* And if we have seen the organs of reproduction especially evolved in the fish and reptiles; and if, in birds, the musculo-arterial system be predominant, with a correspondent high degree of irritability, and with accordant endowments of free motion and of organic capabilities upon which it is dependent; it is the nervous system with a proportionate perfecting of the sensibility, which is the characteristic of the *mammalia*.

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* If the facts in question were evidence less decisive of a process of development, the deficiency would be abundantly supplied by the curious researches of Tiedemann, on the formation of the fœtal brain (*Bildungsgeschichte des Gehirns*). In tracing the evolution of the brain, he has satisfactorily shown the correspondence of the temporary stages of its construction in the *fœtus* to the permanent forms of the organ characterizing the inferior classes.

Here then we arrive at the last consummation in Nature, or rather the point in which the cycle is completed, when that which exists in itself begins to exist likewise for itself. We have seen this instanced in the principle of life as a productive power; and, though we are neither permitted by our reason, nor enabled by our imagination, to conceive the productive power at any moment in entire detachment and perfect abstraction from its product, yet, by reducing the product to its imaginable *minimum*, (and supposing the power to exert itself only in the narrowest cycle of reproduction) we obtain the conception of a seed or germ existing in itself. In the ascending stages—first of growth, as in the vegetable realm, and then of growth combined with instinctive free motion, as in the insect tribes, in more abstract terms, in the powers of reproduction and of irritability, we see this germ existing for others. Lastly, in the form of sensibility, we have the power reflected on its own centre, and the living thing exists for itself. Now there is nothing which can prevent us from repeating the same process in a higher form, and in which—that which was the *apex* of the former series having become the base, that which was the goal having become the starting post, and here commencing with life self-reflected, as already existing for itself,—we are to trace it in its progress to a knowledge of its own existence. In other words, in the functions of

sensibility, it exists for itself as life; but the self-existence still remains an alien and inexplicable thing, unless it shall exist for itself likewise reflectively, not as life merely, but as mind. The self-reflection must itself be reflected.

But before this cycle is completed, and in the pause and silence, as it were, of expectancy, the physiologist has finished his course, he has reached his boundary line, and must either turn back to repeat and perfect his former investigations, or if he stop at the boundary, it is as a spectator and admirer with a human, and not merely with a professional, interest. Nevertheless this does not prevent the commencement of the latter process, of the evidently progressive march in a direction determined by this ulterior end, from being included in the scheme of his proper science. Nay, he will have omitted the noblest and most interesting subject of physiology, if he pass it unnoticed, for there is no possibility of accounting for a series of *phænomena*, but by the discovery of some common end. The efficient causes, separately and exclusively taken, would no more explain them, than an acquaintance with the properties of the wood, stone, and cement, with motions of the saw, the hammer, and the trowel, would explain an edifice, or enable us to determine why it was a simple dwelling house, or a palace, or a church. The conclusion I draw from these remarks is

this:—that as all the *phænomena* of organized Nature, from the zoophyte to the creatures that connect, as by intermediate links, the fish with the *mammalia*, are to be regarded as the gradual evolution of life into sensibility,—which process is completed when the power of sensibility shall have become central and predominant, and have manifested itself in a peculiar structure forming a connected system in itself—in other words, as soon as there exist a brain and spinal cord with abducent and adducent nerves distributed throughout the organism, so as to be manifestly the superior and governing power of the system;—so, and on the same grounds of reason, we must regard the *mammalia* as a process in which, through a variety of forms, Nature is experimenting the different proportions and possible harmonies of the three powers in relative correspondence to circumstances of soil, climate, and habitation, then in reference to the various pursuits, in which one class supplies an object of desire to another, next in correspondence to the free established appetites of the different classes; but likewise, and lastly, as an increased perfection in itself, as measured by its more or less perfect adequateness to the first great principle, from which we have deduced organic Nature, and to which we must now bring it back,—the principle, I mean, of totality and absoluteness which Nature aims at in the whole, and of which, therefore,

we must seek the measures in a right comprehension of the points that constitute the perfection of a whole, and its comparative excellence.

Now we know that every whole, whether of a plant, an animal, or a planetary system, indicates a greater power as its producing cause, in proportion as the parts are more numerous, yet at the same time more various, each having a several end, while yet the interdependence of each on the other, the subordination of the lower to the higher, and the intimate union of all in the constitution of one, shall be perfected in an equal proportion. But as it has been shown before, that every whole that is really such,—and not the creature of accident, as a pebble for instance, or where the wholeness subsists merely in the percipient, as in a heap of corn or the types of a printed sentence,—that every actual whole is but the result or (to borrow an illustration from the convex mirror) the projected image of some antecedent principle, the unity of which is exclusive of parts,—there is yet another mark of advancing perfection, namely when this partless and therefore necessarily invisible unity is itself represented by some visible and central product, to which all the various parts converge, and which therefore represents in respect of power that which the total shape or exterior exhibits in respect of sight and sense. These, I say, give the canons by which the

comparative interior perfection of every whole or *integer* is to be measured. But every finite integer has likewise external relations, and here the canons of measurement are obvious, namely, the comparative emancipation and independence of the *integer*, from the alien external powers, and its comparative superiority over them, and power of commanding them;—these two being connected by an intermediate faculty, or facility, namely, that of adapting itself to its external relations in the greatest variety, and under the greatest change of these relations. The first is a negative superiority of the animal over nature, and of itself can never rise beyond diminished dependency. Thus the amphibious animals are comparatively less dependent than the fish, which can exist only in one elementary habitation. Actual independence of Nature would exclude the animal from the system altogether: it could neither exist as a point in a circumference, nor yet as a centre in itself, to which all other nature formed an endless series of concentric circles. Yet as long as it is a dependence for its own purposes, and not for purposes external to itself, and while it is connected with choice, or an *analogon* of choice, selecting what it can assimilate and repelling whatever would interfere with its processes, this dependence in the physical sense of the word becomes independence in the moral use. And when in addition to this a power

exists of using external Nature as an alien, of using what it neither assimilates nor admits, this is more than independence, it is sovereignty.

In applying these rules to the higher animals, to all namely in which the three powers or functions of life, reproduction, irritability and sensibility, not only co-exist but co-exist in a subordination of the former two to the third, we shall soon be reminded of a truth to which I directed your attention in a previous Lecture, the existence, namely, of a variety of classes evidently not essential to the system of nature in the Idea, but to be explained as parts of a process hereafter to disappear, and consequently arising from the absence of some other result hereafter to come, or if come, yet from its imperfection and immaturity incapable of exerting its appropriate influences. And here it is that we are met by the principle of variety, or the tendency to multiplication of forms, to which comparative anatomists of the greatest celebrity so often appeal in the lower orders, the zoophytes, *mollusca*, and insects, but without explaining the fact by any higher principle;—this same principle, but in a more intelligible form, again presents itself in this last stage of our investigation; and I venture to assert that it admits of no other explanation than in one or other of the two following modes, or perhaps in both conjointly. The first we have already described under the

bold but justifiable language of a natural experimenting, as if nature were learning what harmonies of functions could exist under different ratios of sub- and co-ordination, what the resulting character of the whole would be, and what the resulting type or physiognomic expression of this character. Nor are the products of this experiment without their justifying use: the same absence of the creature, which implies this experimental process in order to the completed type of the same, requires these temporary orders of animals, as proxies and vicegerents in the performance of those lower ends, by which a bound or limit is placed to the multiplication of yet inferior life,—and by which, it may be added, the health of the creation is preserved, which would be endangered by the excessive multiplication of any one kind, not only in reference to the other classes of animals, but to the kind itself so multiplied. The other is that variety of type, instead of being measured, as in all the orders of animals hitherto, by evi dences of ascension in the scale of life, admits the application of a canon of progressive perfection only to a small number of the *mammalia;* while the rest must be contemplated as a degradation, or, to use the language of crystallography, as decrements from the human, assuming the human form as the ideal type of the whole class. In short, in all those classes or *genera* of the *mammalia* which would remain,

and which could not without derangement of the universal *organismus* be lost, even when men, and men in the full prerogatives of humanity, shall exist in all the climes of the earth, and shall every where have civilized and humanized nature—in these, I say, the former scale of gradual ascent will still be demonstrable; but the rest can be considered only as mutilated and imperfect copies by anticipation of the human, to be measured, not so much by what is possessed in each, as by what is wanted, and by the necessary influence and modifying effect of the latter on the former,—even as in the human being, that which would have been perseverance and fortitude, if a proportionate power of comparative judgment had been added, by the mere absence of this gift degenerates into brute and dogged obstinacy.

There is yet another point of too great importance to be wholly omitted, but to which, in this stage of my Lecture, I can do little more than allude. I have before asserted that entire intelligibility can only be given to the system of nature by an insight into an ultimate end, to which all preceding ends must be regarded as at once means and approximations,—that this ultimate end of organic nature is presented in the achievement of that sensibility, and the subordination of the two inferior powers thereunto, by which the animal exists from itself, in itself, and, though imper-

fectly, for itself—and that in order to the full presentation of this ultimate end, nature must not only feel, but must know her own being. Now, this position is the same as to assert that a mind must be added to life, and consequently, that a transition from life to mind, at all events to a state in which it shall be receptive of mind, must be assumed—a transitional state, a life still retaining its essential and distinctive characters as life, but participant of mind. And in a process of such deep importance, the last step to the consummation of all that we still might dare call nature, it may be confidently expected that even the beginnings, the nascent or initial quantities, will be marked or revealed in some appropriate fact or phænomenon. Now I affirm that this indifferency, or intermediate state of life and mind, is given in the Passions. For I know no other definition of a Passion as distinguished from a mere appetite (though I have looked into the numerous disquisitions and essays on the passions, from Descartes downwards) but this :—That a passion is an affection of life having its immediate occasion, not in things, but in the thoughts or judgments respecting the things. This definition, which I offer with considerable confidence, is however, I scarcely need say, a definition of the passions in their completed form ; though even of these the *mammalia* will not be found deficient in striking examples, such as the vanity of the peacock, the jealousy

so amusingly displayed in dogs, the rage, which animals of the feline kind connect with both the appetites,—and our friends the phrenologists would assist us to multiply instances. But these are the branches of the tree; we must go lower to the trunk, and learn to contemplate passion as the common ground of all the passions; and this ground, or passion in its unity, may perhaps be defined as a Predisposition influencing the volitions, pursuits, and acts of an animal, derived from its total life and from the obscure half-conscious sense of the same in its own character. For the life of every animal doubtless has an individual character of its own, though it may not be possible to designate it by words, or rather though the animal itself is the true word, the only appropriate and untranslateable exponent. In this, I repeat, I find one great character, and I might add end, of the *mammalia;* and here, too, the peculiar connection of the *mammalia* with man is still preserved. We find here the base of those mighty agencies by which man, in the minority of his humanity, is impelled and governed, and which; even in his highest state hitherto realized, have not yet come to be superfluous: the Reason, which has conquered them, has taken them into the household as useful and even needful servants, though out of that household, like the wild dogs and cattle of the uncivilized earth, they are among the most dangerous of wild beasts.

I have merely announced the subject, though a fuller inquisition into the passions, as themes not separable from any enlarged views of physiology or even of medical pathology, must find a fitter place and opportunity; and I will now conclude, by giving an explanation on two points, on which I am very likely to be encountered or put to the question.

The first has reference to my frequent assertions of the different degrees of perfection in animals; and I may be told, perhaps, that in nature all things are alike perfect. Let them be so:—the sense in which I have used the word neither assumes nor contradicts it. Each individual creature, considered singly, and in relation to its powers and its circumstances, may be perfect (though I confess that the argument by which the perfection is proved, borders somewhat on the *argumentum in circulo*);—but, assuredly, in relation to some one or more ends of the whole system of animal life, the perfection must needs be as the development, and no physiologist hesitates to use this language when speaking of the human embryo: and the philosophic view, which I have had the honour of presenting, regards the whole chain of ascending life as so many embryonic forms of the animal man.

In close connection with this is the objection to the use of the word Nature, and the somewhat irreverent boldness, it seems, with which I have spoken of her blind tendencies

and imperfect strivings after form;—in short, it is by no means uncommon to meet with persons, who consider Nature, but as a safe way of introducing the idea of the Supreme Being on the most trivial occasions without taking His name in vain. Now this sense of the word Nature is not my sense of it. I have, in the very commencement of these Lectures, distinctly declared, that by Nature, I meant no more than the active powers impressed on matter by the Creator, brought into a form of unity for the purposes of science, and impersonated for the convenience of language. Any other use of the word I reject as false, and denounce as no less injurious in science, than as erroneous and unsafe in religion. That he, who gives a history of nature, must suppose a nature existing, and that as an agent, is to my mind perfectly evident. And as to the question between me and those, who contend that nature is rightly defined "The Power and Wisdom of God in the creation," and who consider it as perfectly synonymous with the divine omnipresence, I will propose a very short and easy, but very decisive test. Let these adorers of Nature, without risk of idolatry, take any volume of physiology or pathology, and every time the word nature occurs, erase it, and put in its place the name of the Creator; and, if before they have proceeded a dozen pages, their own moral feelings and mere habits of decorum do not render them

sceptical respecting both the truth and propriety of their assumption, I will cheerfully promise to revise my own, with all due disposition to the exchanging it for a more correct one.

To add a few serious words :—That system, that view, which makes us feel most, and most clearly understand, the dependence of all law, order, permanence, beauty in nature on a power higher than nature, is the most favourable to religion, and the feelings that arise out of religious truths. And I trust that this effect will rather be aided, than interrupted, by contending that powers are manifested on their opposites, light on darkness, order on confusion, beauty on indistinction—the Spirit of God on the faces of the dark waters, and the controlling, informing Word of God on a blindly striving, but divinely coerced and directed, Nature.

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