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Proofs and illustrations of
the attributes of God



PROOFS AND ILLUSTRATIONS
OF THE
ATTRIBUTES OF GOD,
FROM THE FACTS AND LAWS OF
THE PHYSICAL UNIVERSE:
BEING THE FOUNDATION OF
NATURAL AND REVEALED RELIGION.

BY JOHN MACCULLOCH, M.D.,

F.R.S., F.L.S., F.G.S., &c. &c.

“The invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead.”—ROMANS, i. 20.

IN THREE VOLUMES.

VOL. I.

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TO
THE MOST REVEREND
WILLIAM,
LORD ARCHBISHOP OF CANTERBURY,
&c. &c. &c.

MY LORD,

Though I had long intended to attempt a work of this nature, I know not that I should have had resolution to produce it, but for the encouragement and approbation I received from Your Grace. To you, therefore, I beg to inscribe it, in testimony of my gratitude for your friendship, and my respect for your high character and station in the Church of England.

I have the honour to be,

Your Grace's obliged

and very faithful servant,

JOHN MACCULLOCH.

Addiscombe House, 1830.

MEMORANDUM.

THE accomplished Author of these volumes was long known to the public, by the singular variety of his acquirements, his profound researches in Natural Science, and that purity and piety of mind, which directed all his philosophical views to illustrate the hand of Heaven.

It is due to his memory to say, that the present performance, which may be regarded as the general result of his principles, is wholly unindebted to the series of works which have lately appeared on subjects of a similar kind. It was completed in the Spring of 1830, and was intended for publication in the following year; when its appearance was delayed by the announcement of the Bridgewater Treatises.

It is now published in obedience to the last desire of its lamented Author, and with no other alter-

MEMORANDUM.

ations, than the introduction of a few remarks made by him, for that purpose, in the closing year of his life.

If occasional errors in the printing should be found, the reader is requested to remember, that the work has not had the important advantage of the writer's revision in its passing through the press. Yet no care has been omitted on this head, to do justice to the last labour of his intelligence and virtue, by those to whom his recollection is invaluable.

P R E F A C E.

IF I had not known that Creation was still an unexhausted field, that it contained a wide range of matter untouched by every writer on Natural Theology, I should have been the last to attempt a new work on this subject. It is not for me to ask why former writers have taken so narrow a view of such ample materials. Nearly all the knowledge of which I have here made use, was accessible in their days: and the great book of Nature ever lies open to him who will look on it, and, observing, reason. Zoology and Botany have indeed improved their arrangements and increased their objects; but what is concluded from the whole, might equally have been deduced from a much less number. The objects of Astronomy are also multiplied since the time of Newton, and the theory of the celestial mechanism is perfected: yet almost every inference respecting the Deity which it affords, might have been made in his day. As regards light, no fact, of any bearing on this subject, has been added since the labours of that philosopher: while, under the other great powers of Nature, and the abstruse properties of matter, every deduction here made might have been drawn through

knowledge far less accurate than we now possess. If Chemistry may indeed be termed a new science, still the inferences to which it has here led might have been made long ago. It is Geology alone that has furnished what those writers could not have known. The more recent ones have not even the shadow of an excuse: while it is in this neglect, or narrowness of views, or want of knowledge, that the apology for a new work on Natural Theology must be sought.

As an apology for its length, it appears to me, not simply needful that the evidences should be satisfactory, but that they should be so varied and multiplied as to meet the great variety of information, talents, feelings, and affections, that must exist among readers. He who is ignorant of anatomy, will find what he knows elsewhere; he who delights in the facts of zoology or botany, may feel no interest in chemistry or astronomy; as those sciences may exclusively attract others: while, if the simpler facts of Nature may fix the attention of the youthful, he who would turn from these with coldness or contempt, may be interested in those more abstruse views and reasonings which the former might not comprehend. It is important that such a work be popular, or attractive: and to this end, variety is essential. The great question is one which interests all mankind; and though logicians argue truly, that conviction cannot be increased by superfluity of proofs, this is the objection which judges of human reason at large, by selected examples of it. The value of appeals to pure reason is extremely narrowed in the mass of mankind: while

they have also but little effect on the feelings or the conduct. To excite interest, to engage the affections, and even to influence the imagination, is the wider and surer road towards the effects which are desirable: to that piety which, viewing the Creator in the Creation, may become the basis of a warm, a firm, and a reasonable religion. Under multiplication of evidence also, a wider range is afforded for that contemplation. He becomes present in every thing, in every place; while that impression is rendered as habitual as it is universal, and we learn to feel that He is truly the ever-present, ever-bountiful, and ever-watchful Protector, as He is the Parent of the Universe; the Governor, as He is the Creator.

Observing also, that former works on this subject are often read as if they were mere essays in natural history, I have here intermixed those metaphysical views and moral reasonings, which, while they are essential to the questions treated under this high reference, may also teach those who might have read from mere curiosity, to reason on the similar facts of Creation before them, and thus to form, in the mind, that union between natural and moral science, without which the former contributes but little to its improvement.

Thus ranging through the whole extent of Creation, I have been necessarily obliged to choose and to reject from this immensity of materials. And though the task was far from easy, it seemed obvious to select what was most likely to be understood, and what was most easily rendered interesting: since the great mass must

be attracted by the facilities and the seductions of knowledge. And if I have rejected what seemed too abstruse, or of little general interest, so have I avoided, in natural history, whatever was distasteful and whatever was unfit: regretting, at the same time, that former writers had so little recollected what was due to themselves and their readers, but, above all, to their subject: sometimes adding even coarse language to coarse objects, when there was a choice before them.

The scientific reader will ask reasons for an arrangement which so often contravenes the order of science. That order could not have been followed, where the object was to prove and to illustrate the Deity in His attributes. The same department, or the same general facts, were sometimes required to prove different attributes: and thus did even certain re-statements of those become necessary: producing, however, the appearance of repetition rather than the reality. And no science could have had its separate place: the purpose was a moral one; and such was the division, since to that must every fact have tended. The power of the Deity is displayed in an insect; and it is displayed in the celestial system: it was necessary to approximate the most remote branches of knowledge. And in a single science, the generalizations were to be drawn under moral, not scientific views: while to abandon scientific generalization is to abandon science. But the reader of this class can replace every thing: while he who may gain nothing but disjointed information, will perhaps be tempted to seek elsewhere, that which there

was no room to teach him here. Thus have I also been compelled to refer to well-known books, respecting well-known things: while if more full on some subjects, it was because the facts or views were new, and there was no such reference. And if there are striking omissions of facts of high scientific interest, as in the case of magnetism and much more, it was because they could not be brought to bear on the moral purposes, as evidences or illustrations. We cannot, for example, in this last case, prove wisdom, because we as little can comprehend the contrivance as the mode in which it acts; not even knowing all that it does effect.

It should be obvious why popular statements, like popular facts, have been preferred to scientific ones; and familiar, to technical language; while that is also more rich in the means of explaining science, than they who indulge in the peculiar phraseology of the latter imagine; and who forget too, that it is the test of their knowledge to be thus able to translate that language. But if there is any one who does not know that it is easier to write to philosophical than to general readers, to write technically than to translate and restate to every comprehension, he has not made the latter attempt; and perhaps has not even discovered, that the former is often but a rote, requiring little thought: as, in the latter case, he must make every thing his own, and under the most minute criticism, before he can reproduce it in a new form.

Science may yet require another apology for the road which I have sometimes taken respecting it. Its pur-

suit is that of secondary causes; and, those being attained, it rests: too often also forgetting that there is still an ulterior one, and thus falling into that negligence or oblivion respecting the First Cause, which easily becomes a latent or negative atheism; if not worse.

Is it further true, or not, that an attempt like the present is more especially called for at the present day? It is so believed by men not safely to be accused of ignorance or fanaticism. This is a suddenly risen age, in which all are to be instructed in facts: while if the instructors so teach, the instructed are scarcely to blame in believing that such knowledge is philosophy, that it is not merely the discipline of the mind, but that thus are minds formed and abilities conferred. But if this be so, were the result even better than a knowledge of philosophy must infer, or than the facts prove, is not the effect to separate God from His works, when He is not associated with them? Is it not to generate that very vanity, the vanity of new and of confined knowledge, which has ever been accused, and with justice, of leading to infidelity, and to infidelity of the worst nature, since it is that which, springing from conceit, will not listen. Others shall judge: but if it was the boast of an ancient sage, that he had brought philosophy down from heaven to dwell among men, the separation is a hazardous one; while if it has already been perniciously complete, let it be our endeavour to re-unite what ought never to have been dissevered, and in looking back to the regions whence they have descended, to render science

and philosophy the handmaids to religion. And it is in attempting to effect this, that I have ranged through a space so much wider than my predecessors. With science, however, I have traced secondary causes wherever occasion offered; not merely because this is science, but because we thus perceive the wisdom under which The Deity produces numerous or great ends, through simple means, or "laws." But I have not rested where it stops. Natural Theology steps the interval from the last apparent cause to the First: still, however, professing its anxiety to prolong the chain towards Him; as assured, that the more it is investigated, the more will His wisdom appear.

It must not therefore be said, that this checks investigation. It but marks the boundary of our present knowledge; being, even in this, useful, since it is the assumption of knowledge, not possessed, which is the great obstacle to its acquisition. Of this Cause, too, we are sure: while if we can trace no other, it is perfectly consistent with philosophy to point it out, abstractedly from its moral purposes. The reference is not that of mere piety, nor the utility directed to religion alone. The will of the Deity, depending on His character, offers the solution of many difficulties, for which science has never yet proposed one, and probably never will. Thus does the moral First Cause become also the cause, in a scientific view: and hence does Science deprive itself of its right hand, when, under the influence of a false philosophy, it refuses to turn to the Creator and to inquire of His purposes.

It is true, that the great step thus taken may be but the step of ignorance: but the future discovery of a secondary cause can never nullify the great conclusion. The chain may be traced more accurately, but it will never fail to end in God.

But should the assignment of secondary causes by science be false, or imaginary, and if it is also the purpose of this proceeding to exclude or remove the Deity, the evil is double, affecting science as well as religion; while we cannot excuse philosophy from improper motives in the latter case. Hence, where opportunity offered, have I designedly exposed its false pretensions and its ignorance, under whichever of its hypotheses, and without respect to name or authority. This was a duty to science itself: since, to convict it of ignorance, may induce it to seek and learn. It was a far deeper moral duty: for thus it is that the Deity is neglected or forgotten. Everything seems easy, under the facility of phraseology in which hypothesis deals. There is no display of power, none of wisdom; nothing: we need not admire what is so easy of comprehension; and do not perceive, till we are told so, that we comprehend nothing, that we have been deceived by those whose vanity or ignorance does not always perhaps discover that they have deceived themselves.

After these needful explanations, I must advert to the special purposes for which these evidences are detailed. It would be much to mistake the nature of

this work, to suppose that the only object was to prove the Existence of a Deity, or to display the evidences of an Intelligent Designer of the Universe. That which can be proved by one fact as well as a thousand, does not demand volumes. Hence are the proofs most safely restricted on this point: especially as former writers have here taken so wide a scope. Reversely, they ought to be expanded as they relate to His attributes: since this is to prove God as He ought to be believed and known, as this also is the basis of natural religion: for it is not religion, simply to believe in God. To display also the Divine Intelligence as it reigns throughout creation, so that the universal presence of universal wisdom may be ever felt, is far different from the attempts to prove the existence of that intelligence. This is of His attributes; those constitute His character, and explain his conduct: and thus it is we know Him, if we do not or will not know Him through revelation. Hence does the great mass of the following evidences consist in joint proof and display of His attributes and His conduct: while if they are not to all the only evidences of those, they serve to confirm what may have been deduced, *à priori*, through metaphysical reasoning or through the testimonies of revelation.

The first question, therefore, under such a plan, relates to the nature, or character, of the Deity: and as that must consist in qualities, to us who can only judge through comparison with ourselves, the fundamcutal inquiry here is, which of those inferred

qualities, or attributes, can be proved and illustrated through the physical universe.

The scholastic theologians have here, as usual, refined on words, and multiplied distinctions without differences. The Attributes have been divided into natural, intellectual, and moral; and again, into communicable and incommunicable: nor has the most popular writer on the present subject, corrected the whole of this idle and useless phraseology. Eternity and Self-existence are equivalent terms: Unity and Personality have the same meaning; Spirituality is superfluous, since it is He Himself: and the whole are one, as the proof of Him is the proof of all. The awkward term Immensity is better expressed by Omnipresence: and to name Life, as a communicable attribute, is a puerility worthy only of the unoccupied minds whence such distinctions proceeded. But I need not pursue these idle refinements: suffice it to point out those parts of the character of the Deity which can receive proof or illustration from that universe to which this inquiry is limited.

The illustrations of Intelligence through a Design, for Ends, form the proof of a Divine Cause, and a Sole Deity; God. And though the mere proof is confined within a small space, those illustrations form the first division of this work. With this, His Knowledge is intimately connected: but as the proofs of this occur everywhere, that division, separated from His Wisdom, in conformity to the usage of metaphysicians, contains only a few simple illustrations of its extent. And as

the quality of Omnipresence is peculiarly connected with that of Universal Knowledge, I have not made a separate division for it; especially as it stands in the same predicament with respect to illustration. Under the head of Wisdom, the illustrative facts might often have found another place: the mere attempt marking the futility of endeavouring thus to separate the Attributes of The One. If unbounded Power required no proof, the object, here, has been to make that power felt: as this division has naturally also received all those facts which science is as yet unable to explain. It is Power exciting our admiration and reverence when we can trace the manner in which it acts: it is Power exciting our wonder, when its proceedings are incomprehensible.

To recur to the scholastic division, these seem to be the "natural and the intellectual" attributes which can be illustrated through the physical Creation. The intellectual character must be perfect, *à priori*: it demands but illustration. But the moral character might be good or evil; as we view those, at least; goodness is not necessarily implied in intellectual perfection. The *à priori* reasons of metaphysics attempt indeed to infer the Goodness of the Deity, while they add to this, Justice and Mercy: further superadding the scholastic refinements of Holiness, Immutability, and Veracity. Leaving all this to those who have thus undertaken it, with whatever success, there is nothing but His Goodness which can be proved by facts; and this forms a considerable division in the present work, as it is that

which former writers have, as far as I perceive, especially neglected; though, as bearing on religion, it is the most important of the whole.

Such are the first five divisions of this work: but there remains an essential portion of the conduct of the Deity, which implies His moral character even more than His intellectual one. I allude to His personal Government of the universe. Whether most of the writers on this subject have disregarded and excluded it, because it was not found in the scholastic catalogue of attributes, or because they did not know where to seek for proofs in physical facts, it is not for me to inquire. Christian writers could not have been influenced by a Peripatetic philosophy, at least in modern times; though the habitual influence of Greece and logic united, might have caused the Schoolmen to neglect what Greece did not believe, and what did not conform to the category of an attribute. But viewing this as the most essential subject of the whole, since I scarcely know how there can be religion which does not acknowledge the perpetual personal government of God, the attempts to prove it, in a similar manner, form the last division of this work.

If the wide, yet necessarily superficial views, here taken of Creation, may invite to further contemplations of that boundless variety and interest by which we are surrounded, and thus become a source of rational pleasure, while also cultivating the intellectual and the moral faculties, it must never be forgotten, that the

chief object is Religion. To know God, is to have laid the foundation of a firm and intelligent piety: to see Him everywhere, to feel that we are for ever in His presence and under His government, is to ensure the equal foundation of right moral conduct. This is religion; theoretical and practical; but it is Natural religion only. Creation teaches nothing more; but if it can succeed in teaching this, it has taught much.

- And that writer greatly errs, who attempts to pass his defined limits; since this is to confuse his cause, by the mixture of discordant modes of evidence. Though the Christian Revelation is fully proved, that must not tempt me to transgress my rigid boundary: the evidences of this belong to far other writings; and the proofs from testimony must not be mixed with the proofs from facts, since bad logic never aided any cause. Yet I may fairly and safely infer the probability, both of this, and of prior revelations; since this is the argument which is admitted by the strictest logic. And I may thus also refer to the writers of either revelation, as philosophers and moralists of the highest rank and authority; though I am precluded from quoting them as authorities in evidence, from which there is no appeal. Yet it will be for him, who, knowing all other philosophy and all other philosophers, shall compare them with these men, and their views or declarations, to judge: as the decision might very safely be left to him who is without prejudices.

If therefore to feel that they must not be freely quoted is occasionally painful, there is more advantage

in the avoidance. Such quotation is so common a resource of poverty of ideas, that it gives an air of weakness, instead of strength, to the writings with which it is intermixed: while the habitual and often-heard expressions of Scripture, especially fail of effect; partly from use, and partly because they have been heard from the beginning, without feeling, and without attaching any ideas to them. It is sufficient to translate any well-known passage into other words, to be convinced of this. But, from an abuse too common to require notice, this usage is also apt to convey the impression of insincerity: we more readily trust him who can find words of his own, and thus prove that he writes from conviction and feeling. Nor is there any cause why these subjects should not be treated in the definite and intelligible language of philosophy and reason; since all the great questions between the Deity and ourselves are questions of reason and philosophy.

But there is an evil which no caution can avoid; because every judgment will differ, according to its habitual or momentary feelings. The light use of the Great Name is an admitted evil: and though the use here is not a light one, its too frequent adoption is apt to weaken the impression, as it is also often suspected of insincerity, from the abuses to which I have just alluded. Yet it is unavoidable; since the seductions of interesting facts might otherwise often divert the reader's attention from the purposes of such a work. If it has also been said that the synonyme, Deity, might imply a Heathen Deity, I know but One Deity, and the attempt

has here been, to vary those synonymes with relation to the matters and feelings concerned. But he who can never be right in the opinions of all, must submit to be thought in the wrong by many, adopt what course he may.

In terminating this needful preface, I will not undertake the defence of Natural History, further than to relieve it from unfounded charges, based upon the trifling, or worse, of some of its cultivators. That the pursuit of it is consistent with that of every other study, may be deduced from the following work. It is not necessarily that of weak minds alone, nor need its cultivation destroy the powers of the intellect. But it must not be the sole pursuit: though no more injurious even then than any other under which all the faculties are not cultivated. No partial one is exempt from the same evil, and the same charge; though the evil may not always be so well known, nor the charge brought. Mathematics have their equal, or greater trifling; if the ignorant in mathematics are less aware of it: and if there is any sole pursuit equally capable of narrowing the mind, it would be well to show what that is. Be it true, that the greatest discoveries in "natural philosophy" have been made by men acquainted with the powers of mathematical analysis, the reasons are as obvious as it would be easy to define the limits: and also, to point out the errors and the failures. What those are, I cannot here take room to say: but a silent conscientiousness will feel, what it might not be

willing to acknowledge, and others would not understand. The same censure falls with equal justice on all purely physical pursuits. It is by another logic than the rigid and partial syllogisms of geometry, that the higher powers of the mind are to be expanded, and it is by other metaphysics than those of its speculative portions, that its views are to be enlarged. There are far other logic and metaphysics, and of far other application : and if the cultivator of natural history will ever remain what he has been supposed to be, without the cultivation of modern science, so might the mathematician well exchange much of what he thinks a boast, for the power of moral analysis. This is to cultivate the higher, yes, and the more valuable powers of the human mind : but the fashion has taken a different tendency, and the evil pervades everything. I must not, however, pursue what may be thought a misplaced criticism : yet it is neither misplaced nor uncalled for ; for even thus is it, that if these exclusive cultivators of physical science have not diverted men's minds from the great moral analysis and bearings of Creation, they have given no aid to that which forms its deepest interest.

To end. He who can imagine the universe fortuitous or self-created, is not a subject for argument, provided he has the power of thinking, or even the faculty of seeing. He who sees no design, cannot claim the character of a philosopher ; for philosophy traces means and ends. He who traces no causes, must not assume to be a metaphysician ; and if he does trace them, he must

arrive at a First Cause. And he who perceives no final causes, is equally deficient in metaphysics and in natural philosophy; since, without this, he cannot generalize, can discover no plan, where there is no purpose. But if he who can see a Creation, without seeing a Creator, has made small advances in knowledge, so he who can philosophize on it, and not feel the eternal presence of its Great Author, is little to be envied, even as a mere philosopher; since he deprives the universe of all its grandeur, and himself of the pleasures springing from those exalted views which soar beyond the details of tangible forms and common events. And if, with that Presence around him, he can be evil, he is an object of compassion, for he will be rejected by Him whom he opposes or rejects.

But what shall be said to him, who, supposing that he knows God, refuses to inquire of His works, or rejects the knowledge of them, as beneath his notice? Has he been taught, without teaching; or does he despise what God has laid open to all, revealed to all, that all might learn to see Him in His works, that all might learn to know Him? Has God indeed commanded him to adore, yet ordered him to shut his eyes? given him the powers, yet interdicted their use? Thus did He not command to David and to Job: and thus has He not commanded to us. He has displayed Himself in the Heavens and in the Earth: and His works announce the commands which no one can mistake.



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ERRATA IN VOLUME THE FIRST.

- Page 129, line 1, *after* "nature," *insert* a comma.
,, 436, ,, 9, *transpose* "of" and "for."
,, 484, ,, 16, *for* "ftoation," *read* "flotation."
,, 499, ,, 1, *for* "Bolea," *read* "Bolca."

PROOFS AND ILLUSTRATIONS
OF
THE ATTRIBUTES OF GOD;
§c. §c.

CHAPTER I.

ON THE UTILITY OF NATURAL RELIGION.

THE object of this book is to prove, from the facts of the material world, the existence of God, together with such attributes, or portions of His character, as can be deduced by reasoning from those evidences. It is true that the greater number believe, through instruction, example, and habit; and thence has it been argued that such proof is unnecessary. Yet if we examine the results, we shall find that they too often belong to opinion rather than to what is, rigidly, belief, or conviction; and hence an atheism, of which the history of mankind furnishes sufficient examples. It has also been said that proof is unnecessary, because we know God through an implanted or instinctive knowledge; that all men, in whatever condition, believe in a Supreme Being. That this is not the fact, is now well known of many barbarous people: and even when it is true, we may ask what the nature of the Deity has been, in the estimation of the larger portion of mankind. In any view, it is an argument [which has

never produced much effect: while I need not here re-examine a subject so often discussed. I shall but follow abundant example, in considering a physical proof useful, or necessary: while we have also God's authority, in His own revelations, for the necessity of far other evidences than this implanted or traditional knowledge, be it either. And these imply two modes of proof: the one from facts, or evidence to the senses; the other, to those who did not witness them, or to us, from testimony.

God, indeed, is not to be seen: but there are works, things that are seen; and they contain the evidences under the first mode of proof. We naturally ask, first, whether these things are self-existent; and finding also that there are motion and life, as well as material objects, and that matter is not self-moved, we infer a creating and a moving cause, and thence a Deity. We also perceive that these works are constructed with intelligence, and are, beyond all comparison, greater than any thing that could be performed by man. Thence we infer great power and great wisdom: while further, perceiving distinct designs, and seeing good results, we deduce goodness. Thus we prove, or see, God, circuitously, through His works; just as we infer man, from seeing a work of art conducted in the same manner and to the same ends. Or, performing certain things, and using our senses and our reasoning respecting works that are not our own, we infer Him from a comparison with ourselves: as that comparison enables us also to infer respecting His character, or qualities. And thus proving Him, in a certain manner, through the evidences which He himself has afforded in creation, we may say that He has revealed Himself to us in His works, because it was not right, or possible, or necessary, that He should have revealed Himself to our senses.

And this is The Proof from natural religion, as it is that which is to be adopted in this work.

But He has also revealed Himself in another manner, by direct or deputed language, though not to all men; having limited these revelations to particular persons and periods. To us, therefore, who have not witnessed these, the proof consists in testimony; or, believing this, we must believe in Him: though, in reality, such revelations have been generally received as coming from Him whose existence and power, at least, were previously acknowledged. Whatever is thus declared as revealed, must rest, for its truth, on the validity of the testimony: while this species of proof is of a more circuitous and intricate nature, and thence may be refused, as it has often been. But, being admitted, it is the proof of God's character and conduct, at least, from revealed religion, as it might be that of His existence; while those revelations form the basis of this religion. Thus we can believe much, the nature of which we do not comprehend, or which, to our mere reason, might seem incredible: because this species of evidence is our guarantee that God has declared such things to be true, and of necessary or compulsory reception; having also declared that they are truths beyond our comprehension, or facts, the exact nature of which transcends our conceptions, however intelligible the propositions themselves may be. And this is faith: but it is still a belief founded on proof, and therefore based on reason.

And in this occurs an important difference between natural and revealed religion. Through the former, we believe what we experience, or can infer by our reason; and though such reasonings may sometimes carry us on to conclude on what revealed religion

teaches, their power is still much limited on points of the greatest interest to us. It has, indeed, been attempted to defend the reasonableness or necessity of faith, by saying that we equally do, and must, believe much under natural religion, which we do not understand. Bad arguments are ever pernicious. There is much in the universe of our experience, the nature or causes of which we do not comprehend; such as the union of the soul and the body, so often quoted: but this does not prevent us from believing the facts, which are all that concern us; and which we believe through our senses, or experience, or through that universal experience and admission which, though but testimony, is ever held equivalent to demonstration. In the case of the difficulties and mysteries of revelation, there is nothing of this nature; nor is there any possible comparison between the two instances. The facts are asserted by a limited number of persons: and they are, that certain events occurred under God's direction, and that He said certain things; while, the testimony being believed, we believe these facts and these declarations as matters of faith—of trust in the truth of God, as delivered to us through the truth of men.

Hence the proportion of disbelief is greater under the attempt to prove God through revealed religion; or it is against this that the stand of unbelief is generally made, under a refusal of testimony. And the result of the disbelief in revealed religion may be a disbelief in God himself, or at least in His essential attributes, should no other or more convincing proof be offered. Thence we begin to perceive some advantages in natural religion, or in the attempt to prove the Deity and His attributes through the evidences of creation. The reader must, however, remember that I am not at

present inquiring respecting the sources of belief in men, nor of the existence of a faith independent of proof: it is with proofs that I am here concerned, and the utility of these arguments is therefore directed to those who demand them. But while proofs of the truth of revelation are foreign to a work of this nature, it cannot even refer to that for support, as being the evidence of testimony: since this would be to endanger its own ground, by that faulty logic which mixes discordant arguments, or reasons in circles. But we must take care not to imagine that to support natural religion is to be at variance with revelation, or to neglect it: I shall soon point out the weighty debts of natural to revealed religion; as I trust also to show that the former can furnish arguments why revelation ought to be true.

Before detailing some of the specific uses of natural religion, I must sketch its general bearings: while, even from these, its utility will commence to be apparent. To believe justly in the existence and nature of God, is, first, to know Him as the creator of the world, in wisdom and goodness; and next, as the governor and disposer, first of the physical universe, and then of the moral world, as the end and purpose of that. We thus believe in Him as eternal, and as highly powerful, wise, and good; and further, as all-knowing and universally present. Moreover, as no imperfection can be conceived under absolute power and wisdom, since these exclude external influence or control, with all passion and caprice, we infer immutability, with perfect rectitude and purity, or "holiness." Thus we must also infer justice, if this can be separated from rectitude, as it has improperly been, under views of ourselves rather than a true knowledge of Him. And

lastly, perceiving His goodness distinctly displayed in creation, we further infer His mercy, because sensible of our own imperfections or demerits.

Now this is the moral nature of God, as far as He has allowed us to comprehend it; while the limit is that of our faculties, since it is plain that we thus delineate Him through comparison with ourselves; and it is natural religion which thus derives from its own observations and reasonings, or else confirms, the same conclusions as we draw from the revelations which we believe Him to have made. But it is theoretical religion only. It remains to see whether a practical one can also be deduced from it, and in what manner. And though there may be some self-deception in the writers who have drawn these conclusions, it cannot but be valuable to find that reason, exerted on this subject, continues to confirm what revelation teaches by its authority.

Whatever God can be inferred to do, it must be right for us to imitate, as far as we can; or, deducing His will from His conduct, it becomes right to obey that will. Thus we are bound to act with beneficence, because He is beneficent; with rectitude, because He is just; and with truth, because He is true. And this is the sum of our moral duties as to man: it is, to do to all that which we should desire for ourselves; as that desire, being a first principle implanted by Himself, is our never-failing guide. Thus, also, placing the prime duty last, we are taught thankfulness, gratitude, love, for benefits received; while this love of God leads us to love certain modes of human conduct and character, unless as we love these more directly from witnessing their good results. Thence, further, feeling our own weakness, and seeing His power, we must acquire the

fear of God ; while to that simpler fear is superadded one arising from the consideration of His purity ; forming the virtuous check to disobedience, as the other may be deemed an interested one. And these constitute piety ; while the efficacy of that over our conduct is secured by reflecting on His omnipresence, and on His omniscience even as to our very thoughts. All this, the writers on this subject have at least believed that they could deduce. I shall hereafter inquire whether they have actually done so ; while the most strenuous advocates for natural religion will not doubt that revelation has at least placed in a clear light what was, without it, but imperfectly discernible.

Thence the broad or general utility of natural religion to our moral and religious conduct ; as the practical religion thus derived is truly rational, or reasonable and philosophical ; which indeed true religion must ever be, as proceeding from Him who is pure reason. It has, therefore, a solid foundation assured. It is not to be shaken by arguments, because its logic is sound : and it excludes those false and partial views, those superstitions and extravagant faiths which have ever been the enemies of true religion ; schemes of speculation, not of practice, and therefore useless when not pernicious. It is a belief for which we can show a reason ; but it is also a religion of the heart, since it is founded on the perpetual feeling and conviction of God's goodness as displayed before us.

Now if we discover these things respecting God, and learn His will in any other manner, we receive them with the greater facility and trust, because we are prepared. It was probable before it was known ; it is assured as soon as it is declared. Thus does natural religion lead the way to that of revelation, as I shall show more largely hereafter ; and we also obtain a double

security for our right conduct, deriving that from two distinct sources. And though His revealed will suffices in itself, it needs not be allowed to supersede that which is confirmatory of it, and confirmed by it, whenever that can be taught or known; as it can be by the educated portion of mankind. We cannot be too much assured in right; while, should doubts or difficulties arise under revelation, or opinions disagree, we have always the appeal to that which is of proof.

Religion being founded on the existence and character of God, natural religion is its proper basis, inasmuch as it proves those. If there be an atheist, a person who does not know God, or does not believe in Him, he cannot believe in a revealed religion, because this assumes the previous belief in God as its basis. Strictly speaking, revealed religion declares more expressly the will or the commands of Him who was previously proved, or admitted; or it declares in words that which was an inference from reasoning, aided, probably or possibly, by that law written in the heart which has been termed the moral sense and the light of nature. But that we may justly believe in God, it is necessary to know Him; since belief without knowledge often proves of little value, or is insecure, because not founded on conviction. To possess, therefore, a security for the belief in God, through natural religion, is to acquire a firm foundation for the belief in that which has been revealed; while, if that be insecure, this superstructure may be shaken; as it also is when, being built on testimony alone, that evidence is made to appear suspicious or false.

The very existence of what we, now, especially term revealed religion, is secondary both in time and in purpose; while the latter is supplementary and corrective.

Under this view alone, the neglect of natural religion is an obvious deficiency in philosophical and moral procedure. Had man never lapsed, his religion, as far as we can conceive, must have been of this nature, however there might have been revealed to him what we now imagine ourselves to have discovered. To man, moreover, alone, of all earthly beings, have been given the faculties to know God, and the desire respecting Him; whence, to neglect the means which natural religion affords, must be wrong, because it is disobedient to those obvious intentions which amount to His declared will, or command.

While revealed religion informs us of the attributes of God, some of these at least are also inferred by the other, from their practical display in creation; and thence, under an admitted principle in the human mind, in a manner more striking and influential. Thus we can see and feel that power of which we read, and thus also discern His wisdom, including His intentions, with His foresight and contrivance; while thus we can at least prove His universal knowledge and presence, very clearly and widely witness His goodness, and securely infer His government or providence. This cannot be unimportant, did it do no more than confirm what revealed religion teaches. It is every thing to those who will not receive the testimonies for a revelation. It comprises the essential points in the character of God; and must therefore be the foundation of at least a good religion; as the proof of His mere existence is that of any mode of religious belief.

It is easy to admit that the Christian revelation does not display and enforce the other attributes of God, as the ancient Scriptures do, or as natural religion can

deduce those. It records, indeed, the most splendid and deep example of His goodness : but this, as contingent, might not have occurred ; while, having so done, it is not the only act by which He provides for the good of His creation. To those therefore who will not receive that fact as we do, we prove nothing respecting this most essential part of His character ; and, being Christian, in feeling as in belief, is all God's other goodness to be neglected, or to remain unknown, because of this ? That would not be reasonable or just respecting a human character. Or, are His power and wisdom, as displayed in the universe, to be forgotten because of this one special and peculiar act of goodness ? That would be wrong in morals, and cannot be right in religion. This is not the religion of those great men to whom the religion of redemption for ever appeals. It is great ignorance, it is too often fanaticism, which supposes that the second has abolished the first, or rendered it unnecessary. It is a worse condition of mind which suspects or condemns the basis while it imagines that it understands the superstructure. It would be well were there no more than that simple ignorance which forgets that correction and renovation, grace and mercy, could never have been, had there not been something to be corrected and renovated. If there is now the relation of Redeemer and redeemed, so is there still that of Creator and created, as this was once the sole relation. It is fundamental, and cannot be annulled ; nor are we permitted to forget it, when it is to Him, the Creator, that we are still commanded, by the Redeemer himself, to apply for every thing. Thus, again, is that which natural religion can teach, and does, at least, confirm or enforce, the basis of revealed religion ; or, a simply

rational religion is, or may be, the basis and assured foundation of a rational Christianity, while a firm belief in the one offers a security for an equal belief in the other.

That which can be deduced from the works of God is of the same practical value as if it had been so deduced. It might prove to be of more; because the other grounds of religion might have been, at some given period, or may yet be, forgotten, or detorted, or corrupted; while the proofs from the former are ever open to examination and appeal. Thus examining and reasoning, we learn to venerate, to admire, to love, and also to fear: thence learning to know Him whom we are commanded to know, and, consequently, Him whom He hath sent. In the same way we also learn to know ourselves; that scarcely less essential knowledge, without which we can never know our just relations to Him. Much too often mistaken views of religion keep Him, the Father, out of sight. Need I say how far they have done this, and even more, in the widest division of Christianity? He almost becomes the unapproachable and unknown Supreme of the Hindoo mythology. We thus forget to humble ourselves before Him, to venerate Him, nay, to love Him; forgetting that it is to His love we owe that which is so freely acknowledged towards One who is the partaker, as He was the appointed agent, in this goodness. We almost forget, except in words, to ask, as we have been commanded, of "our Father." Are there not also some, who thus, in their ignorance of Him and of themselves, presume to decide for Him, and to direct His councils, to dispense His justice and His mercy, to set revelation at variance with natural truth, and even directly oppose to the Father the Son of His love? This cannot be right; it cannot be religion: yet not only thus is it termed,

but thus does it claim to be exclusive, the only true religion. All can apply these remarks, if capable of reflection, and then decide if this be the Christianity which our Saviour taught.

I may pass to the utility which seems derivable from natural religion in a religious education; presuming that there is such a thing as the teaching of religion, in the literal meaning of that term: I will not, however, here apply it further than to the teaching of children, in which our systems seem faulty; while the decision must rest, not on opinions, but on the practical result. It appears an error, yet not always an unamiable one, that they can be taught to understand and fear God through revelation: it is a less venial one when this is attempted through an inculcation of its mysteries. We cannot teach them what the ground of our own faith is; and if we command them to believe, the profession of obedience is neither the faith of reason nor of feeling, for the age of neither is yet arrived. It is a nullity; but it may become hypocrisy. We do not teach love and gratitude on the grounds best suited to their comprehension, and, I fear, seldom produce the effect we desire by informing them of the goodness of God in redemption: it is beyond their capacity; we can do little more than give them a rote of words. God is not understood by them in His simplest attributes, and how should He be comprehended in the more abstruse ones? This is to attempt the building of a structure on sand: the first argument of infidelity may demolish it. The youth is without conviction as without proof: he has heard; that is all. He has not even learned the validity of the testimony, which, in reality, is ultimately based on the character of God, and he finally becomes ashamed of his "credulity."

Of that future state, respecting which we ourselves can form no conception, children can scarcely be brought to think ; yet ever making the punishments too tangible, while the rewards are obscure, distant, and uncertain, we inculcate the dread of a mysterious and vengeful Being. We teach fear too effectually, while we do not teach love : and hence our early impressions of God are too apt to be those of a severe and inflexible judge, as they also too often continue during life. Wickedness, reprobation, universal sin, vengeance, punishment, such, and more, are the words ; while if His mercy in redemption be urged, as it rarely is with the same energy, the effect is feeble against the rooted impression of fear. Let all this be taught when it is proper, and these lessons enforced on those who require them ; but it is as difficult to believe that an ever-terrific God can be an object of love, as that the conviction of hopeless perverseness can lead to good conduct. We are commanded, at least, to keep the strong food for adult age. If religion is thus made fearful and odious, as He is Himself thus rendered terrific, and perhaps hateful, the not unusual event is, to shut the eyes and labour to forget, while the bold wicked openly defy. The less courageous wavers, and his state is the misery of uncertainty ; the timid becomes superstitious ; and he who finds profit in the semblance ends in being a hypocrite. The system of fear may be necessary to terrify the sinner, as it is, doubtless, that engine which, for the general mass of mankind, love can never be ; yet it is much too apt to be transitory in its effects, because the punishment is remote, or uncertain, or is soon believed to be such.

The meaning of the term fear is too often mistaken : we must fear to offend the purity and the power of

God ; and we fear to offend Him otherwise, because, threatening punishment, He has the power to punish : and with this fear love is not inconsistent ; while, as we are also told, it may even exclude the former. Need I refer to the authority which, in naming the first great commandment, would found religion on the love of God ? And if this be the basis, the religion founded on it should go on augmenting, because the consciousness of love is pleasing : we desire to increase it, when our efforts are to banish the impression of fear ; and if this love can be excited by displaying the goodness of God in creation, a child may learn to associate Him with the lovely and the loved, with pleasurable impressions made in the age of pleasure and love, so that He may become the object of love, Himself. The association seems easy ; while as the intellect expands and the observations extend, this love should grow into reverence and awe, into that habitual and constant piety, without which the influence of religion, however acquired, is precarious or doubtful. This should be the stronghold of the man : to know and to feel that there is a God essentially good and worthy of love, whom he obeys from the awe of His power, and the conviction of His right to command, as he also feels this obedience to be his interest ; while, though seeing evil, his confidence is not shaken, because his basis is secured in the wisdom and goodness of that God. He is thence also ready to receive revelation, because he sees that it is consistent with the Divine character, and with the imperfect or corrupt nature of man ; while his belief in Christianity is that faith which nothing can move : he has built on a rock.

It is a still more tender point to note a too common injudiciousness in the manner of teaching revealed

religion, by representing man as entirely and inevitably vicious and sinful, utterly without goodness, and even incapable of it through any study of his duties, and any exertion of will. Undoubtedly he is inclined to vice, and is vicious; he has "fallen" from the image in which he was created. But he is not this demon; for we have known him even before the sun of Christianity dawned on the earth, and we know him where that has not yet reached, often, assuredly, virtuous, benevolent, pious, and, in proportion to his lights, religious. Can we hope, or can we endeavour, to become good by persuading ourselves of our utter incapacity for it, of the absolute inutility of all our efforts? Can the virtuous man believe this of himself, when his conscience and his religion assure him that it is untrue? and must he not rather believe that the good conduct which he sees in others, and knows of himself, is right, and must be truly good, since it can ultimately come from no one but God, though the works are performed by man?

If moral aberrations, the love of influence or directing power to be acquired by terror, the spirit of hatred, and more, are the common sources of this, they would want the means of the evil which they inflict, did they not pervert the declarations, as well as the spirit, of that revelation which is professed to be taught; while the evil operates chiefly on those weak minds which are incapable of contemplating more than one idea, or in which that one becomes overwhelming. Thus do such minds, ever engaged in dwelling on their own sins or those of others, learn to view man under the sole idea which has possessed them; and never seeing God but as the pardoner of sin, learn also to believe of the omnipresent, all-powerful, and beneficent Being, the creator and governor of a universe to which our whole system, not the race of man

alone, is but dust in the balance, as of one whose sole occupation and concern are to punish and pardon the sins of man, or of their own important selves. Thence also do the ignorant possess such inadequate or improper notions of the Supreme, even when living under the light of revelation. If a God, invented by man, and copied from himself, has formed the basis of every false religion, so has it been for the modifications of the true one : we reverse the order of things, and make God in our own image.

If there are men who cannot find the remedy in the same place whence they have extracted the evil, or if they will not see God in all that perfection of His character under which revelation displays Him, it is possible that they may acquire juster views from natural religion, and, in the universe of creation, learn to know the Creator and the Father for what He is : the all wise and all powerful, ever designing man's happiness with that of all His other creatures and children, and ever providing him with the means of increasing in knowledge and goodness. Assuredly, they who can and will, may there behold Him, the powerful and the great, beyond all possible conceptions, the governor and the protector of incomprehensible myriads of beings, of which every individual is His care, the dispenser of happiness in a degree, and to numbers, which the meditations of a life could not estimate ; not the petty ruler of an insignificant spot, but the parent of a boundless universe ; not the mere punisher and pardoner of human sins, but the good, the beneficent, the amiable, the adorable, the universal Father.

If I have already alluded to the following use of natural religion, I may point out more distinctly its indirect value in opposing or disproving a wrong belief.

“Atheism,” or some kind of disbelief respecting the Deity, has existed, and is thought to occur still. Disbelief in religion, in the necessary relations of man to his Creator, or in its utility or its sanctions, assuredly does exist; as this is popularly, yet incorrectly, termed atheism. Against this, even the revelation of Christianity is powerless; because, while the testimony on which it stands is not received, the basis in natural religion has been neglected or rejected. But if the evidences of creation, by disproving atheism, prove natural religion, they may, and perhaps should, open the way to the reception of Christianity; while, if they effect even less than this, it is a great gain.

If it is an indirect value, it is one not to be despised, that in the cases alluded to, natural religion offers a consolation to human vanity; anxious to possess, or to assign to itself, the credit of having discovered what it spurns when taught. Or, if there be men who refuse to listen to professed authority, or are averse to acknowledge what perhaps they still believe to be true, yet who will attend to what they consider as appeals to their reason, then is it of use, if it be admitted that such religion is better than none: as will not, I presume, be questioned.

I may lastly observe, that there are minds, which, from high activity and comprehensive powers, or from an evil constitution, or from more culpable causes which I will not explain, the simple religion of the Gospel alone cannot or does not occupy; as I need but allude to the evil effects, not merely as to religion but on the mind itself, which follow the effort to dwell for ever on that which no intensity of contemplation can render other than it is, the generous, the simple, the beautiful, the sublime; but which thus for ever tormented,

has divided Christianity by wars of words and incomprehensible disputations. To the first class of minds, the studies of natural religion offer an almost boundless scope, while they cannot fail to generate that habitual piety which must ever be favourable to the religion of Christ; as even its necessity will be most strongly felt by him who has thought most deeply. Nor, in the second case, can I doubt its good effects, though I will not specify its mode of action, that I may, as far as possible, avoid detailing faults or failings which are subjects of painful reflection. And to a very different class of dispositions, it might be a remedy, if there be one, for a constitution in which great warmth of feeling, or passion, is united to slender knowledge and feeble powers of reasoning, or where a restless and active spirit accompanies the possession of a narrow range of ideas, or of one leading idea: while I will not name other vices and faults, to which they who reflect can apply the same reasoning.

As I must not enlarge on any of the uses of natural religion which I have thus briefly enumerated, I may now state the objections which have been made against this study, together with the answers that may be given to them, and which ought to be satisfactory.

Peculiar views of Christianity, or peculiar divisions under it, disclaim all knowledge, or teaching, of God, or religion, but that which themselves think the only and the exclusive: while their own views are couched in a various phraseology, which they often cannot or do not explain, and which produces a belief, when it does succeed, in which the understanding has consequently no share. Not to inquire how often or how far these views differ from those of revelation, owing to causes which I decline noticing, and even granting that they

explain it justly, the answer here is, that they do not fully explain God the Father. . Unquestionably, every thing which natural religion teaches can be found in the books of revelation ; as many are thus taught ; and thus its necessity is superseded, though its utility as already shown is not annulled. But the question is, whether men in general do so study them as to acquire this knowledge ; above all, that habitual and firm sense of God's attributes which becomes a part of their very being, and constitutes a true and firm piety. And if such reading is, much more commonly, formal and periodical, it is not easy to see how it can produce the effects which follow from perpetually contemplating the works by which we are ever surrounded, as proofs of His character and government, and, what is most important, of His constant and superintending presence. If also a thorough knowledge of the Father is the foundation of true Christianity and of a sound belief, as it is an aid to right conduct, a rational Christian gladly adopts every means in his power ; adopting natural religion, therefore, on account of uses not so readily or fully derivable from that knowledge which has been revealed, or because confirmatory of that revelation.

But if, from whatever causes, the mass of Christians is not thus taught through the usual instructions of Christianity, this is especially the case under certain divisions which disclaim or else censure natural religion ; holding it in aversion as if it renounced revelation, and often applying to it terms of theological odium. Under such teachers, it is not visible how men can acquire that knowledge, the utility of which I need not repeat : while this ignorance must produce those evils which arise from a want of that assured basis of

Christianity, the knowledge of the Father ; which can scarcely fail to be taught by natural religion, because it teaches nothing else, and possesses nothing to distract or occupy the imagination, while ever appealing to facts and to reason.

The further answer to these objections rests on obvious grounds. The revelation of Christianity, in particular, is posterior to natural religion ; while, as already remarked, it is explanatory and corrective, confirmatory and remedial. God cannot have intended to supersede what He himself originally implanted or taught, nor to counteract through His word what He teaches through His works. He cannot mean that we should neglect any teaching which He condescends to supply, nor can He be pleased if we reject or despise what He has thought fit to demonstrate respecting Himself, for our instruction. On the contrary, we must believe that to act thus is disobedience and rebellion, and therefore sin. His revelations do not teach us that we shall know more of Him the less we study Him, that we shall learn to feel, what we acknowledge in words, His power, His wisdom, His goodness, by shutting our eyes to the demonstrations of these attributes by which He has surrounded us. And we must believe far otherwise of His character than either natural religion or Christ himself teaches us, if we can believe that the exercise of that reason which He has given us that we might study Him and learn our duties, which He has given to us exclusively, thus creating us in His own image, is an offence against Him ; that it is an evil, and the source of evil, not a gift demanding our gratitude, and to be used in His service. Shall we hope to comprehend His greatest works by determining to remain ignorant of the least ; or shall we be enabled

to see what He is, by shutting our eyes to what He does? He has given His works, and He has also given the means of studying them: and when He implanted the desire of knowledge in our minds, He commanded us to study them; for thus does He express His will. Has He not also given us examples for our guidance, in the conduct of the great men whom He favoured? to whom even they who object to such studies believe that He revealed Himself. It is an argument which even a child might urge, that if reason be averse to revelation, then must revelation be opposed to reason; that each is truth, and that truth can never oppose itself: while I may add, that he who fears reason is an impolitic partisan rather than a valuable friend, and incurs the hazard of rendering his cause suspicious.

To the objection that philosophy and the study of nature are proved by experience to lead to disbelief in revelation, the answer is easy. They are not friends to false views of religion: and this is the point of soreness. They are conversant with truths, and generate a discernment for truth: they detect falsehood, and are condemned because falsehood fears them. If ever they have led to so false a conclusion as religious disbelief, the reason is, not that they have been pursued, but that they have not been pursued far enough. Partial studies may be injurious; they have led to doubt and error: but the real cause is then no other than it has been under superficial inquiries into revelation; it is ignorance united to vanity. In each case alike the cure must be sought in more knowledge; as this is ever the remedy for the evils which follow from a little.

I grieve that I cannot avoid noticing another objection derived from peculiar views; since pious minds easily suspect that the charge of extravagance which is

directed against the ignorant, includes the possessors of reasonable and just opinions. It is said that the influence of the Holy Spirit suffices for everything, and supersedes all teaching; that the needful belief, or faith, is the produce of this alone, and that reason and knowledge oppose its operations. If far more is said, it is my desire here to avoid noting more than is rigidly necessary. On opinions, or feelings, of this nature, all reasoning, even from the words of revelation, is thrown away: as it would be purposeless to suggest the possibility of "false spirits," or to ask which is the true, when many discordant systems assume to rest on such personal revelation or influence. There can be no direct answer, defending natural religion, beyond what has already been given: the rational will equally admit the influence in question, though not to the same exact ends; while even natural religion teaches that God does govern and direct the minds of men for His own purposes.

To the objection that natural religion cannot be taught, the answer is, that its evidences can be explained, very widely at least, to all but the exceedingly ignorant, as the inferences from them are of the most obvious nature. It is not indeed the usage so to teach; because that demands knowledge and thought, both equally inconvenient to the objector. Indolence and ignorance find an easier road to that superiority which teaching confers, as there is a presumption which even devises a short one to religion; while ambition is cheaply gratified, and vanity pleases itself in depressing that which it envies and cannot attain.

When, lastly, it is objected that natural religion is unnecessary, because all the inferences derivable from it are taught, or known, though their grounds are not,

I fear the answer must be that this is not the fact. Under the predominant instruction, those attributes of God which it teaches or illustrates are scarcely even an object of allusion: or when reference is made to them, it is in mere words which produce no impression.

We hear of an omnipotence, a wisdom, an omnipresence, a providence, but we do not reflect on them, because we do not see that they exist and how they are exerted: as all of His hourly and universal beneficence, even all else that He is ever doing for man, is forgotten in dwelling on that single act of goodness, the greatest, through which provision has been made to relieve him from the consequences of his own disobedience.

Deficient in that influence which attaches to the clerical character, a laic cannot expect attention except through the support of that authority which, to the mass of mankind, is argument, conviction, truth. The human authorities are direct, the Divine sufficiently explicit: and I proceed to note a few, in defence of the utility of natural religion.

It is probably fruitless to quote pagan authorities; yet it would not be easy to speak better than Cicero and Galen have done on this subject: and the latter particularly, when he says that to study the Deity and His attributes, and to teach them to others, is a more acceptable devotion than incense and sacrifices. In the Jewish dispensation, they pervade all time: and though I am here precluded from quoting them as of Divine origin, the opinions of such philosophers have ever been of authority in philosophy and morals. He will indeed be a careless reader of that which is much more read than considered, who does not perceive that there was a natural religion independent of "the law,"

that the study of the works of God among these great men was far more extensive than the poetical brevity of their expressions seems at first to bespeak, and that their views were habitually directed to the conclusions which form the object of works like the present. Even in mere philosophy those are high authorities for the study and the value of natural religion; since these are men whom we may safely compare with the greatest philosophers of pagan antiquity. They should be far higher to us who believe in revelation: as they ought to overrule the objections of those who say that we require no other teaching than that which they consider all-sufficient and exclusive. Those great men thought otherwise; though knowing the revealed word of God as we never can, since it was personal to them and ever present with them. It is a strange ignorance which does not see, that in condemning the study of natural religion, it assumes to be wiser than such men, condemning also those to whose authority and teaching it professes obedience and attachment. If it be said that the anteriority of these writers to the Christian revelation nullifies this argument, and that the propriety or necessity has ceased, then ought they not to be studied or followed; they are not examples to us who live under another dispensation. This will not be said by those at least who maintain that every word is of inspiration; yet is the study of natural religion most condemned by those who are most ardent in defence of revelation.

There is a long interval of ignorance and neglect as to this subject, commencing in the early ages of Christianity and extending downwards towards our own days, on which however I need not dwell, since the history of the Church is well known. But the

light dawned at last, and the study of creation has since walked hand in hand with religion, if the bearings of the former on the latter have been less frequently and less widely pointed out than is desirable. It is sufficient that I give the names of Newton and Clarke and Butler and Watson and Chalmers and Dwight; of Boyle and Ray and Derham and Locke and Bonnet and Paley; among whom, some have merely made the general declaration or defence of natural religion, while others have undertaken the illustration in more or less of detail. These names comprise persons who will not be suspected of want of knowledge, of powers, of religion, or of Christianity: and while they include men ranking under different divisions of the Christian world, they may furnish separate authorities to those who, adhering to one division, might dispute an authority under another. I must be content with here selecting two for quotation; he who desires more, must read what my space does not permit me to state at more length. "The books of nature and of revelation," says Watson, "equally elevate our conceptions and invite our piety: they mutually illustrate each other: they have an equal claim on our regard, for they are both written by the finger of one, eternal, incomprehensible God." "It is a most Christian exercise," says Chalmers, "to extract a sentiment of piety from the works and appearances of nature." Yet to these I may add the words of Locke, when he says that, "the works of nature and the words of revelation display" religion "to mankind in characters so large and visible, that those who are not quite blind may in them see and read the first principles and most necessary parts of it, and from

thence penetrate into those infinite depths filled with the treasures of wisdom and knowledge.”

This ought to suffice: but it would require many more separate authorities to satisfy all those who rank under leaders to whose opinions they look for their own, and who see no religion beyond the circumscribed line. They, I presume, are not to be convinced: but the general answer to a reasonable mind is simple. If the study of nature and of natural religion is wrong, then are religion and Christianity distinct things: it is either useless or wrong in us to attempt to know God in this manner, and was merely pardonable or expedient in those who knew not Christ.

If this be a just conclusion, then must Christ himself have erred in recommending the knowledge not less than the love of the Father. “He that cometh to God must first believe that He is.” It is the indispensable foundation of all religion, to believe that God exists, in the manner, and with the attributes, which every work of the present nature attempts to display by means of His creation. “Every man therefore who hath heard and hath learned of the Father cometh to me.” I will not quote more to the same apparent effect; knowing the other interpretations often given. But if I am not in error, the general deduction is this. Every man must lay the foundation of His religion in his conviction respecting God, and he will become a Christian in knowing Him. “I and my Father are one.” I teach under His commands, but He taught you long before I came on earth: learn to know Him, and you will know me and conform to my teaching: you will come to me.

Have I attempted to draw, from creation, an argument for the power of God? Christ did the same. You

cannot imitate that little flower: His power as much surpasses yours, as His works do your works. Have I said that it was His goodness which has made creation beautiful? "Those flowers are beautiful, of His pure bounty, without any thought or labour of their own." Christ himself desires us to look at creation, that we may there see God. Have I endeavoured to extract from it an argument for His providence? It was that of our Saviour, when he consoled us by pointing out God's watchfulness over the least of His works. Is not this authority? Does it reconcile the religion of nature with that of Christianity?

But I will end these answers to objections. It must be regretted that they should ever be made by good, and, otherwise, reasonable men; that the works of creation should be considered as uninformative in religion and useless to piety; though such negative censure is far from the least which is indulged. I confess myself among those who cannot see how he who especially claims purity of religion under the Gospel, can avoid contemplating God in His works and His ways, with awe, reverence, and gratitude; how he can renounce that which is so calculated to excite the spirit of perpetual admiration and praise, with the steady conviction of His superintending presence, and of His love and care for all that He has created.

I proceed to inquire in what respect natural religion is capable of inferring a revealed one, or the special interference of God in teaching Himself to men. But if there are any persons who think the arguments incapable of proving to that extent, they can at least be used to repel the objections which have been urged against the expediency or necessity of revelation. And the whole argument is necessarily of an *à priori* nature. We

cannot even confirm it in the correlative manner, because the only proof that the fact has occurred, consists in testimony, which, by the postulate here admitted, is presumed to be invalid.

It is matter of experience that civilized men have at all times known religion, if in different degrees ; while this knowledge is greater and more diffused now, than it was in former periods of the world. In what manner has this happened? If every man, thus knowing, knows in and through his own mind, there must have been revealed to each what it could not otherwise have acquired. But knowing that we require to be taught, we do not admit this universal revelation : while we are also sure that natural religion, or the study of creation, could not have taught all that is known and believed. This knowledge must therefore have been taught by one man, or more, to others, and must consequently have been revealed to such persons. If not, and that any man made the discovery by his own powers, why was it not made much oftener, and by more men—why not by the highest abilities of a cultivated pagan antiquity? We must conclude that the teacher was informed ; and we know that he could have been informed by no one but God : which is revelation.

Natural religion having thus inferred revelation from a consciousness of its ignorance, proceeds to do the same through its knowledge. All other animals are perfect according to the scale and degree of each, and fulfil the ends for which they were appointed. But the peculiar nature and condition of man evince that other and greater ends were in view as to him ; while though natural religion cannot discover what these are, this much at least it can see. The free-will of all the other animals is restrained ; or their courses of action, which

comprise their moral conduct, are tied down within certain limits, never to be passed. Hence they are perfectly good, in the Creator's view, as that goodness was fixed by Himself: their morality being in His hand. But it is not so with man. His morality is not fixed and compulsory: he is left to his own will, under his passions, which are also of a wider range: and thence, while he may be evil, he is evil. Had he therefore not been taught what was good and what evil, how to pursue the one and avoid the other, the conduct of God, as to him, would have been imperfect; wanting in goodness and wisdom. This would have been to care less for His greater work than for His inferior ones; while moreover, in making man perfect for his animal ends, the essential would have been neglected in providing for the subsidiary. This also would have been to permit all those disorders which the unchecked passions and will of man might produce, to the very subversion of His design; or rather, to make provision for evil, and furnish no remedies; which would not be the conduct of a good being. It is therefore reasonably inferred, that as He could not have done what is contrary to His character as proved by creation, He has furnished the remedy in religion: while further, when natural religion sees that this remedy does exist, and that itself alone cannot provide the means, it concludes on some other demonstration of the will of God; which must be a revelation.

Now, whenever philosophy thus infers *à priori* respecting that which is probable, it proceeds to inquire whether it actually has occurred, or it seeks for the *à posteriori* evidence. Thence does natural religion search for facts to prove that what it has thus inferred has been: or its reasonings hold out inducements to inquire respecting revelation, as being the confirmatory

fact of which it is in search. He who does not thus proceed in religion, which is a branch of philosophy, must forfeit the character of a philosopher: he is a bad reasoner, or, if he denies this, is guided by evil moral motives. Or else, he is, at the very least, not so informed in natural religion as he supposes; because in refusing to inquire respecting a revelation, he shows that he does not believe, or does not comprehend, that character of God which he professes to demonstrate and to believe.

This illustrates one of the modes in which natural religion may become the foundation of the revealed; implying therefore one mode also of its utility. It is a foundation, in a philosophical sense, as containing the *à priori* arguments, or the circumstantial and preparatory evidence. And this evidence being demonstrable, or tangible, and the *à priori* references logical and sound, it not only becomes that aid to the testimonies of a revelation which this mode of reasoning ever is towards the reception of asserted facts, but is, for some minds, more efficacious than the simple evidences of a given revelation, since these must consist in testimony. However solid this may appear to many men, under the aids and checks of which it is susceptible, others may refuse it, on the grounds that history may be false, that men are so from interested or corrupt motives, that true religion has been corrupted, and false ones invented, that there have been false preachers, or prophets, and fictitious revelations. Of all this, doubt can take advantage, as it has widely done, in refusing the testimony for any revelation; but when natural religion is proved, it becomes an assured basis and point of reference. The fact of a revelation under testimony is then supported by a set of previous and admitted facts by which it can be tested: and should those of *priori* proof and those asserted by

testimony coincide, we are in possession of that which we admit to be a reason for believing in every other department of philosophy.

It follows, consequently, that they who refuse to believe in revelation, or who decline inquiring into its evidences, from whatever causes, cannot be sound in their belief of natural religion; as, reversely, they who are convinced of its truths, and especially so convinced as to practise the duties which may be inferred from it, rarely, if ever, refuse revelation. It is a clear inference that they ought not, and, if perfect in their knowledge and professions, can not. Therefore is that assertion of Christ's not a mere assertion of authority, as it is commonly reputed, but the sound logical inference which I have just drawn: arising, we cannot do wrong in supposing, from some analogous train of reasoning in His own mind. Why He did not thus philosophize and explain, I need not say: but he who will read with an attention not frequently bestowed on the teaching of authority, will often discover a depth of reasoning, as of knowledge, which he has not been taught to seek. "If ye believe in Him, ye will believe in me also."

If this belongs to the utility of natural religion, it has a further use as it bears on revelation. Be testimony what it may, it cannot prove any thing which contradicts the inferences drawn from natural religion; supposing these, of course, to be fairly deduced; since, on many points, we cannot be so sure of these inferences as to oppose them to the express words of revelation. Or, no testimony can prove a fact or a doctrine asserted to be among things revealed, if those be inconsistent with the character of God as deduced through the proofs of natural religion. Yet such doctrines have been maintained, as they have produced sects and schisms under the Chris-

tian revelation : false religions springing out of the great truth, through the wickedness or ignorance of men : essentially false, at times, as not existing in that revelation ; or false from dwelling on a single doctrine, to the exclusion of others, or from overcharging it, or from misinterpreting its meaning : being the falsities of error, suppression of truth, or partial statements. I need not point out what these have been, nor what their pernicious results ; constituting, as they do, too much of the history of the Christian church. Now, to all this, natural religion is a standing check : holding a control over what is not truly deduced from revelation, as it gives additional support to that which is true. No doctrine can be received which is contradictory to the character of God. “ I and my Father are one.” This is the answer from authority : but it is the answer of reason also.

It remains to inquire whether natural religion can effect, as to the peculiar revelation of Christianity, that which it seems capable of doing as to revelation in general : the reservations being the same as before. The arguments are of a similar nature ; but it is plain that they can infer nothing respecting the time, or the person, or even as to the mode adopted ; having no ground but that of the rectitude and goodness of God. Yet for those who have doubted this great fact, it will be something to show that it is consistent with the inferences of natural religion, or with His character and conduct as thence deduced.

His rectitude, or justice, being thus inferred, we learn the will of God to be, that we should do good and avoid evil ; while, through an instinctive feeling, which must be of His appointment, we also expect good in return for good, and the reverse. Hence a system of reward

and punishment, of which He must be the dispenser ; while this justice should also take full effect, were it not for the attribute of mercy, deduced too, if more remotely, from the reasonings of natural religion ; as, of this, it is the nature to remit punishment.

Now though there are in this world rewards for good, and punishments for evil, they are not sufficiently certain, nor so proportioned as to fulfil our expectations from the Divine justice. Thence does natural religion infer a future life, in which this shall take effect, in remedy of its imperfections in the present.

Thus inferring, it supports its judgment by other arguments, so well known that I need do little more than name them. The difference between the soul and the body is so absolute, that the destruction of the latter can prove nothing respecting the former : and if certain materialists have attempted to evade this conclusion, I have here answered their systems, at some length. Again, there is an analogy in favour of the duration of mind, because God himself is mind. The natural desire, hope, or belief, of a future life, which is found almost universally prevalent, is held to be another argument, as being presumed a belief implanted by the Creator : and the horror of annihilation, not less universal, may also be ranked under it. The remorse at crime has also been enumerated among these, as springing from the same source. The principle of curiosity, or the aspiration after a knowledge which is only bounded by the universe, is also numbered among these arguments ; and it is thought to be the more forcible, because that wish extends to the knowledge of God himself. Our desire for future happiness has been further ranked among them ; on the ground that God would not have implanted these high hopes and desires for no purpose, or for that

of deceiving us. If it is the last of those arguments, that the intellectual powers, and also the moral ones, undergo a progressive improvement, doing this too, if under exceptions which can be explained, even while the physical ones are decaying, I must add to them the utility of a future life to our good conduct and happiness in the present. That utility is indeed so obvious, that they who disbelieve, attribute the opinion to the invention of man: as if God, who made man, and might have governed in any manner that He chose, should govern him through a fraud, and that fraud of His creature's own contrivance.

The final *à priori* argument from all this, as it refers to the Christian revelation, is, that as it was useful, or necessary, that man should be more fully assured of his future existence than he could have been through these reasonings, so it is conformable to God's wisdom and goodness to have given that firmer assurance of it which could only have been given through a revelation of His intentions. Thus does this probability strengthen the testimony asserting the occurrence of the Christian revelation: while I need scarcely remark that this argument can infer nothing more than the disclosure of immortality through the Gospel.

The same inference can be drawn on somewhat different grounds. While natural religion proves the goodness of God, and shows that He has bestowed boundless wisdom and thought on creation, exercising those also in its government, so as to imply a love of what He has created, it is visible that He exerts this care for man in a higher degree than for any other part of His living world, as far as that is known. It is again seen, that great as may be the care for man's physical condition the attention bestowed on his moral one is

still greater, and that his happiness is distinguished from that of all other animals, as being chiefly of a moral nature. Hence, observing that it is imperfect in the present world, and noting also the implanted desire of a future life, it infers the probability of this, and is thus prepared to receive the testimonies for the direct promise of it, through that which is the Christian revelation. Or, that revelation itself is a probable one, and hence the testimony for it acquires additional force ; because, in all cases, the knowledge that a fact was to be expected, becomes an argument in support of the assertion that it has occurred.

On similar grounds, natural religion infers a moral revelation of God's will, or a set of declared laws for a man's conduct, in addition to those which his reason might deduce from creation. It perceives the necessity of right moral conduct for the purpose of that general happiness which it has previously inferred to be the intention of the Creator, and therefore argues that He could not have left us in ignorance or doubt respecting this, as that would have been to leave His work imperfect. Experience also shows, that whatever He may have written in the heart of man on this subject, or whatever our reason might infer, it is not sufficient to produce this necessary result. Thence does natural religion consider the actual revelation of God's will, or of the rules of right conduct, probable ; and therefore, when informed that this has indeed been made through Christ, it is ready to receive the testimonies for the Christian teaching, as it before received those for the immortality of the soul : while those two constitute a main portion of the entire system of Christianity.

There yet remains a third point under this revelation, the probability of which natural religion equally

attempts to infer, on the same grounds, or the goodness of God, though the reasoning is of a more difficult nature. This is the promise of pardon for sin, under certain conditions: and it argues in this manner. It perceives that a system of passions was necessary to the very nature of man, to his position in creation, and to his happiness; and that whether absolute liberty was necessary or not, it does exist, so as to render these passions productive of evil as well as of good; unless man was that being of pure reason which he is not, and could not be, in consistence with his nature and position, and even with his good as now constituted. This is termed the weakness of man: and natural religion would therefore infer that God had made him a weak creature, liable to error and evil-doing, or incapable of giving perfect obedience, though told that he ought to obey: revelation alone teaching us that He has permitted us to render ourselves what we are. Now, under this condition of things, it would not have been consistent with the goodness of God had He not provided some remedy for this defect: and thence is inferred the probability of pardon for disobedience. And I think that natural religion may also infer the conditions, as far as they are natural and reasonable ones, on which this pardon would be granted. The purpose of God's goodness is the happiness of mankind; and hence, if there can be a condition attached to pardon, capable of securing this, it is the one that should have been adopted. It might therefore be concluded, that repentance is this condition, because the end in view is thus gained: while thus also is inferred the true nature of repentance, which is not simply sorrow, but that change of conduct from disobedience to obedience, by which the general hap-

piness will be restored and secured. Thus, again, does natural religion compare its own inferences with that assertion of testimony, namely, that God will pardon sin on a true repentance, and is therefore ready, on this point equally, to receive the Christian revelation. To be prepared to believe is, under every circumstance of human life, one of the greatest securities for producing belief: in the more vulgar cases and the weaker minds, this is the power which is attained through prejudices. To be therefore prepared to believe through reasonable probabilities, or *priori* inferences logically deduced, cannot fail to influence belief: and in this manner does natural religion pave the way for the reception of Christianity, as it confirms the asserted occurrence of that revelation.

I have thus shown that natural religion tends to produce the belief in Christianity on its three great practical points; the immortality of the soul, with a system of reward and punishment, forming the great sanction of religion, the authority for the Christian morality, and the pardon of sin on repentance. This comprises the whole, as far as the religion of the Gospel is a practical one, or the guide of life; but here its bearings on Christianity terminate. It must conclude, of course, that the teacher was commissioned from God: but it cannot conjecture His nature, nor pretend to judge of the value and effects of His voluntary death, as those are stated under revelation. Yet having reasoned thus far with some success, we may perhaps reason somewhat further in this manner. The same testimony asserts, respecting Christianity, that which natural religion can infer as probable, and also that on which it has no grounds of reasoning. It is not a case

of two independent assertions from separate sets of facts in evidence, but it is one assertion of two different points from one set; or, the same testimony uses the same facts to prove everything which it has asserted. Thence, being true in part, it ought equally to be true in all.

But I leave to the judgments of others this sketch of an argument which many, I am aware, will think without value on the subject in question; being at least sure that it can produce no bad effects: there is an important consideration yet demanding notice.

In pointing out how the attributes of God are derivable from natural religion, I have but followed the steps of men distinguished for intellectual powers and for a firm faith in Christianity; yet drawing my own boundary much closer, by confining myself to those which seem really capable of proof from the physical universe. I have also done all the justice to it which has ever been claimed, and if I have read rightly, somewhat more. But I cannot end without suggesting some doubts respecting its rights to assume that knowledge which it professes to teach, as being the produce of human reason exerted on the works of God. I must not indeed question that the persons to whom I have alluded believed it possible to deduce what they have done, by the mere light of reason, yet can have no hesitation in saying that they have not done this, though scarcely comprehending how they had deceived themselves. That, however, will not nullify the utility of natural religion; while it will be a new argument for the truth of Christianity, if it can be shown that this knowledge has been unconsciously derived from that source, at least to a great degree, and that, in

reality, they who boast of the efficacy or sufficiency of the former are unsuspectingly giving testimony in favour of revelation.

It is sufficient to appeal to the facts; while it is surprising that these should have been forgotten by men of learning. Not to go through the history of mankind, it is enough that the knowledge of God and of the duties of man was worse than imperfect among the ancient nations most highly civilized, and even in those which we have been taught to venerate; although we may find, in the writings of some of their philosophers, the leading arguments of natural religion, with just views of our moral duties. If indeed the want of authority in the teachers, the general ignorance of the multitude, and the political establishment of false religions, prevented these sounder doctrines from producing any extensive and useful effect in the cases of Greece and Rome, they will not account for every thing. Everywhere philosophers have succeeded to philosophers, and reformers have arisen on reformers; yet the last has not always improved on the preceding: the tendency indeed having often been towards deterioration, if it is the fact that we can trace the corruptions of a true religion. If India, Egypt, Greece, did not discover such a system of natural religion as we can now lay down, why should we suppose that we owe this to our own unassisted reasonings? The self-deception is obvious. We have learned from revelation: it is God who has taught us, in His own Word; and in overrating our powers we endanger the slighting of that Word. But if in thus over-estimating ourselves there may have been vanity, and pride, and ignorance, there is at least an innocent and excusable ignorance. We are surrounded as by an atmosphere

of religion and morality, and do not consider it; like him who, cast in modern times, in the midst of knowledge, attributes to his own powers of mind that which he has received, like the air he breathes, unfelt.

If it is from revelation therefore that we have drawn the truth, it is there also that we are bound to seek it. Let us indeed bring it to the test of reason, since we shall thus confirm ourselves by being able to show grounds for our faith: applying towards God and His teaching that faculty through which He has created us in His own image. Yet never forgetting, that as natural religion is insufficient to teach, and more especially to control our moral conduct, since this demands positive and authoritative laws, so it is in His word alone that we shall find His will and our own rules of obedience, together with that of which natural religion knows nothing; the means of obtaining pardon through that only power which He has announced, the power of Jesus Christ. But if this just acknowledgment was most needful, it would not be just to admit that the value of natural religion was thus nullified. Be its self-deceptions what they may, it still possesses the uses which I have assigned to it in the preceding remarks. It teaches and it confirms. Creation, be the knowledge of the Creator acquired in whatever manner, is a standing lesson in religion, a test of truth, and a preservative against error: as it is also God ever present, a steady check to our disobedience. And if it be the error of certain religious systems to forget that the government and the purposes of God are universal, that His beneficence and care are not limited to a few men only, not even to the human race, that they comprise all the living creatures of an incalculable, incomprehensible universe, then a religion which tends to convey

correct notions of the nature and the extent of that goodness, cannot fail to produce valuable effects, did it but inspire that universal charity which is but a faint imitation of this Divine attribute.

If now the above remarks are true, or if it is from revelation that we have learned what we imagine ourselves to have deduced through reasoning, we may infer a further argument for the truth of Christianity. The same writings which declare God, declare Christ also; and having been admitted to prove the former, they must equally prove the latter: or, it is a deduction from reasoning, not the mere assertion of religion, that God and Christ cannot be disunited. Thence is Jesus reasoning correctly, not speaking merely by authority, or asserting on the strength of His character, when He says, "Ye believe in God, believe also in me." That is, you ought thus to believe, not simply because I, the Son of God, command it, but because there are the same reasons for believing in the one as in the other. And if further it be true, that we have derived our knowledge of natural religion from revelation, though unconsciously, then is the following remark of Christ a truth which we must grant on evidence, not an assertion resting only on His authority: "No man knoweth the Father but the Son, and he to whom the Father will reveal Him."

To conclude: if I have thus stated the advantages of natural religion, let it not be supposed that I think that necessary which is only useful or expedient. Its evidences are beyond the reach of the great mass, even in civilized countries; as the reasonings are beyond their powers. Nor are they needed by the laborious and the uneducated. The wise and beneficent Father of all has ordered otherwise, knowing what the bulk of

mankind must ever be. The religion of salvation is simple : it was preached to the ignorant, and is within the reach of all men. But if a just God does not ask for the produce of the talent which He has not given, He does expect what is possible, and has assured us that He will punish those who have known His commands, and disregarded them. If therefore it is the duty of the educated, in common with all, to know the religion of the Gospel, so is it incumbent on them to apply to the knowledge of God and to His service those abilities and that leisure by which He has distinguished them. Whatever be the promises of revelation to those who believe in Christ and conform to His commands, I know not how they can be deemed guiltless, who, with the works of God displayed before them, refuse to see and to reflect ; or who can thus benefit by all the provisions for their happiness, and yet neglect the Author of all these wonders and all this good : their Father, the Father of a universe.

But let me repeat this, lest I mislead others, or be myself misunderstood. I do not believe that pure, unaided, natural religion has ever truly taught men the knowledge of God and of their duties ; whatever may be deemed possible, and whatever purity and justness of views we may find in the writings of certain heathen philosophers. But though it could effect this, there is that which it cannot teach, and which I avoid expressing in that habitual phraseology which too often falls on inattentive ears. God himself declared at the beginning, that nothing but absolute obedience could secure the eternal reward, under that first law which He promulgated. Under a second one, He withdrew that restriction, and appointed a new power, in the belief of which we were to commence and pursue our

course of action ; assuring us, that under a firm will and endeavour to obey, our deficiencies of conduct should be pardoned, through Him—that power—so as to ensure the reward which it was impossible to obtain through our own exertions. This is the purpose and end of all : and this can natural religion never teach. It must be sought where alone it can be found, in the testament of Christ himself.

But let me end. To every one in whose power it lies, I would say, let not the prime, the essential, study of revelation induce you to neglect that of the visible universe. Creation deserves your attention, were it but for the pleasure and instruction which it affords ; but let it be studied with a perpetual reference to its Author, for thus alone will it be understood. Thus also may you form, or confirm for yourself, that religion of the heart and understanding which will not fail, which will be with you wherever you go, under which you will perpetually feel yourself in the presence of Him whom you will love and obey because you are always surrounded by His goodness and His power ; whom you cannot willingly disobey, while you are conscious that He is ever around you, the ever visible, if the invisible Governor and Father of the universe.

CHAPTER II.

ON SYSTEMS OF ATHEISM.

THE fundamental purpose of this work being to produce facts in evidence of an all-powerful and intelligent Creator and Governor of the universe, as the ultimate object is to prove Him under such of His attributes as admit of physical proof, it was impossible to avoid noticing the explanations given of them by philosophical systems which have not seen those evidences in the same light. And those systems, arguing from premises which we must presume they believed to be sound, have doubted or denied the existence of this Creator and Governor; yet under modifications: while, to this species of philosophy, or mode of belief, the term Atheism has been applied.

In detailing the following evidences, for the opposed purpose, while it was often needful to notice those hypotheses, it was inconvenient either to state their exact nature, or to argue against them at any length; and thence the reader might frequently have been at a loss respecting the allusions; as also in making the necessary distinctions among systems, which, though popularly classed under a common term, are by no means coincident. It appeared to me, further, that there was a moral inconvenience, or an evil, in constantly reminding the reader of disbelief, especially where the answers could not always have been given. This was to be

perpetually fixing his attention on untruth; distracting him from the real bearings of the evidences, and also incurring the hazard which arises from a familiarity with false conclusions and pernicious opinions. But further, while it would have been unjust to the reader to have left him in the dark respecting those systems, it would not have been just to those philosophers, to have opposed them under garbled statements, and without a fair hearing. Nor would it have been even politic. He who was not convinced of the feebleness of those systems, might still have approved them: as he would have had a right to suspect the honesty of a writer who was unwilling to enter on an open field.

I have therefore thought it right to give a general view of the systems termed Atheistical, in a preliminary chapter. And while it is a statement of those, it will also form a general answer: since the mere statement is often the only answer required. Thus will the disproof indispensable in this work be condensed in one spot, as it can also be brought into a small compass, compared to the proof. The Atheistical hypotheses cannot deal much in evidence; because their labour is to prove negatives, and their practice to make assertions: their opponent proceeds on evidences, and collects them out of the whole circle of creation. But as far as there are practical and partial ramifications from those hypotheses, not admitting of being thus generally answered, a separate chapter is allotted for them: as specific answers to particular points are occasionally introduced among the proofs, where that seemed necessary.

The real meaning of the term Atheism is a disbelief in the existence of a Supreme Creator: and this, which is the only pure Atheism, is also the most simple

of these hypotheses. Yet it can scarcely be called an hypothesis; it is rather a nullity; since it is to assert a negative; which is nothing. Whatever therefore those who do not think, may assert, or fancy that they believe of themselves, every philosopher professing what is termed Atheism has been compelled to adopt some invention, of a positive nature, as a cause for that which exists; since, without this, no system could have attracted any attention: while also compelled to it by an unconquerable instinct of the human mind.

But, to defer these inventions for the present, it has been said that real atheism, being a disbelief in a Supreme Creator, is impossible; or, at least, that no one capable of thinking can persuade himself into such an opinion: whence also it is said, that attempts to prove the existence of a Creator are superfluous, or ought not to be made. But if even Cicero has asserted that a speculative atheist cannot exist, he has not himself followed this rule; since his proofs are urged, sometimes even to repetition; as they contain the essence of all that can be said on the subject. It may be perfectly true, that no man, professing to reason and reflect, ought to think thus: but it is a question of facts; and experience contradicts the assertion.

Be the cause what it may, men of powerful minds and great information, reasoning correctly on other subjects, have declared their full belief in the truth of atheism, if I may use such phraseology as this; while we have had no reason to doubt that the declaration was an honest one. And if those were not the opinions of ignorance only, demanding no attention, neither have they been always unreflecting assertions; merely negative opinions, demanding little more. They have been supported, systematically, and at great length, by

arguments, or assertions, attempting to explain what, under the rejection of such a First Cause, required explanation. And in proof of this, I might produce a long list of names from the Greek philosophers, too well known to the scholars and metaphysicians who may take an historical or philosophical interest in this question, to require enumeration: while if there is a reader, who, yet ignorant on these subjects, desires information which I have no room to afford, I must refer him to Cudworth and Clarke, as I might to a whole host of writers besides: since it is a subject on which the writings are endless.

Nor is this true of the Greeks alone, in the infancy of philosophy, or under systems unjustly honoured by that term: since it is not less so, and under a longer list of names, of our own days, and even of very recent, if not present times; amid all the lights of modern science, and a far sounder philosophy than Greece ever knew. These names, however, I will not give, for different reasons. They are known to all who are versant in philosophy: and while others would learn nothing by reading them, it would help to perpetuate a popular odium which has seldom been deserved, and far less to the extent which the common abuse of the term atheism implies. I will not quote a celebrated decree passed during the revolution of France, as an example of modern and declared atheism: since it can scarcely be viewed as other than an act of popular excitement; of a temporary enthusiasm verging on the bounds of insanity. But it would be untrue to say that this doctrine was not professed by many men concerned in that decree, as it had been by the party called Encyclopædists, before; and not only professed, but maintained against opposition, under circumstances far too noto-

rious to admit of any dispute, and with a speciality, as well as an urgency, that permit of no evasion. It was that pure and absolute atheism which has been pronounced incredible and impossible. But one name at least is required; and one shall here suffice for all: though not many demand much tenderness. Grimm, an organ of those philosophers, says that it is difficult to conceive how motion without intelligence could produce a world, but that, nevertheless, it is a fact: while he ridicules Voltaire, an associate of the same party, for dissenting from so outrageous a doctrine. It is not therefore the question here, whether, in the opinions of any given individuals, the existence of the Deity requires proofs; but whether proofs have not been required, and whether there have not been, and are not, persons who did not, and do not, believe in that existence.

If I therefore hold it to be established, that to prove the Deity is useful, or necessary, so is there also utility in displaying the opposed systems for disproof. Most persons borrow their opinions, without reflection or examination: and if there are any who have thus borrowed atheistical ones, the opportunity of seeing what those hypotheses really are may induce them to think differently. Thus at least they may become more ready to believe, as thus the value of the proofs here given may appear in a stronger light. And with respect to these, the utility is various, though all to whom they are offered need not be considered as unbelievers; of whom the number, under any modification, is probably very small indeed. The proofs to reason should compel him to believe who is a disbeliever under bad reasoning: and if, in others, the cause of disbelief lies in temper, or moral feelings, to offer arguments to their reason may counteract those: as it may also be to make an

appeal to them which never was made before. If there are, on the contrary, some who do believe in a Deity, but in whom that belief is careless, imperfect, or unsteady, such statements may lead to assurance, and to more serious thoughts; as they cannot fail also to convey more accurate notions respecting His character. Even to those who already believe, without unsteadiness or doubting, the effect will be to make them reflect and feel, where they may not yet have done this: to make the sense of God's existence and government, not a single temporary conviction to reason, but that firm and perpetual impression, which, in teaching them to see Him wherever they turn their eyes, will also become the rule and guide of their lives.

But I must explain the term Atheism, as it is commonly used, before proceeding to examine the systems which have been ranked under so loose and sweeping a word: from a sense of justice to those who have been confounded under a general term, as equal objects of censure and aversion. It is a term of odium: and a term of odium is rarely, if ever, a just one. Were it even justly applied in any instance, this is not the spirit in which those who have the misfortune to disbelieve ought to be treated. Calumny is not argument: nor is hatred a proof of superior knowledge or superior rectitude. I need not say that it is not the spirit of Christianity, for it is not the spirit of religion. The "odium theologicum" argues little in favour of those who have recourse to this weapon: nor is hatred any more the proof of evil in others than of goodness in ourselves; while producing no effect on reason, it is worse than powerless over those feelings which are the most common source of this aberration of judgment. And it is most pointedly and wickedly unjust, when it confounds a

purely speculative or philosophical atheism, often found in the most irreproachable men, with that depravity, under the same term, which is displayed in immoral conduct, and in a spirit of proselytism for evil purposes.

That it is generally a combination of ignorance and injustice, as far as these censures have been passed on the ancients, is most apparent: whatever evil-mindedness may be supposed to attach to the moderns, or to any one among them; though it is notorious how often they have proceeded from the hatred of philosophical controversialists, or the still more acrimonious spirit of religionists. So far from having any reason to believe that the ancient atheisms were evil-intended, or that their propounders and abettors were wicked men, we know that, in many instances at least, neither was the fact. These speculations had no bearings on religion or morality: they were philosophical theories, akin to all the other philosophy of the same age. We may call those philosophers, bad observers and feeble reasoners; ignorant naturalists and weak metaphysicians: but that is all which they deserve. And we ought not to forget, that they were deprived of the advantages which we have derived from a Revealed religion: from that which, in reality, has taught us what we know, though we so easily forget our debts both to the knowledge and the teacher.

If there is any one inclined to doubt the knowledge, the reasoning, and even the temper and principles of any one among the moderns, who, in the present state of science, under a far better philosophy, and cradled in a very different morality and religion, with the evidences of their Divine origin before him, chooses to maintain such doctrines, I am assuredly not about to defend him. I have not even a defence to suggest for those who have promulgated opinions, which, however

abstractedly philosophical these may have seemed to themselves, or however little influential over their own conduct, they must have perceived to be hazardous, at the very least, if not certainly mischievous. If they intended evil, let the censure fall undiminished: for if the intention has succeeded, the evil is enormous; far exceeding all human criminality, in the wide extent of misery and guilt, of which it is the source. If the cause has been vanity or ignorance, the censure is still sufficiently deserved; since it is the wicked self-love which cares not who suffers for its gratification, or the carelessness that launches a firebrand without previously informing itself where it may fall. Yet are we bound to distinguish even those, from the declaredly vicious atheist, if indeed there be such, who in disbelieving in a God, disbelieves, rather in defiance, than under any care whether it be so or not; wishing, or endeavouring, to persuade himself that he is relieved from all moral restraint.

I would willingly have offered a more complete apology for the writers of the last age who have promulgated such opinions; on the ground of their very vanity and love of singularity, and their assumption of superiority to prejudices; aware also of the influence of a silly system of education, which had rendered the Greek philosophy the standard of human excellence, and thus produced those apings by which philosophy is even yet oppressed. But they could not have been so ignorant as not to have known, that while the philosophical writings, and teachings also, of the Greeks, were confined to a very small number of similarly speculative pupils, while they had no bearing on the religion of the people, their own writings not only tended to subvert a religion, of the utility of which no one doubts,

as not many doubt its truth, but were to be circulated among the ignorant, of all classes, unable to see their weakness, and ever ready to be misled, not only by the boldness of assertion, the stimulus of novelty, and the pleasures of dissenting from what is enforced as a belief of duty, but by some hopes, more or less confident, of being released from the encumbrances of a religion and a morality deemed too rigid.

In considering the various meanings of the word Atheism, a word which it would be very desirable to suppress, from its ever prejudging the cause, and which I have therefore avoided as much as possible, I should commence by excluding pure ignorance of a Deity. The atheism of a savage is less than a negation : it is a mere nullity : not disbelief, but nothing. And if I have already said, that there can be no such atheism as this, in any one who has the power of thinking, and the will to think of this subject, the chief distinction is into the physical atheists and the moral atheists. The former must be conceived to deny the existence of any First and intelligent Cause ; a denial, it is plain, involving that of a moral governor : as the latter admit such a cause, but simply deny the interference, or providence, or moral government, of a Deity.

The physical atheist denies, because he does not perceive the evidences of design, or cannot reason from them : while being compelled, from the very impulse of the instinct of causation, to account for the production and conduct of the universe in some other manner, he splits into sects or systems, forming those distinctions which existed in the ancient atheism of Greece, and which have been often borrowed under a mere change of terms, by modern philosophers professing similar opinions. And it must be remembered, in defence of the

phrase, physical atheism, and still more in defence of these speculators, that the purpose was not to set aside a moral Governor of the Universe, but to account for its production : whence, as I have already suggested, they were comparatively undeserving of censure, however open to philosophical criticism.

Under the other division, the intelligence and the power, with the existence therefore, of a Deity, the Creator of the universe, is admitted. The term Atheism is therefore wrongfully applied in this case ; at least in a rigid, and in a philosophical sense : since in a moral and a practical one, it includes the same evils which might arise from the purest atheism. And it may also be judged more harshly. It is more unphilosophical, in separating the attributes which it acknowledges from those which it denies : denying a moral purpose, or almost any purpose, in the Creator, and proposing a Deity without a moral character or a moral conduct.

It is a singular oversight or aberration of mind in any philosopher. The moral being has ever been esteemed superior to his physical dwelling, and to all that surrounds him, ministering to that machine for the sake of its moral tenant. The mere vanity of man ought to have judged otherwise : the first, in rank at least, of logicians, and one among the ablest of moralists and politicians, ought to have judged otherwise : and India, above all, maintaining that every moral being was a portion of the Deity, to return to His unity at a future period, should have judged otherwise : since this was to discharge Himself of all concern for Himself. But whether men invent hypotheses or borrow them, such has ever been the history of hypothesis : and such, what has been termed philosophy. If it has been said that this mode of "atheism" implies a greater moral aber-

ration in those who have maintained it, that cannot be just respecting the ancients, since it is but bad and contemptible philosophy, as I have remarked of all their systems : and if it is said that the modern professors of this, the prevalent atheism, if atheism it is to be called, of our own day, seek in it a greater liberty of evil, by removing Him who must be supposed averse to it, if He is the moral governor of the world, they must invent their own defence.

There are ramifications out of this mode of "atheism" also : but, necessarily, formed on different grounds from those of the preceding. If all government has been denied by the most pure party, others have admitted an original appointment for a government ; merely maintaining that the Creator took no further interest in what He once commanded, but had committed every thing to original "general laws." Or, under a yet more moderate system, the quality of goodness has been denied, or that of justice : and thus also may the denial of a future state be considered to branch out of this system of "atheism ;" while that term is also very generally applied to this modified hypothesis ; so as to confound a partial and philosophical doubt, with the absolute denial of a Deity ; as, often, with much worse opinions. Whether the systems of Demonism and Manicheism should also thus be classed, it is scarcely worth discussing in this very brief sketch : but it is plain that the whole are projects of Theisms, not of Atheism : rendering the misapplication of this term even more evident than before. And thus, finally, may they be conceived to unite with, or graduate into, the simple denial of all revelation, and, more particularly, of Christianity : while to this, the term Deism has been commonly applied in modern times ; though generally under such a looseness

of thinking, and ignorance, with, not seldom, considerable temper, that this, otherwise inoffensive word, has become a term of odium with the vulgar, great as well as small, equivalent to atheism.

It would far exceed my limits to examine all these systems in their details. More especially, it is not within my plan to examine the several modes of theism : above all, for disproof : while, involving a vast mass of discussion, these questions do not admit of sufficient abridgment. As far as this work required and permitted, such of those systems as include doubts respecting the government and the goodness of the Deity are examined where it became necessary, under the statement of evidence on those subjects : but, further than this, my design compelled me to avoid questions of metaphysical theology, and above all, of revealed religion. And it is equally beyond my bounds to enter into any inquiry respecting the causes of atheism. As those have been detailed by Clarke and others, they bear indiscriminately on proper physical atheism and on systems of theism ; as they also involve questions on morals and religion, when they refer to depravity and vice. "Atheism" like this, is a question of a far other nature than those which my plan includes ; while it would also be to continue that abuse of this word on which I have already remarked.

Slender as is the following sketch of physical atheism, I would willingly have avoided most of the details, and trusted to a general answer, on the grounds of the intelligence and design demonstrated in creation. But many of the variations require distinct answers ; especially under some of the evasions of those inferences, proposed by modern writers. Yet the systems are classed, as well as could be done in so small a space,

not as philosophy or history would class them, but so that they might be most concisely answered. Ancient atheism is a wide subject, connected as it is with the philosophy of the most ingenious people of classic antiquity ; but its chief interest belongs to the metaphysician and the moralist, the historian, the politician, and the biographer. The concern of religion with it, is comparatively trifling. As to the modern variations of those hypotheses, by Spinoza, Bolingbroke, Hobbes, Hume, and others, the examinations would be as wordy as endless, since they are seldom more than words ; while the world also is filled with this fruitless writing, leading us round and round, in mazes and circles,—to what but to more words ? As far as they demand answers on their physical assumptions, the same will serve for all.

The simplest atheism is that which denies the existence of any Supreme intelligent Mind ; while compulsorily admitting matter, as a subject of sense, or experience. But, thus simple, it is imperfect, as I have already said, and has therefore been propounded, under various additions, by different persons among the ancient philosophers. Yet among these systems, if I have justly read what is often so obscure, or defective, or self-contradictory, that we are not always sure of the meaning, I can perceive but two essential distinctions, while but one of them is proposed as a perfect hypothesis of pure atheism, as it is also a singular failure. The others appear similar, or identical ; and are often also mere quibbles of words, or little better : admitting some kind of Spirit, or First Cause ; but under different and various terms. I am aware that modern commentators have not thus considered and classed them : while even Cudworth has arranged them under a refinement of verbalities not more solid than the hypotheses them-

selves. In reality, that has been sought among them, which they do not contain; whether they were ever meant to contain it or not, or whether they are but specimens of ignorance, carelessness, and confusion in those philosophers; of the loose quality of whose logic, we have, otherwise, ample assurance. The success of Cicero in rendering them clear, is not very conspicuous: while the modern commentators, expecting to find in Greek philosophy, because it was Greek, what was not there to be found, have patched these systems into some shape, from their own ideas; yet inevitably leaving, after all their efforts of affection, that confusion and those contradictions which are truly their own. It was not this, but an accurate analysis and a just criticism which were required: if indeed they merited this labour.

The only pure atheism, or rather, attempt at atheism, as it appears to me, is that of which the original credit seems to be given to Democritus; but which is better known through the name of Epicurus, and is reputed as well as assumed to be detailed by Lucretius. I will say nothing on the clumsy and contemptible invention of the deflection of atoms; while even poetry cannot embellish this worse than puerile contrivance. How chance could guide them into forms, unless chance be the deity of this system, it is not easy to explain: but every aid may be safely given, by adding to it La Place's theory on the results of probabilities; on which I shall offer no remark at present, though it might be easy to ask of the fate of the atoms which effected nothing. But, by the hypothesis, this chance is not matter: it is either a mode of motion, or implies motion, which is power. Unless therefore matter and motion, or matter and power, the thing moved and that which moves it, be one thing, a conclusion which

our very instinct refuses to believe, the power which moves, whether it be attached to the matter, or a mere remote force, is the Deity of this system, though it will not be a designing and intelligent one. Thus does this hypothesis become a theism, such as it is. There is a prior cause, powerful and energetic, the source of motion: and our instinct of causation as much compels us to believe this, as a similar one assures us of the distinction between matter and power; Spirit.

If metaphysicians have judged this system differently, and possibly from expending on it more words than it deserved, it is thus at least that I must view it, here limiting myself to the original physical exposition of Lucretius; and thence conclude, that not only is it not a system of atheism, but that such a system is impossible; I mean under reasoning, since, of its existence under other causes, I have already spoken. And if this one is a mere nullity, a deception in words, much more will that be found true of the other systems, where a cause is granted, even in terms, though under an exclusion of its intelligence and intentions. But is it true that this is the Epicurean hypothesis? It may be so; but it is not that of Lucretius. If he intended to have maintained it, in assuming to expound it, his poetry has carried him beyond his mark, or his metaphysical acumen has deserted him, or he has found that it could not be supported. He is a theist, and could not but have known it: as Gibbon has justly remarked, "he proves a Deity in spite of himself," "combining the enthusiasm of a poet with that of a missionary." And there is not then even an Epicurean atheism; or at least we know not where to find it. Of a jargon which applies to nothing, and which, jargon as it is, leaves the chief facts untouched, it is too much to say

that it is a system of anything : but as far as a system of chance has been applied to insulated facts, the answers will recur on future occasions.

In proceeding to the hypotheses which follow, I may rank together those of Strato and Anaximander, and that which has been called the pseudo-Zenonian, a stoical system : since I confess myself unable to perceive any real differences, unless any one should choose to look at that of Strato in a stronger light, in which case it would be a purer atheism, in words at least, than that of Democritus.

Under the former, system on systems, matter itself is animated : and if thus, matter and motion are but one, a supposition which I have just answered ; or else matter itself is the spirit of the universe, or is the Deity of this school ; or lastly, there must be an *anima* resident in matter, which is the same thing. And if this system does not adopt the Epicurean power of chance, then this matter is also intelligent and designing ; which is more especially a Deity ; but under other words. And it is an eternal Deity, because matter is eternal ; being, further, an omnipresent one, as far at least as matter exists throughout the universe. Under other words than these, the aspect of this system is much more imposing : but thus do they all vanish, when translated into brief and plain language. If we despise such systems of theism, we may also wonder at the self-deception which could have believed them to be more. Whether we ought to despise the age which could promulgate and receive such philosophy, is another question. We know little of these men but that they taught, and had followers : we do not know that they were not more despised than followed ; we do not even know that they were not contemptible men.

It would be hard were the present age to be judged by some whom I forbear to name; yet even thus might future commentators have judged, could their works alone descend to posterity.

Borrowing the term pseudo-Zenonian, matter, under this system, is arranged by a "plastic nature," or a forming power: a term unfortunately adopted by Cudworth, as a secondary cause under the God whom he acknowledged. It is not the only instance of evil results from familiarity with untruth; and even India may divide with Greece the honour, such as it is, of having perverted the judgment of men who had given too much attention to their dreamings. We become fond of the infant on whom we have bestowed much labour, and cease to perceive that it is a deformed urchin.

I need scarcely repeat, that this also is but a verbal substitution: a forming power is a Deity: the plastic nature is the God of this system. Yet it has this advantage, that a plastic nature must be possessed of intelligence, since design is implied in the mere regularity and consistency of its conduct, though we did not seek for the more refined evidences of that which are pointed out in this work. It is surprising, however, that the philosophers of the Greek schools should not have traced the marks of design in the universe more systematically; still more so, that they should have overlooked or denied them. The dissections of Democritus appear to have taught him little, and the wide information of Aristotle seems to have been equally purposeless to him: whence a confirmation of the conclusion deducible from every thing else we know of their writings, that their philosophy was but a system of wordy and bad metaphysics, contemptible

even then, and still more deserving of contempt now. That which has occupied volumes of discussion, hardly merits even this slender sketch. But the ages which had no knowledge of their own, occupied themselves in discussing and tormenting that of a preceding; and we have scarcely yet discovered that we are still entangled in the trammels of these Cimmerian schools. When men shall learn to think for themselves, and not after others, they will do what few men have yet done.

Neglectful equally of the distinctions and the order of ardent commentators, I may next note the Anaximandrian system; while considering it a mere modification of that of Strato, and the most contemptible among these verbal quibbles. Yet, in our own day, we see similar philosophers seeking fame in the same manner, and equally acquiring it. But had there not been so many of those dull, and empty, and unintelligible schemes, there would not have been so many celebrated men: while, under congeniality of powers, we cannot wonder at their followers, and their success, and their celebrity. But it is as much through discussion and controversy as through credulity, that all the dreams of philosophy have acquired their importance: without it, they would have fallen into immediate oblivion.

In this hypothesis, matter, being possessed of certain forms and qualities, arranged every thing by itself. That may suffice. Let those who imagine it an explanation of any thing, read the comments which I shall neither repeat nor imitate. The system of Anaximander does not even claim the small praise of being termed an hypothesis; since it does not conform to the mere usages of thinking. I was about to say that an

infant in philosophy would not condescend to answer Anaximander now, were he one of ourselves ; but I must correct myself, for this kind of philosophy must have its merits, and why not be philosophy too ? when La Marck has discovered that the “ force of circumstances,” or “ some other cause,” is The Cause in Creation.

But Anaximander at least was a Greek and a philosopher ; and therefore he must be revered. Reason and good sense will despise the contemptible, under any language, and any antiquity and prejudice : the La Marck of his day was versant in words instead of shells ; that is all, and the difference is not important. And we should form juster estimates of those philosophers and their philosophy, did we substitute for the sonorous names of Leucippus and Strato, Anaximenes and Diagoras, the familiar ones of our own day, and mix with them as tutors, masters of academies, writers of speeches for parliamentary orators, special pleaders, attorneys at police-offices, and disputers in debating-clubs : for even such were the philosophers of Greece.

In truth, those men and their systems were never worth the examinations and the attacks to which they have been subjected, and by which they have been raised to an importance that would surprise even themselves could they revive to witness it. Equally vain and empty, aiming at conspicuity from motives of gain, as well as the desire of notoriety, since this was their trade and their estate, pert, disputatious, and babbling, they were ever seeking to walk in air (*αεροβατειν*) ; as Aristophanes, with little justice, says of Socrates. And this too is all the censure they merit : while those who have brought against them charges of which they never could have dreamed, should have simply asked what

the men were, and what their knowledge and usages. That no question of religion ever appears to have been concerned, I have already said.

This is sufficient respecting the apparent, or assumed atheistical systems of Greece, little as they can truly claim this title ; although, that some of them at least did pretend to it, we must believe from the remarks of Cicero. But they pass into indisputable theisms, however these may have been confounded with the others, under the common odious term, by certain writers more remarkable for ardour than knowledge. The briefest possible notice of these will, however, suffice ; as they also only require notice here, on those points in which they oppose what I have attempted to prove in this work.

The hypothesis of Aristotle admits that God created the universe from matter, but, like that of the Stoics, asserts that He is over-ruled by fate, or necessity. If this system has afforded abundant ground for wordy subtleties, a very few remarks on this fate will suffice for the present purpose. It denies the supremacy of the Deity, unless indeed it should be deemed only to deny His unity : yet so acute a philosopher, had he been as much interested in these questions as we are, should have declared this more distinctly. If the Deity is over-ruled by a superior power, that must be a superior mind, or spirit : in which case the real God of this system is removed but by one step. But of this and much more, I may remark, that these philosophers had borrowed from the Oriental theology, what, possibly, they did not well understand, or what, with equal probability, they wished to pass for their own under new terms. In any other sense, necessity, or Fate, can have no meaning, under the Greek philosophy at least : but

the views of the Roman theology were widely different, when Seneca says, “ Ille ipse, omnium conditor et rector, scripsit quidem fata, sed sequitur. Semper paret, semel jussit.” The translator of Mosheim has indeed said, that this was the real view taken of fate by the wiser among the Heathen philosophers : but it is visible from Cicero (Nat. Deor.) that such was not the case in Greece at least. That the views of modern theology agree with those of Seneca, I need not say : the “ necessity” of this, meaning that the will of the Deity, being His rule of conduct, fixed in wisdom, must be, as He is, from all eternity. But I am not here called on to investigate the thorny ramifications of the question of necessity : as it was also not a part of my plan to examine the whole of any of these systems.

The only other assertion among these hypotheses which it seems necessary to notice here, relates to the eternity of matter. As stated by the Epicurean school and those branching from it, I have already noticed it ; but when by Anaxagoras, Plato, Aristotle, and more, as a co-eternity with a Supreme Deity, it is but a mode of theism, not an atheistical system, as it has been unjustly termed. Yet it is a singular oversight in so acute a philosopher as Aristotle, to say that the Deity created this eternal matter : since that is a simple contradiction in terms, to be detected by the meanest arithmetician, and which surely ought not to have escaped the very worst of metaphysicians. A poet and an orator, like Plato, may be allowed to forget himself occasionally.

And if I might still have protracted these examinations, as I might have adopted an order and a minuteness of statement more conformable to the usages on this subject, I shall conclude with one general remark on the “ atheisms” which seem to myself but awkward

systems of theism. When they do not substitute one term for another, yet doing this under a discreditable ignorance of the facts before their eyes, and a lamentable want or laxity of reasoning, they only remove the Supreme Cause by one step, producing a plurality which increases the difficulties instead of destroying them, and terminating in a mythology almost as unwieldy as that of Hindostan. It is Brachma creating under Brihm.

This must suffice on the subject of the Greek philosophy respecting the Deity and the universe : on that which has been called ancient atheism. But the remarks which I have made on the feebleness and carelessness of these hypotheses demand some extension, for the sake of those who may be surprised at such criticisms on what they have been taught to venerate, or who, in the ardour of illustration or controversy, have conferred on them an artificial importance, as the warmth of their own minds has blinded them to the errors or oversights which I have pointed out. Had they originally been treated with the neglect or contempt which they deserved, we should long since have ceased to hear of them ; and even the modern atheisms, which are but copies of them, might never have been produced. But the idleness and ignorance of the schoolmen prolonged their existence by the logomachies which formed the philosophy of those days, and our systems of education have done the rest.

But they alone will be startled by these remarks, who hear or talk of Greece without knowing what she really was. He who does, will not wonder ; though his reading should never have led him to inquire respecting this portion of her philosophy. It has been said, with as much truth as satire, by a well-known writer that the Greeks

had written many words about very little : “ tant de phrases et si peu de choses : ” and even a slight knowledge of their works will prove the truth of this remark. Useless subtlety, loquacity, frivolous investigation, love of argumentation ; these are as visible in Euclid as in the disputations of Socrates and Epictetus. Cicero calls them “ *Homines contentionis quam veritatis cupidiores ;* ” and says it is a national fault : “ *quocumque in loco, quoscunque inter homines visum est, de rebus aut difficillimis aut non necessariis argutissimè disputare.* ” Poets, orators, rhetoricians, rather than philosophers, the contrast between the scantiness of their ideas and the profusion of their language is remarkable ; while the impression left by all this brilliancy is that of sound, not sense : pleasing the imagination, but teaching nothing. The French wit should not however have forgotten the nearly equal claims of too many among his own philosophical countrymen ; who, in their admiration of “ style,” to the neglect of facts and thinking, seem to forget that it is but a splendid dress on a lay figure ; the brainless statue.

I do not say that this censure applies to the whole period of the literary brilliancy of Greece ; yet such is the character of that long and somewhat early portion of its history which we have been taught most to admire, from its military features and political energy ; such as those were. It might therefore be considered, as I have already suggested, that those systems of “ atheism ” (if they must have this name) which I have first noticed, were, like all else of its philosophy, but specimens of that want of depth and exactness of thinking, of that substitution of vague generalities for accurate ideas, and of hypothesis for observation, which pervade all the analogous writings of the Greeks. But I know not that I am

quite justified in attempting to acquit these doctrines of evil consequences, or always, perhaps, of evil intentions, by saying that they had no bearings on religion ; even should I refer to their prayers, and other practices or creeds, or to occasional passages in the writings of the poets and philosophers, in proof of the belief of some ruling Deity, on the part of the multitude.

This suspicion arises from the equally wretched nature of their systems of ethics, and of their practical morality : while, if not competent to prove that, it at least indicates some radical deficiency in the intellects of this people. With but few exceptions, their writings display an utter indifference to vice and virtue, exclusively of the military and political ones : their moral rules relate to little else than the petty interests of a state not often much exceeding in importance a town or parish in our own country ; and if they do not bear on the great interests of mankind at large, or on private life, we also know how these political ends were pursued, and what their practical morality was. And that their systems of atheism, or theism, had some evil influence, we might also conclude ; since, when their moralists note guilt, they seem to consider the guilty as an irresponsible being, the toy of fate, and the sufferer as a victim deserving pity rather than censure. This is at least a species of practical atheism : but we must not scan it too closely, lest we discover that the fatalists of Greece are not the only censurable speculators on this subject.

Be this deemed a proof, or not, of the intellectual deficiency of this people during the period to which I refer, it is already apparent that a great change had taken place about the time of Aristotle ; while every one is acquainted with the far superior moral and reli-

gious views of Socrates. And this improvement we continue to trace onward, from the first great change in their political condition, to their final subjugation by the Romans : while it may confirm the already suspicious ill effect of their theological philosophy, to remark that juster views of the Deity, and sounder systems of morality, arose and proceeded together. And as the period to which I allude was prior to the Christian revelation, we cannot attribute the change to this cause ; as we have also no evidence to prove that they had derived any knowledge from the Jewish people. How far, and in what order, these two great facts were mutually dependent, it is out of my bounds to inquire ; as it equally is, to note the debts of the Romans, at a much later period, to the true religion. But this at least is plain, as it is deducible from their political and private conduct, when contrasted with that of the Greeks, that these were a people of a more solid character, observing better, reasoning more justly, and, in philosophy, more sound : as will easily appear from a comparative examination of even the poets and historians on both sides. Nor do the evident debts of Cicero to the philosophy of Greece annul this conclusion ; when we find in him what we cannot extract from the whole of them ; juster views of the Deity, under arguments which often leave us little more to do than to illustrate them by facts then unknown, together with a system of morals which the united writings of Greece could not have furnished.

Terminating now with the Greek systems of atheism, as I trust that even this very brief sketch is sufficient to show their futility as well as their nature, I do not perceive that the other systems which attempt to exclude the Deity, are aught more than substitutions of one term for another ; as the modern phrases have sometimes

perhaps been varied to conceal the plagiarism, though not unlikely also to have been the original produce of men no less vain and superficial than the Greeks, and too ignorant to know that they were borrowing. In these, it is rather the word God which is suppressed, than the existence of a Deity kept out of sight, far less disproved ; and they are thus mere self-deceptions, while they ought never to have deceived those who have so carelessly been misled by them. If to disprove them by facts be necessary, they are disproved by every page of this book : but they carry their own condemnations with them.

The modern systems, or rather, terms, in question, which have been most celebrated, are, Order, Principle of order, Nature, Laws of nature : and if there are more, they differ only in the sound. A very few remarks will serve for the whole. They have been abundantly discussed, it is true ; but it is the virtue of few words to render plain that which thousands have obscured ; as one glass will transmit a bright image of the sun, where hundreds produce but darkness and confusion.

Order is a fact, the produce of power and wisdom : it is not a cause ; and still less is it a moving force superior to matter. If principle of order means anything more, it is, that this order is universal, or is under the guidance of some designer, inasmuch as it is a design. Hence there must be a preceding and a superior cause : while that Cause must be wise, since to conceive order implies wisdom ; and powerful, because to put it into execution requires power. And if this is not a Deity, God, the advocates of the principle of order must show what it is.

Nature is a convenient term : in ordinary scientific

inquiries, it is indispensable, that there may be due reverence to a name not to be rendered familiar with impunity; as there are also many associations in which it ought not to enter. But while it means either the Creator or the creation, none but those who use words, without ideas, can suppose that Nature is a power which is not the Deity.

The phrase, *Laws of nature*, demands more explanation, as it has been used in more senses than one. The laws of a supposed power, called Nature, are the rules, or the order, through which the Creator governs what He has created. But using nature, in its just sense, as meaning creation, these laws are laws for nature, and consequently, laws proceeding from the Creator. In a strict philosophical sense, the things usually comprised under this improper term are not laws, but general facts, commonly including subordinate ones, or principles uniting certain effects, whether under sources, or in modes, of motion; classifications. If any one can be misled by the sound of the word law, as thus abused, he may recollect that a law requires a lawgiver, at least; and further, that to execute it, requires an agent: while the first can be nothing but a Deity; as is not less true respecting the second, unless we adopt a species of polytheism. Or unless we adopt the other interpretations of this phrase; in which case, the term *Plastic nature*, which, as I have already said, Cudworth borrowed from the Greek philosophy, is more appropriate and explanatory. In his case, believing in the God of revelation, it must mean that the Creator had communicated to matter certain powers through which it governed itself; and I need only note the badness of the philosophy: but if any one has believed that such

powers were inherent in matter, it is but the system of Anaximander, and does not require to be again answered.

Thus do those systems, like the predecessors which they have aped, vanish at a touch; so impossible is it, by any efforts of what has been so idly dignified with the name philosophy, to rid ourselves of a Deity; to be, in the rigid sense of that term, an atheist. If any one imagines himself such, not having read or thought, he is only an atheist as a quadruped is: he is nothing; a nonentity under this question, and demands no notice. If he has thought and read, and still believes thus, he has proved that he can read without understanding, think without reflection, and therefore, believe without conviction: whence it would be equally easy for him to believe in the Deity, did he choose to do so; since such belief is a belief of the will, not of the understanding.

Hence the existence of a spiritual and eternal Supreme Being, the Creator of the Universe, and therefore Powerful, at least, if nothing more, remains established, even without direct proof: or through disproof of all the attempts to evade a conclusion, which depends, partly on extremely simple reasonings, and partly on our instincts, or implanted convictions on certain points. The several systems of atheism differ in little more than words; but differ as they may, their analysis has shown, that so far from excluding a Supreme and Eternal Cause, they establish one. They have chosen other terms than Deity for it, but that is all. They cannot annul that which is a compulsory inference from instinct and reason: it is a vain effort to labour to prove the negative of a fact which cannot but be; and the end is that self-deception which ought to deceive no one; substitution. The question may be tormented and

darkened by words ; but the analysis of those will ever bring us back to the same conclusion, and that conclusion is compulsory. There is nothing without a cause : matter could not create itself, and it is inert : it exists and moves : it can move but through the power of Mind, the source of motion, as it exists but through that : and this Mind must be, and is, God.

But I must not terminate this chapter without some remarks on another celebrated hypothesis, which has been called an attempt of modern atheism to shift its grounds, as finding the former systems untenable. If Hume viewed it as a more perfect system of this nature, he has committed a singular oversight, in not perceiving, that if even the presumed fact were established, the existence of the Deity was as effectually proved in this manner as in any other ; while there was granted to Him, power even more incomprehensible than what we already believe, with a spirituality and a universality which leave nothing to be argued in proof of those modes of His existence. That such an hypothesis is not fairly deducible from the theory of Locke respecting ideas, metaphysicians have shown.

I allude to that hypothesis which disclaims the existence of matter ; of the invention of which Berkeley has the reputation, though it is of a long prior date in the Hindoo metaphysics, and even in all the fulness of this writer. Be it admitted that we cannot prove the existence of matter, metaphysically, nor even prove it physically, if the only proof to be admitted must be contact, it is, still, one of those instinctive beliefs which no reasoning can shake. Let the words of metaphysics go for what they are worth : but the physical arguments are sufficiently worthless, as it required the heat of hypothesis on hypothesis not to have perceived this. The

non-contact of distinct bodies does not prove their non-existence: and the expansions and contractions of bodies under changes of temperature prove nothing but our utter ignorance of their nature, and of that of heat; while the inference in question, hypothesis as it is, rests on a previous one; that of ultimate and impenetrable atoms, the corpuscularian hypothesis: a pure fiction of the metaphysical mathematicians, on the further bearings of which I shall have occasion to make some remarks in the course of the following work. This is of the things which have, not very judiciously perhaps by a metaphysical writer, been called questions of Common sense: we can form no conceptions of the motion of nothing or the repulsion of nothing. To apply a vulgar, but expressive term, from the same source, it is, simply, nonsense: though experience has proved that sensible men can write nonsense, provided they use words enough, till they think it is sense.

If the hypothesis of Boscovich is viewed as a mode of the Berkeleyan one, it thus amounts to nothing, as inferring non-action in the Deity, as much as it does in a physical view. We may write words in abundance, respecting spheres of attraction and repulsion, but there are no conceptions attached to them: the subject eludes or confuses us when we attempt to think: and were it not indeed from the facility with which words can be divested of ideas, and still collocated in the form of language, few of these and similar hypotheses could ever have existed, to excite controversies among the dealers in words, and be neglected or despised by those who think. We can as little also divest ourselves of the compulsory belief in power, mind, Spirit, as of our belief in matter; though one class of these philosophers has denied the one, as the other has denied its

own peculiar object of aversion; while the great sceptic in this cause imagined that he could disbelieve both. Such aberrations of mind are beyond argument, if they are of bona fides, for they are hallucinations: if otherwise, they do not deserve it. But the spirit of controversy can feed on anything, and thus has it conferred celebrity on that which should have been allowed to fall into silent neglect.

But independently of this, the mode of reasoning in this case, as in many others of a similar nature, is so radically faulty, that we must wonder how any metaphysician could overlook aught so obvious, since it involves the very nature of Proof. To prove, is to appeal to axiomatic principles, to instinctive truths, or to the senses: and whatever previous steps may be required, they are but the means of arriving at that which is The Proof. Nor can there be any appeal from that: it is final. Be it refused, there is no other; we must be content: and to attempt to prove, through reasoning, that which is already thus proved, is a superfluity; as to disprove it, is an impossibility. In the former case, we return to the same point, through identical propositions; in the latter, the mind may be bewildered, though it is much more common to fancy that it is so, merely from the want of words of meaning to answer words without meaning; but it cannot be convinced against conviction. If there is a metaphysician who imagines that he has thus counter-convinced himself, he is either thinking too much of his words, or he has disordered his own mind.

The undeservedly celebrated syllogism of Des Cartes is an example of the first case; as I must note it: of the last is the attempt to disprove matter; of that, I have not yet said enough. "I think; therefore, I

exist." The former is as much an assumption as the latter : or rather, the consciousness of both is similar and equal. Or, if the existence is to be proved from the thinking, this latter should first be proved ; else is the syllogism nothing, for want of the first step. But the folly of this much-discussed and vaunted proof of existence, is still more striking than the badness of the logic ; as the very logic itself is even worse than I have thus represented it. To think without existence, or before existence, is an impossibility : but the very first word in the " magus," the I, has already assumed the existence as proved, since the Ego is the consciousness of existence. The internal, instinctive, conviction, is the proof, in both these cases, as in others : and he who does not believe that it is so, must contrive for himself some means of believing that he does not exist, and is not thinking, or believing, that he is non-existent.

If this is an example of the metaphysical folly of attempting to prove by words, that which neither requires arguments nor admits of any further proof, so is it an instance under the instinctive belief of the feeling of power, or of something which cannot be matter. It may suffice therefore to illustrate the nature of our conviction, or proof, respecting spirit. Respecting matter, the appeal is to our senses : so that, pursuing this system according to the rules, it was first necessary to show that we actually did possess senses.

Whether those senses, however, are really senses or not, or can feel contact, see light, and so forth, I have no means of proving : each man must judge for himself : but if they do not, then is there no such science as geometry : it is not indeed very easy to see what there is to be. The final term of all mathematical proof is an appeal to sense. Under the Berkeleyan

dispute, that proof is ever present: matter and mathematics must fall together. Two triangles are cut or drawn, and placed in opposition: we see and feel that they coincide: and this is the ultimate reference; The Proof of all geometry. Deny the validity of the senses to the conviction of magnitudes, or of matter, and it falls: all else is but a catenated series of syllogisms, based on this most vulgar proof to sense: to common sense, if that term is to be allowed. Had these metaphysicians forgotten even this, or not known it?

But enough of this. Let it be granted that there is no such thing as matter, no such thing as spirit: neither matter nor spirit; nothing. Let that which has been called the most solid of all the atheisms be admitted. There is at least the person, or the thing, the entity, the something, that which is without matter or spirit, capable of believing, and believing, that there is neither spirit nor matter. It is therefore a thing, some sort of entity, capable of being deluded into the belief that it does not believe any thing: but if this conclusion is too absurd a deduction, where it is really not easy to draw any other, there is at least such an incomprehensible entity, actually deluded into the sense, if not the belief, of the contact of matter. It must therefore be deluded by some cause, or power: and as this great deluder must needs be a power of universal presence and eternal existence, or at least of an existence prior to all else. and further, possessed of means of delusion which nothing but the most incomprehensible qualities could include, it can be nothing but the Deity: a will and a power every where, and from all time: the omnipresent, and universal, and eternal Cause. If there is not the God who is to be believed by us, then must the abettors of such hypotheses prove

that they did not think while they were thinking, had no existence, were nothing.

Less than this had been more than enough. Greece itself deserved more: but modern celebrity demands what may safely be refused to antiquity. I have therefore disposed of those systems which have been regarded as projects of total or perfect atheism: but there are some partial ones remaining, such as they are. And such as they are, they are rather evidences of the wishes of their propounders, possibly much more of their ignorance and vanity, than specimens of their success. Their pretensions indeed are not very extensive, as their objects are partial, or limited: but be the motives what they may, the purpose ever is, to disclaim or renounce a Deity, as far as it is possible to succeed in this attempt, consistently with the lights and evidences of modern philosophy; though the power has not kept pace with the will.

These projects, however, I have reserved for another chapter: their specific and detailed nature sometimes demanded detailed answers: as there also will be found a general answer of detail, serving for numerous partial hypotheses based on the Epicurean system of chance: a species of answer which was needed, because the celebrated mathematician to whom I have already alluded, has evidently attempted to re-establish or support such a system, through mathematical reasonings which Greece never thought of adducing. It was content with words: but he who assumes to prove, must be answered by facts.

CHAPTER III.

ANSWERS TO CERTAIN SYSTEMS OF ATHEISM.

I SHALL not commit any great error, in considering the larger number of the hypotheses here collected, as imitations of the Greek systems; however partial, or modified by new knowledge, or concealed under new terms; as their tendency, and also the apparent wish, is to substitute some other power for that of a Supreme Deity, or at least to set up another one as His associate in the creation or direction of the universe. The accusation of atheism is not however my own: I borrow the term as it has been used, while I have already given my opinion on its abuse: but, of many of the propounders of those schemes, it appears safe to say, that they would be little thankful for being defended from this charge. Let it however be recollected, that men do not always trace their own motives, nor follow their trains of thought, either up to their causes, or to their consequences; as they will often renounce inferences which they had not contemplated. And while there is implanted in us an insatiable spirit of curiosity, with a restless desire to ascend to the causes of things, so is imagined success a subject of self-complacency or pride: whence it is not wonderful that vanity becomes the frequent stimulus to the substitution of hypothesis for truth; as the mere exercise of the imagination is also a source of gratification.

Of these hypotheses I would willingly have said less than I have done, since time might be better occupied ; yet it will be something to show the yet uninformed reader, to what awkward contrivances, untruths, and contradictions, this philosophy is obliged to resort, in its attempts to set aside a designing Creator, while, in labouring to remove an imaginary difficulty, it encumbers us with impossibilities. Had they any beauty or ingenuity, they might still have had their attractions : but romances equally dull and clumsy can only make us wonder that men pretending to talents should have promulgated them.

Such as they are, they are referable either to the system of Epicurus, namely, that of chance, or to that of Anaximander : if indeed it be worth while thus to class them : but in the former case, the attempts are both partial, and disguised under another phraseology and shape ; as, in the latter, they seem limited to organized bodies.

The speculation of Buffon respecting the planetary system is one of those partial hypotheses ; intended as a scheme of chance, yet productive of no result. Mathematicians have long since answered what belongs to mathematics : and though they had not, the previous existence of the sun alone, leaves it in a state of nullity as to the proof of anything : since that body implies design as well as creation. What he has borrowed from Des Cartes respecting the machinal nature of animals, will come under examination in future parts of this work. Were it even admitted that they were pure machines, such machinery as this is a sufficient proof of an intelligent Designer. The great stand indeed of all those systems has been made on the animal creation, under different forms and terms : but

though they were as true as they are not, they would not prove what they have been intended for, though they might change our views of the modes of Intelligence and Design visible in Creation, or alter the complexion of the still overpowering evidences. If it has been thought that such wretched reasonings were a proof how far a hatred of the Deity, and of those who believe in Him, could pervert the judgment, they are at least safely pointed out as examples of vanity and presumption; as of ignorance alike uninformed respecting the facts thus brought forward, and those which might be adduced in opposition.

It is one of those speculations referable to chance, that the animal creation was not arranged as it now is, by the Creator, but that a much greater number of forms was originally produced, without any plan, and that the present ones have remained, while the rest have perished. If the purpose is not very intelligible, the answer at least is easy. It is the assertion of a general fact, unsupported by a single instance: and that it is also a gratuitous one in the face of all experience, will hereafter appear from the remarks on design in this part of creation.

It has been said also, that as all organized bodies must have had some forms, the existing ones are incapable of proving a design; whence, any appearances of such design are but the results of chance. But although we should grant this, it will not set aside a designing Creator, as long as there is a planetary system in which design is so clearly proved. Yet it is an hypothesis that cannot be granted. It is answered by facts so simple as the genus in an eagle or a rose: as it might be, by thousands more, all through creation.

If there are more of those partial systems of chance,

they are but fragments which will occur in the course of this work, together with their answers; but, wishing to condense within these two chapters, as far as possible, the sufficient answers to general systems of "atheism," I have selected a single and special instance for analysis, as a reply to that universal hypothesis of chance which supports itself on the mathematical doctrine of probabilities; because it is one which is susceptible of rigid calculation under that very doctrine. And if that which exists could not happen under that hypothesis, then is it not the cause which it has been asserted or suggested to be. I leave to others to explain the bias, or aberration of judgment, which could thus have misled such a mathematician as La Place, on his own subject.

In its embryo, the feather of a peacock is little more than a bladder containing a fluid, while every one knows the general structure of those long ones which form the train. The star is painted on a great number of small feathers, associated in a regular plane; as those have found their way from the root, through this long space of three feet, without error of arrangement or pattern, in more millions of feathers than imagination can conceive. If this is sufficiently wonderful, the examination of each fibre of this canvass (to adopt this phrase) will much increase the wonder. Taking one-half of the star, the places and proportions of the several colours differ in each of those, as do their lengths and obliquities: yet a single picture is produced, including ten outlines, which form also many irregular, yet unvarying curves. And further, the opposed half corresponds in everything; while this complicated picture is not painted after the texture is formed, but each fibre takes its place, ready painted,

yet never failing to produce the pattern. If this is chance, the coloured threads of a tapestry might as well unite by chance to produce a picture: while every annual renewal is equally accurate, as it has been in every such animal since the creation. And whatever the other chances may be, enormous as they are against the hypothesis, this further number cannot be evaded, because it would be to abandon the very principle of Chance, to say that renewal, or perpetuation, was governed by laws. If the system is to mean what it pretends to do, every feather that ever existed must have been the result of fortunate chances. This would be enough, had this object not demanded the arithmetical calculation: for, omitting all else, who would even hope to reproduce the star from the same, separated, materials, under any number of chances?

But the entire analysis I need not here make in words: it can be done by any one, on the subject itself; and with a more satisfactory effect. Let him take each fibre separately, note the number of the colours, their gradations, the very different modes of those on the different fibres, and the very different places of those colours on them, with the still more remarkable differences in those fragments of the many outlines included in the star. The painter, who best knows the difficulty of producing gradations on even a fixed plane, will best also conceive the impossibility of producing, under any number of chances, such a coloured plane, from a hundred separated fibres, previously painted, or even of thus producing the much easier outlines.

But who will compute this unwieldy sum? The result alone, the figures expressing the chances against one, that this little object was not the produce of

Chance, would fill a page : it is equivalent to infinitude against one. Suffice it here, that I inquire of the probability of simply replacing, by chance, the disarranged and intermixed fibres of the star, in their original places or order : while, even then, I need not take more than the half, as the result of the total is equally unnecessary and unwieldy. It would be a purposeless parade of arithmetic to detail those figures : if the reader will place a unit before sixty-four zeros, he will have a sufficient conception of these chances, for the present purpose. And chances far short of this have ever been held competent to any proof.

I need not say that similar conclusions may be drawn from creation, without end. They have been thus drawn, from the parts of the eye, from the arrangements of the planetary system, and much more ; as equivalent arguments against the chance power of Epicurism in nature, have been produced from works and proceedings under art, by showing the equal impossibility that types should thus be arranged into a book, stones into a building, and so forth. But that which is answered is answered. And this might suffice for those hypotheses which are most easily classed under the doctrine of chance, if I knew where better I could place what has been termed the System of Appetencies.

The system of appetencies is not justly designated by this term ; since the hypothesis includes both appetencies and efforts ; confounding itself, moreover, in such a manner between the two, that its conclusions defeat themselves ; as will immediately be seen. That it is intended to exclude design on the part of the Deity, in the animal creation, is the obvious, or rather the declared purpose : and since efforts and resistances are at least uncertain, whatever desires may be, it is, if any thing, a

mode of the system of Chance. Of the inventors of these hypotheses I have seldom spoken ; since it is not the contriver but the system and its purpose, which is the object here in view. In the present instance indeed I know not that the claims would be easily settled ; and although they were, the rights to error are of as minute a value, as its chronology is little worthy of investigation.

I am compelled to state this system because it can scarcely be known to general readers : especially because Paley, in answering it somewhat fully, has neglected to do so, and has thus left his own readers at a loss. Perhaps indeed the mere statement is the best answer that could be made to it : while if there are any who doubt my good faith in this, I must refer them to La Marck and De Maillet.

The least known animal of creation is termed monas : and it was once supposed a simple form, without organs, either external or internal, or a merely living atom, and therefore the lowest form of life. This is said to have constituted the first and sole animal creation ; and, that desiring to improve its condition, this desire, or appetency, became sufficient for the acquisition of what was desired, while the several marine tribes were the gradual result. Some of those fishes forming desires to fly, and others to walk, the terrestrial creation was produced : while all those improved productions became also perpetuated. And the imaginary transitions, such as the manati and the penguin, are adduced as proofs of this process. The same is asserted of certain variations of parts, in animals of a general similarity ; though, in this case, effort and resistance are added to desire. If the bird which desired to swim became web-footed, the effort to penetrate the ground caused the woodcock's bill to elongate, and the

action of the water on the thighs of the wading birds deprived them of their feathers.

This idle and puerile romance is not at least an atheism, though it may have been intended as such by some of its abettors. The Deity created and gave life to the monas at least, and, with life, the imaginary powers: since, of all power, there must be a cause still more powerful, till we arrive at the prime Power. It will shortly be seen how this monas and its energies bring this hypothesis into union with a subsequent one: as the application of the well-known term, monad, of Leibnitz, to an animal, has probably been the source of the whole dream.

Of facts in evidence of this system, there are none; other, at least, than the worthless ones just noted. And as the "onus probandi" lies with itself, the legitimate and sufficient answer should be—, it is not true. But it is not necessary to avail ourselves of this logical privilege. We are now fully able to reject the ancient doctrine that "nature does not proceed *per saltum*," and that there is a gradation of forms all through creation. There is no such graduating scale: the species are determinate, notwithstanding those imaginary transitions, which are, themselves, parts of a definite plan. No species passes into another, or has ever done so: the varieties which we occasionally see are variations of unimportant parts; and they return again to the original condition, or type, as it is termed; that type being a portion of the total plan of the Creator. The extinct creations present the same steadiness of forms. If anywhere, we might look for the imagined changes, in the lowest organizations: but the Hydra, Actinia, Medusa, the Fasciola, Tænia, Hydatid, Ascaris, Ligula, the still simpler, or at least more minute, Volvox, Vibrio,

Enchelis, Trichoda, and even the Monas itself, are now what they have been from all our knowledge of them, and their successors are for ever the copies of themselves. But the prime foundation is false : it is but one of the numerous cases, so often noticed in this work, in which science mistakes its ignorance for knowledge, and then proceeds in the erection of its theories. The infusoria which possess no external organs, are known to be of an intricate internal structure, equalling that of animals far higher up in the scale of magnitude, and exceeding in this respect many of considerable dimensions.

This general answer from facts is ample, for any one acquainted with natural history : for others, I must follow the method of the writer just named : especially as this includes the cases of effort and resistance. If efforts could produce a modification of parts, the men of the South Seas would have gained palmated hands and feet, as well as the duck : the monkey might have acquired a better thumb. If desires could produce wings, as they once did in the fishes, man should have flown long since. A desire prolongs the bills of woodcocks ; but if resistance destroys the feathers on the legs of the waders, why does it not wear down those bills, and reduce the palmated foot to the divided one ? Comparing the breasts of the swimming fowl and the thighs of the wading ones, how does the same action of water destroy the one and increase the other set of feathers ? The desire overpowers the resistance in the former case ; and it is the reverse in the latter, we must presume : as the desire for warmth suffices for the legs of the ptarmigan, but not for those of the waders. The camel's hump arises from pressure : but whence that of the buffalo, and why has not the horse one ; or why a Bactrian and an Arabian camel ? How did the elephant drink before wishing had produced his

trunk ; the whale feed on shrimps, without suffocation, before its whalebone strainer was generated ; and how did this food produce such a piece of machinery ? Whence did the Beroe acquire what was not needed ? since the Medusa does as well without, and it was originally a medusa. What was not wanted could not have been desired : but, being there, in whatever manner, the resistance of the water should have destroyed it long ago. One worm desiring to be a centipede, gained sixty legs ; and another, a hundred and sixty : but when walking was once possible, whence the superfluous desires ? The Actinia shows the most intense desire for light, yet has not gained eyes ; though it was thus they were acquired by other animals. All fishes should have equally desired to fly, since many of the wingless ones are always attempting something equivalent ; yet only a very few have succeeded. All should have had the defences of a Balistes, since all are equally in want of them : and though the stag at bay would willingly have the horns which it lost a month before, they have never yet been permanent. But, to drop these endless answers ; under a system of efforts and wishes, unless indeed this hypothesis will also define when, and why, and under whose command, they ceased, the present creation would be ever changing, and monsters and chimeras would no longer be the work of imagination : while, under a system of resistances, animals, originally complicated, might have been worn down to a fish, or even to a mere monad.

There is a feeling of shame in being compelled to give such answers to such folly : for the self-contradictions of this childish system are apparent. A metaphysician might return the much briefer one, that the desires of all animals are specifically, and even indivi-

dually limited, under the limitations of their several freewills : as I shall hereafter show that the order of Creation is preserved by this equally simple and effectual contrivance. "Atheism," however, cannot contrive to agree with itself : and thus do the several propounders of those systems oppose each other, at least as much as a sound philosophy opposes them all. The machine animal, and the animal possessed of such powers of willing and attaining, are not very reconcilable disproofs of a Creator.

But this system would have been imperfect, had it not also attempted to explain the origin of plants without His intervention : while that attempt ends in nothing ; or rather, perhaps, should be considered as appertaining to that Anaximandrian system, the Nisus, to which I shall, thus, easily pass.

Borrowing from Thales, water was the first and only created thing, or perhaps, to be more accurate, the only existent thing. If, out of this, the solid earth generated itself in some manner, so did plants, and in an order similar to that of the production of animals. A Mucor is the equivalent of the Monas : and the gradual progress from marine to terrestrial plants, first, and onwards to the oak and the rose afterwards, is a parallel to the preceding case. That plants possess appetencies, I think has not been asserted : in what manner the Nisus acts in this case, the system itself must explain. But having fairly arrived at the hypothesis of the Nisus formativus, I must bestow a few remarks on it.

I have already said, that this is but a mode of one of the systems of Greece. Matter is possessed of "certain qualities," or powers, if not also of "certain forms : " the present improvement is, that it has no

form but that of the sphere. And the *nisus* in those spheres, being at the same time life, produces all organized forms; in some manner: while that "some manner," though not declared as such, and in those terms, is the great accessory cause; as the "force of circumstances" is declared to be by one of these philosophers. But the system of to-day is but that of the living monads of no distant one, as I have already said: so difficult is it even for folly to be new, though it is a sufficient proof of ignorance to reproduce an old folly as a new one.

Be matter spherical, or though it should consist of *spiculæ* and pores, or of any multitude of forms that an Anaximander could desire, the words that once satisfied Greece, will not now suffice: objectors at least demand something more: and thus must system makers attempt more: whence the answers become more special. There is a *nisus*, not to produce forms generally, but specific forms; because specific forms exist: and therefore there is not one *nisus*, but millions. There are not millions of elements or forms of matter: in the spherical hypothesis there is but one. Whence then so many separate *nisus* in one, or a few forms; and such *nisus* being a constituent, inseparable, portion of the material element? The same element, or monad, wills to produce an animal at one time, a plant at another, a stone at a third, and thus, to millions. And if the "principle of life" be substituted for the word *nisus*, as in the more modern fashion of this system, the conclusion is the same: there are many qualities of lives, designing and acting, in one body, or one life designing and performing many different things. It is pitiful to reflect, that man, the only being created to reason, should reason so ill. But this is more than enough: the *nisus*

formativus pretends to be a purer system of atheism than some others ; and it gives us a million of Creators instead of one : if indeed it is easy to say what it does. Let it be accepted as a species of polytheism ; if there is any one who thinks it more philosophical and desirable thus to believe, than to repose on one God, the source of all thought, all will, all action, the Creator of matter, and the Creator of the universe.

I am, fortunately, approaching to a close : what remains is almost too trifling for notice : but the reader to whom all this is new, should at least see what this philosophy has attempted ; and wished.

Organic forms have not been created as we suppose, but under a system of “ pre-existent moulds.” This is but to remove the Creator by one step, if He created those moulds : otherwise, this is the self-existence of forms of matter ; the former system in a more operose and awkward shape.

Lastly, and quitting these more perfect attempts at Atheism, it is said that the parts of animals were not made for their actual uses, but that those have been discovered by trial. If this means anything, it is an attack on final causes, as far at least as animals are concerned : yet, were it a successful one, it would but diminish, not abolish the evidences of design. The eye may here serve for a sufficient answer : but the following work abounds in answers.

More there might be found, and much more I might have answered to all that has preceded : but if modern courtesy will not allow it, I may borrow from an ancient philosopher, and say that I have already answered “ the fool according to his folly :” it must suffice to have been thus much “ like him.”

I may conclude now, generally, respecting the sub-

jects of both these chapters: "atheisms," as they have been called, whether so intended or not, in the odious sense of that term. I have shown their inefficiency, when, in attempting to establish the non-existence of a Deity, the only result is to remove Him one step more; while the inventor fancies the triumph achieved, because he then shuts his eyes. I have shown their want of variety when ancient, with the plagiarisms, or imitations, of the modern ones. It has also been seen, that if the more perfect systems are unsuccessful, the failures of the partial ones are as complete, on the few points which they have undertaken to oppose or question: while, endeavouring to enter on more detail, the falsity or deficiency of evidence is as conspicuous as the badness of the reasoning. Their true nature and value will thus be seen, while, believing that the most honest statement was the best answer, I have, in no instance, attempted to misrepresent them. And this view will be the more useful, from its condensed and general nature, or from that approximation by which their weakness, with their want of ingenuity and variety, have been equally shown. An undue importance has been attached to many of them, especially by young persons, or by those who had read but of one or two, or who were unacquainted with the philosophy under which they rank, or lastly, were unacquainted with creation. They have also gained importance, as well through controversy as illustration; and they have gained that too, under weight of names, both ancient and modern, if most so perhaps, under the prejudices respecting Greece and Greek learning. If a certain acceptance, or habit, has further given weight to some of them, so has the high and dogmatical tone in which those have been proposed; conveying that air of security

and authority, which indolence and ignorance are ever ready to follow. What species of philosophy these have thought proper to follow, they can now see.

It still remains to compare the ancient and the modern systems of this nature, more fully than I have yet done. I have attempted to excuse the ancient philosophers, whether successfully or not, is of little moment; yet one apology for them must stand: they were ignorant of the God of revelation. This defence at least, the moderns cannot claim. The knowledge of Him is around and about them: it has formed, and is the basis of, their morality itself; and they cannot but acknowledge it. The majority of opinions is against them; and they more than suspect that the majority is right: at any rate, the argument "ad verecundiam" is against them. This were much, though they did not believe in the evidences that are before them: evidences which have convinced thousands; as, of all these advantages, Greece possessed nothing. But have they even examined the evidences which they suppose themselves not to believe; has there been any desire to believe? That may be doubted: but Greece at least was never thus tried. Are they not living too among those lights of science which Greece never knew? amidst an accuracy and extent of the knowledge of facts, and a precision of reasoning from those, of which that nation had never even dreamt? Therefore are they worse reasoners, worse philosophers: and its faults, be those what they may, are centupled upon them. I must not say that they are sinning against conviction; but they are sinning against a knowledge which they might convert into conviction did they desire it, and thus also renouncing or disgracing the philosophy to which they pretend; since the highest aim and pursuit of philoso-

phy is the study of Him, the author and the parent of all philosophy, the All-wise, the Most High.

And if philosophy cannot avoid expressing its infinite contempt for the contrivers of the partial systems which I have noted, so do these especially appear to be a species of rebellion against knowledge: bearing marks of a spirit of wilfulness, or hatred, if of nothing more. The desire of proselytism would imply wickedness: while if vanity is the excuse I have already offered, others must be permitted to judge. But let us not impute criminality, because we flatter ourselves that we "do right to be angry:" the spirit of hatred should have no place in the pursuit of mere truth; still less should it find one under religion; nor must anything ever supersede the claims of justice.

I may terminate that portion of this work which I have called the negative one. The entire subject is indeed of far other dimensions; since I need not say how widely it extends through the endless regions of metaphysics, how deeply it is involved with the whole history of philosophy, how inseparable from the great mass of human and divine learning. But the plan of this book is to produce evidences of the Deity, rather than to answer negations and nullify false conclusions: and if what I have thus said has occupied some space, it will save both distraction and space hereafter: while the state of condensation in which it has been presented, will render error more sensible.

DIVISION I.

OF THE

EXISTENCE OF THE DEITY,

&c. &c.

CHAPTER IV.

ON THE EXISTENCE OF THE DEITY.
NATURE OF PROOF. SOURCES OF BELIEF.

WE have already seen that the existence of a God, of an ultimate Superior Being, the creator of the universe, possessed of unbounded power and knowledge and wisdom, is not one of those intuitive or instinctive truths which we seem always to have known, or which, on being proposed, we receive without hesitation. If the reverse has been said, as the appeal has been made to a universal belief, I do not here mean to inquire into the value of this argument; as neither my space allows of these discussions, nor does my plan require them, while they may be found in writers beyond numbering. There is abundant proof that better reasons than this have been demanded; those it is here my business to give; and where there are arguments of a certain force, it is neither of utility nor policy to accumulate feebler ones.

Metaphysicians have treated their main argument in various modes; each according to his peculiar manner; and many, with little regard to brevity. There is little satisfaction, and no use, in following them through tiresome disquisitions, often consisting in the examination of opinions or statements which did not deserve it, or in multiplying words which a plain definition would have rendered unnecessary. All can find, if they take pleasure in this reading, what abounds everywhere.

The consciousness, or certainty, of our own existence, is the proper basis of this argument. We feel that we did not produce ourselves; and if there is an ignorance which could possibly be satisfied with parentage, it is at length driven to some prior and different cause. The same view naturally extends itself to existences of all kinds, and to everything.

To proceed a further step, somewhat more rapidly than metaphysics do, the proof of the existence of a Supreme Creator depends therefore on our belief in a cause, or in what has been termed causation. I am not here to discuss this tormented question; they who wish it may examine Hume, and those who have examined him. Suffice it, that to believe thus is insuperable; and therefore that we must thus reason and believe, whatever wordy arguments we can produce why we ought not to believe and reason in this manner; whence, justly enough, such belief has been rated among those original principles which belong to the human mind, as portions of its very nature; an instinct.

If this is the essence of volumes on this question, what remains can be rendered equally brief. Whatever visible cause there may be for an effect, that cause is, itself, an effect of some prior cause. We trace, or conjecture these, as far as we can; but there is still a preceding one; and the ultimate one must be the primary power, a Deity; The Deity. This cause must be Mind; on the same grounds, or our instinctive feelings: it can never be aught else, by what term soever atheistical systems have distinguished their imaginary First Causes: be it Fate, Nature, Order, or whatever else, there must be A Mind directing and producing those; and, again, this is the Deity; God.

It is not because of any peculiar neatness or force in

the manner of reasoning, that I subjoin the argument of Chrysippus on the same question, but because there are modern readers, and still more, modern religionists, who have formed very improper conceptions of the opinions of antiquity on those subjects; as the writers on Natural Theology have often borrowed the arguments of the heathen philosophers, and without acknowledgment; nor always improving on what they had thus found. “ Si enim est aliquid in rerum natura quod hominis mens, quod ratio, quod vis, quod potestas humana efficere non possit, est certe id quod aliud efficit homine melius. Atqui res cœlestes, omnesque eæ, quarum est ordo sempiternus, ab homine confici non possunt: est igitur id quo illa conficiuntur, homine melius. Is autem quid potius dixeris quam Deum? Etenim si Dii non sunt, quid esse potest in rerum natura, homine melius? in eo enim solo ratio est; qua nihil potest esse præstantius.” “ Ergo est aliquid melius, est igitur profecto Deus.”

It is but another modification of the same argument which Cicero adduces, and which others have expanded after him, when he appeals to the existence of mind, in man, as a proof to the same effect. “ Unde enim hanc homo arripuit?” It is not the produce of matter; and as it is the supreme gift, it must be derived from that superior in power and mind who must be God.

And this is the proper metaphysical and *à priori* proof of the Existence of a Deity. Yet, thus simple, it proves nothing more: and it is necessary that something more should be proved of the Deity, under the mere proposition of His Existence; and also, in the same *à priori* manner.

I cannot see, however, that this mode of argument can prove aught more than His eternal existence, or

Eternity, as being a necessary character of any existence on His part. The proof of unity is at least better sought in a different class of argument, if metaphysicians have sometimes preferred their own *à priori* method, and sometimes also failed to perceive that they were deriving from evidence, what they had imagined to belong to their own peculiar division of reasoning. And if such writers have produced separate discussions, on the eternity of the Deity, and on His necessary existence, expending also many words on the latter attribute, as it is called, it is very difficult to see the distinction, in aught but words, or how the facts themselves are not perfectly equivalent. As such, I, at least, must here view them.

The First Cause, the Deity, must be eternal in the past, because there was no prior cause to produce Him; the proposition is so purely identical, that it is a waste of words to discuss it further; as it has been often tediously discussed. He must be eternal in the future, because nothing is destroyed without a cause destroying; and we cannot even imagine so vain a supposition, as that He, the only sufficient cause, would destroy Himself. And this is His necessary Existence: torment the phrase as we may, it can never amount to more.

And this, if I mistake not, is all that can be proved as to the qualities involved in the existence of the Deity, by pure *à priori* reasoning; being His eternity alone. I do not here allude to His moral attributes, or His character generally, whether intellectual or moral; respecting which there are metaphysical arguments of paramount weight. But the question of His unity is one belonging purely to His existence, independently of any attributes of any nature: being, if I

may be allowed a term which, as a merely metaphorical expression, can produce neither error nor offence, a portion of His physical entity. And I cannot see that the *à priori* arguments of metaphysics are of any value on this point: if it is to be proved at all, it must be proved by evidence; by inferences from facts, or from the nature of creation: and thence I must reserve this question, until I have stated the other mode of argument whence the existence of the Deity is proved.

This is the argument *à posteriori*, or from evidence: and the general bearing of it may be very briefly expressed. There are facts in creation which prove intelligence or design, as much as their mere existence implies a cause: the cause therefore must have been an intelligent one; an intelligent cause is a mind, as we know, in the only way that we can know this, from our own minds; and that mind being the First Cause, must be the Deity; God.

I have stated this argument, purposely, as plainly and as briefly as possible. It has been proposed, under endless illustrations and fancies, by writers of all kinds, from antiquity down to our own day; and very often, very recently, under a load of the most oppressive superfluity. I cannot see any useful purpose in this: and the more particularly, since the details of the evidence are to form the properly physical parts of this work, as they have done of some of those to which I allude.

But as I must here state it in a general form, I shall give it in the words of Cicero; since I know not how it could be more forcibly or more briefly expressed; while the reader will there find, in a few lines, what has been lately expanded, in a most wearisome manner, into as many chapters. “*Quis enim hunc hominem dixerit, qui cum tam certos cœli motus, tam ratos astrorum*

ordines, tamque omnia inter se connexa et apta viderit, negat in his ullam inesse rationem, eaque casu fieri dicat, quæ quanto consilio gerantur, nullo consilio assequi possumus? An cum machinatione quadam moveri aliquid videmus, ut sphaeram, ut horas, ut alia per multa, non dubitamus quin illa opera sint rationis: cum autem impetum cœli admirabili cum celeritate moveri vertique videamus, constantissime conficientem vicissitudines anniversarias, cum summâ salute et conservatione rerum omnium; dubitamus quin ea non solum ratione fiant, sed etiam excellenti quâdam divinâque ratione?"

Nor can we fail to be struck with his earnestness, when he says in another place, " Quid est enim verius, quam neminem esse oportere tam stulte arrogantem, ut in se rationem et mentem putet inesse, in cœlo mundoque non putet; aut ut ea quæ vix summa ingenii ratione comprehendat, nulla ratione moveri putet?" And that I may do justice to this writer, let me point out to the reader, his admirable sketch of the value of the physical creation in demonstrating the nature of God: a sketch which, brief as it is, has been the germ of every modern treatise; while sufficient to prove that had he possessed the materials, and intended such a work, he would have left little for his successors to do.

I might also state this argument, as the same author has done, from Aristotle, under the supposition of a man suddenly brought out from a subterranean cavern into the midst of all the works of art and of nature. I might state it as Plato or as Xenophon has done, even as Voltaire has; as a host of writers more, whom I cannot take room even to name, have done. But did I limit myself to a selection from one, I know not

where I could choose what is more brief, and at the same time more effective, than this, “The heavens declare the glory of God, and the firmament showeth His handy-work.” It contains, within itself, all that the subject requires; it is the sum of the argument. It was an argument of sufficient force, when little was understood of the real beauty and wisdom of this “handy-work:” and far more ought it to be an argument to us, who have at length learned to know what these works truly are.

The facts, under which this design, proving intelligence, proves, with intelligence, the consequent existence of an intelligent Being, form that portion of these evidences, respecting the nature and bearings of which this is but a preliminary statement. But they are the same also which constitute the argument for the Unity of the Deity; and I ought therefore to state, as I indicated the intention to do, how they bear on this inference.

An evident intention to produce some end is evinced all through Creation; and the design for that purpose is always complete and consistent. There is every indication, or evidence, of a consistent train of reasoning with a correspondent execution, for an end, which ought to have proceeded from one mind, or could, perhaps, have proceeded only from one mind. Still more remarkably perhaps, at least to obvious observation, there is a general consistency of design or plan, pervading all that we know: it is very striking in our own earth, in animals and vegetables; it is far more so in the wide universe of the celestial mechanism: and yet more, if that be possible, in the universality of Light, and in that of the Chemical Power: that great agent of a superior cause which pervades the entire universe,

acting everywhere, and everywhere in the same manner. A universal agent must have been the agent of One ; as uniformity of plan and execution indicates one planner and executor. And this is the argument for the Unity of the Deity. If His Personality, (that awkward term,) on which so much has been said by a writer to whom I must sometimes allude, means anything different, or more, I confess myself unable to see the metaphysical distinction ; as I am, at least, sure that the proof of the one must be the proof of the other.

These, in their several ways, constitute the proofs of an existing, first, or ultimate Cause ; of a Deity : and they also include the proofs of His eternity and unity. And this is all which the present preliminary chapter has proposed to indicate : while, under the division which it includes, the details of evidence are to be stated ; as far as it is possible to arrange evidences, for the proof of one truth, which shall not also prove something more ; and as far as it is expedient to reserve facts which might equally have been adduced, that they may form evidences for other purposes.

I may only add, as a general indication under this first of the preliminary chapters, that it is from similar and analogous statements of facts and general reasonings, that we are enabled to deduce the other remaining inferences as to the Deity ; including all which ought, in strictness, to be termed His attributes ; as implying those intellectual and moral qualities which are not His Existence, but His character ; the quality of His nature. Thus we deduce His power, His goodness, and His wisdom, especially ; and thus, if with more difficulty, we infer His providence ; aiding ourselves, however, in this case, by the *à priori* arguments of metaphysics : while respecting His omnipresence

and omniscience, we have little more of argument than the metaphysical one, and must content ourselves, as far as physical statements can avail, in showing under what demonstrations they are displayed.

All this is of the usual proceedings of philosophy. It must not be said that these are the mere views of religion; used, as that term too often is, to throw suspicion on every attempt at argument or proof. The mode of argument is that which the most rigid philosophy adopts and acknowledges; it does not indeed often adhere very strictly to its declarations; and would, not unfrequently, be surprised to find that he whom it censures or rejects has followed its own rules better than itself. It is of the purest rules of this science of sciences, to deduce what cannot be seen, from what can be seen and studied: this is generalization; and, be the logic sound, its validity is not questioned. It is not questioned in matters of pure human science: it ought not to be in the present case: when it is, the cause lies elsewhere, not in the invalidity of the process.

I have not often willingly quoted any one, for I do not see the value of authority on that which belongs to observation and reasoning: and there are objections to quoting the sacred writers here, above all, under an appeal to authority. Yet I may quote St. Paul, just as I might quote Plato: it is a purely philosophical statement, and I do not think that any one has expressed better, or more concisely, the general proposition which I have thus stated; especially if the reader will divest himself of the feelings which so frequently arise from the peculiarity of this philosopher's style, as the familiarity of scriptural language often also deprives it of its force and value, and causes the profundity of reflection which it contains, to be overlooked, not less than

does the brevity of the expressions. "The invisible things of God from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead." This is the basis; it is thus that we infer, and must infer, His attributes; Him.

But before entering on those subjects, or the evidences which are adduced, directly, to prove the Existence of God, I must premise a few remarks on the nature of those proofs, and on the terms which are in use on subjects of this kind. If superfluous to philosophical readers, they cannot conveniently be omitted, under a regard to those to whom such works are most properly addressed; persons little accustomed to accurate thinking, or to reasoning: and still less to distinguish words which they see currently used in a lax or interchangeable sense.

It has been customary to speak of demonstrating the Being of God; and it has been answered that demonstration was impossible: with the consequent evil of making an opening for cavils, not unfrequently injurious to weak or young minds, ever ready to give assent to a plausible or strong assertion, or to what carries the appearance of reasoning, without waiting to ascertain its meaning. I hope to show that whether this term is properly applied in this case, or not, the objectors to it, misled by its limited application to mathematics, have not understood its meaning: and that although it is true that God cannot be demonstrated, inasmuch as He cannot be brought before the senses, there is nothing in this objection which ought to produce any effect on the mind of an inquirer.

Confining the term belief, here, to a persuasion of truth, from reasoning upon evidence, the direct

grounds of it, in matters of physics, are observation and experience, being proof to the senses; and, in matters of morals, moral reasonings, or summations and comparisons of probabilities, deduced from our knowledge of the human mind and human conduct. To this latter division, the belief or proof from testimony has been confined, as if it were thus limited; but that is incorrect, because from the necessary difficulties attendant on physical knowledge, the great mass must inevitably trust largely to the testimonies of those who have observed and proved; though always possessing a power which they cannot attain in the cases of moral testimonies, namely, the final appeal to their own senses.

As moral reasonings, and testimonies relating to moral questions, are excluded by the very plan of this work, though occasional allusions to them, or the occasional use of them, will be unavoidable, I may proceed to notice the nature of the grounds of belief in physics, and the distinctions between them. The first of these, taking it now as it is generally used, is a species of proof, applicable only to the pure abstractions of number and quantity; and it is limited therefore to mathematical truth. Proofs of this nature are absolute: because, assuming or knowing certain bases, or things, which we can command and define, which cannot change under our hands, or which we can prevent from doing so, while we can also prevent the intrusion of any thing foreign or irrelevant, our command over the proof is perfect, to the extent of our knowledge, which can also be ascertained; and our belief therefore is as compulsory as it is absolute.

The term, however, implies an appeal to sense, to the sight: it is the thing shown. And, in reality, the only

perfect proof is to the senses : every thing, at least, which relates in any way to objects of sense, must seek its final proof in their conviction. Let their imperfections be what they may, this is the law of our nature, our instinctive feeling: and if it is by excluding or denying this, that metaphysicians have thought they had succeeded in establishing that universal scepticism so well known, their failure has been as complete as their logical demerits have been conspicuous, when they did not perceive that they had rejected the fundamental and necessary element of all their calculations, and had thus deduced fiction from falsehood.

Thus has the very nature of geometrical demonstration been misunderstood, and also misstated; often where we should little have expected it, by mathematicians as well as metaphysicians; as if it were something mysterious, to which nothing else in the class of proofs afforded a parallel. It is not therefore surprising that even the acuteness of Hume should have overlooked it: while the whole dispute to which I have just alluded, might, like more in metaphysics, offer a useful though a mortifying lesson, were there any hope that this science would ever be other than it has been. Such demonstration is nothing more than an appeal to sense; as it must finally rest on the universal and insuperable conviction respecting the value of that, as proof; in spite of the idle metaphysical debates about the competency of sense to command belief, or the still more outrageous speculations of the Berkeleian system. If the senses do not prove the existence of matter, not even geometry has any foundation; there is no geometrical proof, no mathematical demonstration. The final term of all proof is an appeal to sense: to the Berkeleian this is ever present; yet such men have

chosen to doubt its value, and to bewilder themselves amid metaphysical quibbles. This geometrical process, claiming an unjust monopoly over the term demonstration, consists in a concatenated series of syllogisms; and the usual proof is a single inference of necessity, out of a chain of necessities. That single fact must be true, if others are true; these others are proved to be true, retrogressively, on the same conditions, until we arrive at the last step; and this, in geometry, is an appeal to sense, the most vulgar of proofs, as it is held, and therefore despised by affectation, though it is the actual and only demonstration. Deny the validity of sense, and even this, the undisputed proof, ceases, with matter, to exist.

If there are other proceedings in mathematics, they do not concern the present inquiry. And as far as belief is a moral condition, we cannot, in this case, influence or destroy it by a moral act, by an effort of will, or through prejudice or temper; because the consequence becomes an evident absurdity, or a contradiction in terms: that peculiar result which the universal, or common sense of even the most prejudiced or ignorant, agrees in rejecting as soon as it is stated. Where demonstration or proofs of this nature do not produce conviction, the fault must be sought in a deficiency of intellect, or a low state of the reasoning faculty. And on this subject also, it is proper to remark, that two moral causes are always aiding in ensuring reception to the truths of geometrical demonstration. There is a previous conviction, or prejudice, that it does possess the power which it claims; a moral condition of vast influence over the mind: and, at the same time, there is rarely, if ever, any moral feeling concerned in opposing this species of belief, because it is indifferent to our wishes, hopes, or interests, what it is that is so proved.

Now it is plain that the Existence of God, still more His nature, together with the questions involved in His administration of the universe, are not amenable to this species of proof, because the final appeal to sense is unattainable ; and we must therefore have recourse to a lower description, founded on observation, but proving by inference : or consisting in high probabilities from facts, ultimately based on our compulsory belief in causation. But the nature of observation and its proofs must first be explained ; while it is also, in terms, the act of seeing ; and therefore, the proof from it is, as before, a mode of the proof to sense. In physical nature, it is the evidence of our senses ; and the accumulation of observation forms experience. It is observation that the sun rose to-day ; it is experience that it has done so every day of our lives. But knowing that our senses convey only impressions, and not the causes from which they arise, we learn to correct one observation by another, and thus arrive at a truth which a single observation would not have reached, but which is, not less, a truth of observation, commanding as perfect belief as the demonstrations which relate to abstract number and quantity.

And here it is, that testimony also steps in to fill up the blank which experience, strictly so called, cannot supply. It is recorded, by those who lived before us, that the sun has risen every day ; and we believe it, because it agrees with our own experience, and because we cannot conceive the reverse : nor have we any moral feeling to affect our will to believe. We shall immediately see how much further we are fairly influenced by similar testimony. In those cases where observation is to be corrected by observation, under whatever nature and manner, we must have recourse to com-

parison and inference, or to reasoning ; while the proofs will also be valid in proportion to the purity of the logic. It is not here necessary to inquire of the varieties in the force of proof thus obtained, or into their causes ; but in every case where the proof is perfect, the appeal is still to the senses, in some mode : whence, it is to be remarked, the proof from observation does, in fact, conform much more nearly to mathematical demonstration in its manner, than is usually supposed, though, in consonance to usage, I have not chosen to adopt that term here.

And of this kind of proof, analogy is but a modification. There is a great mass, or number, of observations, which, brought together by reasoning, or logic, approach to a proof : while if the chances in favour are far greater than the chances against, it is a proof on which we act, and must act, as we believe. Thus also we often believe, and act, both, on very inferior proof, or on probabilities of a lower order : while, at the other extreme, if the chances are as a very great number to one, that the fact is so, the proof is sufficiently perfect, inasmuch as it would be absolute, if they were as infinity to one.

Again, if accumulated observation, in a simple case like the foregoing, forms experience, so it gives rise to wider inference or conclusion : to a generalization, or to what philosophy may call a law : a law of nature, or a steady and universal fact. Or, we conclude that the sun will continue to rise every day, popularly speaking : philosophically, that the earth will revolve on its axis, as it has hitherto done, as long as the sun and the earth shall exist. And thus does every man believe, although this is a species of proof still further removed from pure demonstration. It is, in fact, not a

primary proof, even of observation ; it is in a secondary order, as being a more remote inference of probabilities : and we can admit that it might not happen, or is not necessary or compulsory. Yet we do believe ; or, such less perfect kind of proof is judged a sufficient ground for belief. It is important to form ideas of these subjects, and of these several grounds ; because the proofs involved in the object of this work, might not else be fairly estimated. Interposing this needful remark, I proceed.

The case of the sun is a single and simple fact ; one species of one genus. But observation becomes acquainted with many facts, or with sets of facts, which, while each one differs in some manner from one, or every, other, all agree in some common feature or principle, or seem to be in some way united under a common cause. Thus, the sun and the stars agree in producing direct or primary light, and in being at rest, compared to the other bodies of similar form and bulk ; and Thus, heat increases the dimensions of every substance to which it is applied. On these observations, or this experience, it is concluded that each star is a sun, and the centre of a system of planets, and that it is a general property of heat to enlarge or expand all bodies. This is generalization under a wider sense, or it is philosophical induction : if, to avoid refining too far here, I have attempted to be both brief and simple, this is science. And this also commands belief ; though it is evidently a still more remote and refined species of proof. It commands belief, in proportion to the extent and accuracy of the observations, and the clearness, or logic, of the comparisons and inferences : and these being good, or sufficient, such proof has also a force, equal, or nearly equal, to that of demonstration : though,

as in the former simple case, we cannot prove that it might not be otherwise, that there might not exist, for example, a star which was not a sun, or a body which heat did not expand.

In as far as the evidence of testimony is here accessory, or necessary, a very simple remark will suffice. Observations of this nature cannot be made by every man; they are necessarily confined to a few. Yet their testimony commands belief: a single testimony will often do so; united ones never fail. In such cases, the conviction, being purely moral, is influenced by the analogy of other and similar truths, or by what is sometimes popularly called the course of nature: or else it results from the general intellectual and moral characters of the witnesses, and from the absence of all motive to assert what is not truth. Thus it is, that every philosopher is ready to believe him who should assert, that in a certain part of the globe the magnetic needle, free to move, was vertical: and thus every person believes that there is an island called Jamaica, though possessing no other proof of it than concurring testimony; not always even that.

I presume that I need not say more: and if it was needful to show distinctly on what species of proofs the following arguments rested, and what they did not pretend to, I hope that the application and the utility will be equally visible.

We cannot, as I have remarked, demonstrate the Being of God, because His existence, and His properties, or attributes, equally, do not fall within that kind of proof which is called demonstration; within the cognizance of sense, or within the conviction that we might, if we pleased, make a final appeal to it, through a series of syllogisms, as we do in geometry. Yet we

prove it nevertheless, to as perfect conviction as we possess regarding the far greater number of our subjects of belief: or, having a proof as full as respecting all the other beliefs which range themselves under this particular order, we ought to believe. The facts are, or the observation is, (to repeat what I said before,) that there are created things which must have had a Creator, and motion which must have had a mover; with intelligent proceedings which must have demanded intelligence: and therefore, that there must be some Being who performed, and performs, all this; who is, consequently, or must be, God. Or the proof is complete, unless we surrender the general principle, and declare, with Hume, that we also will not believe any thing which is proveable by that species of proof, only; or rather, that we will believe nothing at all. To act otherwise is simply illogical or inconsequential: and he who thus acts must either abandon his claims to sound reasoning, or else admit that his will is opposed to the specific case excepted: that he is prejudiced, or that his moral condition is such as to render him an incompetent reasoner, or judge of the Truth: implying the obvious consequence, that his opinion ought to have no weight with others, however it may influence himself.

But as it is not less important, in the present case, to ascertain the true nature of belief than to determine that of proof, I must offer some remarks on a subject very widely misapprehended, as it has also been misconceived by writers of high metaphysical reputation. And if the causes, as well as the nature, of belief should thus be more clearly understood, these remarks may prove of some value as to religion in general, not simply to the subject immediately under consideration.

The celebrated maxim that belief is involuntary, is

well known; as are its pernicious effects on weak or juvenile minds, receiving it as they would a mathematical axiom, without considering its meaning. The slightest analysis of this assertion should suffice to show its falsity, while it is the needful preliminary to the following remarks. There are involved in it two distinct assertions; namely, that we believe nothing but what is proved, and that we believe whatever is proved. Or, the state of the mind being compulsory in this case, man cannot help believing when proof is produced, and, reversely, cannot believe what is not proved. He is passive in all cases of belief: and thence he must be a structure of pure reason, acted on by the causes which influence that power, while all else belonging to his compound nature is excluded. Though this analysis should place the maxim in question in a stronger light than may have been intended by its promulgator, it is indifferent; since the same doctrine has been frequently maintained by metaphysicians. It will even be found in the writings of Locke: a singular contradiction in one who has written on opinions as he has done, though not the only instance of oversight in that profound philosopher, productive of evil unforeseen consequences.

If the enormous assumption respecting the universality and power of human reason is here the chief one, this maxim involves another so obvious, that it is surprising how these doctrines should have passed for a moment without notice. It is equally assumed that all men know the nature of proof, under all its varieties and applications, and can give to each its due value: while if I cannot take room to expose the falsity of this in detail, the preceding remarks on proof will suffice to indicate an outline which it will not require much re-

flection to complete. This examination, slender as it is, should suffice for an answer to this long-received dogma respecting belief: but that will be rendered much more striking by even a slight appeal to familiar facts.

It is an obvious question, to ask who there is that possesses, or ever did possess, proof respecting the far greater number of the subjects which constitute his beliefs: while of those we can always judge, sufficiently for the present purpose, by his conduct; since it is not what a man says, but what he does when called on to act, which is the true test of his belief. We are ever doing something, because believing in something; often acting very decidedly, because fully believing: yet how often could we produce the proof of what we thus declare ourselves to believe, how often indeed is there proof, or aught resembling it, to be found? The question, here, is not how an individual philosopher may act in a specific case, but respecting the conduct of men at large: though the former himself may safely be asked how often he does believe, and act, on proof, in conformity to the dogma under review. And, of the vulgar, using that term in an inoffensive sense, it may safely be said that there is not one in a million who can produce any proof of what, nevertheless, he fully believes, or who even ever imagined that proof was necessary to belief.

It could not indeed be otherwise, from the very nature of proof. In the case of simple facts, appealing to the senses, whatever difficulties may occur are nearly the same for all; but where observation must be corrected by further observation, and by reasoning, the few who believe on proof are the rare men who are destined to correct and enlighten the world, and to show

the multitude what ought to command belief, with the reasons why. Thus also, if there are a few who believe on testimony because they have ascertained its validity, it is a perpetual foundation of belief to the mass of mankind, apart from any considerations of that nature. We all believe in Cæsar and in the Norman conquest; yet few can state the grounds of their belief, or ever supposed that to be necessary. I need neither urge nor illustrate this further. It is plain that we believe, incessantly, innumerable things, without proof, or even an approximation to it; nay, without an endeavour, or even a wish to procure it. And this is as true of the thinking as of the vulgar: while there would, in reality, be very little belief in the world, if proof were necessary for that purpose.

If this is an answer to the assertion that we do not believe without proof, it is not less easy to refute that one which says that men believe that which is proved, or that to produce proof is to insure conviction. For this end, it is necessary that we should possess the power of investigating proofs, or of ascertaining the exact truth in every case. This is a task of great difficulty, for ever exercising the highest powers of the most acute among mankind: while the result of much labour is often but uncertainty, as, in thousands of cases, no proof can be procured. If it be a question of mathematical proof, the narrow limitation of the objects renders it of small value; and I need not say that the power of examining its truth is confined to very few. In cases demanding observation and experience, the requisite mass of knowledge cannot fall to the lot of many; and not less rare are the reasoning powers required for the investigation. And if it is little otherwise as concerns testimony, though under other forms,

I need scarcely ask whether mankind possess the leisure to investigate proof, even had they the knowledge and the powers. Respecting the latter, they who assert that men believe what is proved, should at least show that the "rationis capax" is also possessed of this quality, if not universally, at least very widely: as they ought also to satisfy their opponents, that even those who can reason are never governed by feelings, passions, and prejudices.

This general statement ought to be a sufficient answer to the second assertion, namely, that men believe whatever is proved: but our experience confirms it most amply. Not to believe on proof, is one of the most prominent features in the moral and satirical picture of mankind: nor is it even necessary to this disbelief, that the proofs should be difficult to understand, whether from their own nature or the want of capacity in those to whom they are offered. The inference may be so plain that it must be understood, and so forcible or necessary that it cannot be denied. It may even be admitted, and still it does not command belief; for this is the question. That which appears so marvellous that we should pronounce it impossible, is the history of mankind, and has been so at all times. And that most common reply, "What you say is perfectly true, but you have not convinced me," is perhaps the best answer to the assertion under review. It has overlooked the simple fact, that man does not choose to believe.

This ought to suffice as to both assertions under the dogma in question: and it may now be seen, without the necessity of explanation, how the facts bear on the proper subject of this chapter,—a belief in the Deity; as they may also be equally applied to religion at large,

and, what is highly important, to belief in Christianity. Any one may disbelieve either, or all, if it pleases him: but he must find some better reason than this hypothesis respecting belief; for it has crumbled beneath him at a touch. I have shown that the cause does not consist in want of proof; and his disbelief will not therefore affect the truth of the evidence. Like belief, it is a condition of mind depending on other causes than reasoning and inference: and if it can be shown what those are, not only are the proofs freed from blame, but he who doubts may perhaps, in re-examining his mind, discover that he might, or ought to believe. It is indeed necessary for the purposes, not of this chapter alone, but of religion generally, that I inquire of the causes of belief in mankind, whether these operate independently of proof, or against it.

Men believe from example, or from the principle of imitation: one of those beautiful provisions for our education, which we must consider as an instinct implanted by the Creator of the human mind. We believe as others do, without inquiring whether they possess any reasons for their belief. If this is the source of more beliefs than I need here notice, it is, admittedly, the great ground-work of all false religions: as it is also the extensive foundation of the true; respecting which we may despise those sneers at a religion of birth and geography, which a little more knowledge of the human mind would have suppressed. Thus also men believe from habit, in whatever manner that was first established; and thence, to adhere to the same illustration, the difficulty of changing a false religion: while if prejudice is esteemed the source of additional tenacity, it is no other than the accumulation of habit. If philosophers admit that these are the

two great sources of belief independent of proof, the mass of mankind does not perceive it : seldom doubting that it possesses reasons for its belief, though unable to assign them when asked, and commonly ending in the well-known identical assertion.

Men have ever believed in witchcraft and ghosts and omens, and in far more of an analogous nature which I need not enumerate. Of all this there never was any proof : or though there may have been disputable ones, it is well known to those acquainted with the history of the human mind, that such belief has neither sought nor cared for proofs. In these cases, there may be no more than habit and example as causes : but another source of belief is thus developed, as it is also the most influential one ; consisting in a mysterious pleasure, of which fear forms a portion, and being one of the modes of superstition. And he who has thus believed in the influence of a star or the hazard of a die, has often been the very man who doubted of a God, or at least disbelieved in His government. This is to combine, in one instance, examples of the falsity of both portions of the dogmas under review.

Such belief as this is not indeed merely a belief without proof, but often against proofs of great weight. In the cases of a star and of a hazard, mathematics afford a perfect disproof, yet without influencing the belief. In witchcraft and similar cases, the opposing argument is the high improbability that superhuman powers should be granted to one individual of millions, and that one feeble-minded, contemptible, or wicked ; independently of others which I need not here point out. In other cases, of which the appearance of ghosts may serve as the type, while we determine that God governs the world by general laws, admitting His interference

with those in such cases alone as the miracles of religion, performed for great ends, this belief concludes that He is perpetually disturbing the laws of nature, and working miracles for no ends at all, or for purposes the most trifling, contemptible, or ludicrous. To believe thus, is to believe against proofs as strong as any which do not belong to pure demonstration: while in these instances, as in the former, it is common to find the believer incredulous in the proofs of revelation.

If there are no beliefs more unreasonable than these, it is well known that none are stronger. It should be the duty of those to account for them, who say that man does not believe without proof, and ought not so to do; who have said that man ought not to believe in God or religion without proofs. This however they have not done: and I may therefore inquire whether a solution cannot be found, whether there be not something in the constitution of the human mind, of the appointment therefore of God himself, to which this can be referred.

Since man cannot exist without acting, and must believe before he can act, he must at least have a readiness or a propensity to believe: while his history and conduct show that he is a believing being. But if, as I have shown, he does not, and cannot, believe much on proof, yet must still believe very much, that he may conduct himself aright, while example and habit alone will not account for every thing, he ought to be possessed of some other principle or groundwork of belief. And that he does so, would appear from the study of children, who believe largely, without any apparent cause, if it be not an instinctive propensity; believing almost without measure till they find reasons for disbelief.

I do not think that man has, in any instance, been

left without provisions in his constitution for conducting himself according to the Creator's intentions ; however this may have been contested by the vanity of philosophy, presuming on the efficacy of our unassisted powers, and yet forgetting that those are the gift of God ; while also reasoning inconsequentially, when, admitting that the physical machine is admirably contrived, and made for the use of the mind, it will not allow that any contrivance has been exerted on this, the essential portion of man. Thus concluding that there are principles, or instincts, as essential to the structure of the human mind as are the sentiments and passions, or as geometrical knowledge is to the bee, the present inference is, that the Creator has implanted in man a propensity to believe, or an instinct of believing. If this be not the fact, let it be explained whence arises the desire to believe, or the ever-ready submission to belief without proof, or any other apparent cause.

There appears however to be another, and a very different cause by which belief is regulated ; and, for aught that we know, it is peculiar to man, while the preceding must, for the reasons just assigned, be common to all animals ; whence an argument for its existence in ourselves, in addition to those just given. I have shown that belief does not necessarily follow proof ; and if I then said that we did not choose to believe, I know of no other explanation. Belief is therefore, in some degree, an act of the will, or this at least exerts a great influence over it. This inference is indeed not new, but it has made little impression ; while demanding peculiar notice, from the important practical consequences to which it leads.

I do not say that in all cases of this nature the cause is a pure volition, or a philosophical and cold act

of choice; since the will is influenced by a motive, though not always perceived by those who are not accustomed to mental analysis. This is at least the general fact; but I cannot admit it to be universal, as is maintained by metaphysicians; since, if this leads to the doctrine of "necessity," abolishing the free will of man, I also believe that the mere exertion of the will can be a sufficient or paramount motive, and that it is so ordered by the Creator, for valuable ends, which might easily be assigned were this a fitting place. But admitting the action of motives, these may be pride, vanity, hatred, the spirit of opposition, the hope of applause, and more; acting, in the cases of disbelief, of course, much more frequently than in those of belief. Many of these are especially difficult of detection: while if an act of the will is necessarily implicated with them, so can it control them by an effort, just as it controls an evil temptation or propensity, whether under a ruling motive or not. If placed in another light, this cause of belief may perhaps appear more satisfactory. Our feelings are under our control; without which, man would be as the beasts, while that control lies in the will, be the motives acting on this what they may. And as even our feelings govern our will, among other moving powers, so complicated are these actions and reactions, thus do they govern our belief: the practical result still being, that we do not choose to believe.

The facts both explain and confirm this metaphysical statement. It is admitted that we easily believe what we wish, or hope, or fear: that our interests produce the same tendency or effect as our passions, while we are sensible also that we willingly believe what promises us that gratification which is our instinctive pursuit. Thus

also is it familiar that we perpetually change our beliefs, not because of new or different proofs, but while all the facts remain the same. The philosopher who was the best of reasoners when he coincided with us, becomes the reverse should he differ; he that was amiable has become odious, and thus without end. No one however is changed: it is ourselves: the same reasons for the same belief remain; but the belief is reversed, because our interest or passions are differently affected. It is proved that our own valley is more beautiful than that of our neighbour; let the possessions change, and the proofs are no longer proofs. Whence do matters of pure proof find advocates and opponents, credulous and incredulous? there are gainers and losers. And such belief is honest and real; for this is the important point in the present case. Men are convinced in all these cases, in some manner, and thence they believe. But it is not through proof, or by reason: it is through another department of the mind; through the feelings and through the will.

This must suffice on the general nature of belief; as it was a needful preliminary to the great question before us, the belief in religion, to which I must now proceed.

If God has not left human belief to human reason in the ordinary cases of life, it would not be reasonable to suppose that He had done so in the case of religion, the most important of the beliefs of man as a being destined for a future state. And the facts confirm this assumption; whence that desire or tendency to believe in religion under some form, which is unquestioned in the case of superstition, and scarcely disputed in that of a rational religion, be it natural or revealed. On this, however, I need not dwell: it is more important for

the present purpose to show, that if He has caused the will to influence belief in ordinary cases, so has He in that of religion, conformably to His general proceedings respecting man, and because our future destiny is to be regulated by our conduct in a prior existence.

The free will of man and the justice of God are inseparable. The responsibility, and therefore the appeal, or claim, of the former, rests, fundamentally, on the power of choosing good or evil: the nature of the choice regulating the claim, and that being founded on a promise, implied or actual. If this power is placed in his will as the governor or check over his propensities, or his choice, if he can choose to do either good or evil, it is a reasonable inference that he must have the same power over that prior, or previous, act of his mind whence all right or wrong must ultimately proceed, since it is that by which his actions in general are regulated. Were it not so, this would be the only exception to that power over belief which I have shown to be a general law of the human mind: as it would also be, on the part of the Deity, impossible conduct, because unreasonable, and wrong. And if such a government on His part is incomprehensible, it is not easy to see what free will can mean, if it is not to be concerned with man's belief as well as with his conduct.

Leaving this reasoning to the reflections of others, I shall not depart from the ultimate object of this work, though I may transcend the formal one, if I inquire how this view of the nature of belief is concerned in the reception of Christianity as well as of religion in general.

If the Christian religion is not a question of mere philosophical truth, to be examined like a mathematical

proposition, and to be received or rejected with equal indifference as the proof may determine, then must it be intimately concerned with this view of the power which our feelings, and consequently our will, exert over our belief. That it is not this, I need not say, when, involving the deepest interests of man, it is, above all else, calculated to act on our wishes, hopes, and fears. Abstractedly, it is a moral question of high interest: practically, that interest is far greater; since it is by the belief in its truth, or not, that we must, chiefly at least, regulate our actions, and essentially regulate them with a view to those ulterior interests, compared to which all the good and evil of the present life are as nothing. It would be extraordinary, then, if this were the only case among the possible beliefs of men, in which the feelings and the will were not to operate, the only one to be determined by pure reason, did even all men possess this; by proof, even if proof were attainable by all. It ought not to be thus, because it would form a sole exception, and because this would be inconsistent with the conduct of God as to man: nor can it be so until man is created another being than he now is. And, hitherto, it has not been thus, as it probably never will be.

Further, it is one great purpose of Christianity to be a rule of life; or such is one of its ends: while its value and effects are admitted, even by those who do not believe all of it which is believed by Christians in the strict sense of that word. And being such, it is not easy to see how the Creator of man could better have attained the object in view. Belief was essential, as the fundamental source of right conduct; and He has thus brought feeling to act against feeling, high

hopes and strong fears against others of less power ; thence producing that particular belief which, in this case, is Christianity. This is wisdom : because it is through the passions and affections, not through reason, that the great mass of mankind acts : and almost inevitably, since it is these, and not our reason, which are engaged in our moral conduct as the source of our enjoyment or suffering ; so that the proposition is almost an identical one. Cold demonstration therefore, or the most perfect proofs to reason, could not produce the necessary effects ; while to maintain this is to say that reason can master the strongest feelings, or at least, that all mankind is governed by reason ; an assertion requiring no answer. It is religion which has been given, to effect what reason cannot ; by producing counteracting feelings, for the purpose of counteracting conduct, while, to religion, belief was to be, as it is, fundamental. Thence has belief been largely intrusted to our passions and affections : and thus is illustrated the assertion, that perfect reason would require no religion, since it would effect all which that enjoins and produces.

Having thus shown that religious belief is governed by the same laws as belief in general, while these must be from God, in conformity to His general conduct respecting man, as the end is to master those passions which He had implanted for good purposes, though leaving us free to choose evil in consonance to our responsibility, I may now state the same proposition in a manner which may be more acceptable to many persons, while the coincidence of this view with those of pure philosophy ought to give it weight in the minds of all. This is, that God, purposing to oppose the adver-

sary of man, be that a personal "adversary," as with some persons, which, with others, consists in the passions, and knowing that this enemy would oppose Him through those, has, in His wisdom, ordained that the opposition should be founded on the same ground as the attack, because He had not granted reason to a sufficient extent to constitute a security.

Continuing to adopt the language of revelation instead of that which belongs to natural religion, or philosophy, I may now also, for the term belief, substitute faith, without altering any portion of this reasoning. Rejecting the misapplications of this word which have proceeded from enthusiasm and ignorance, it is a belief which does not indispensably require reason, or proof, for its foundation. In this it therefore differs from that rational faith, or belief on conviction, which I explained in the first chapter, as being the belief that God had commanded us to receive certain truths which our capacity does not allow us thoroughly to comprehend, founded on our confidence in the declarations of those who had received them from Him, with a command to transmit them to us. But if it is beyond my limits to inquire by what peculiar influences simple faith can be produced, it is now apparent, under metaphysics, or the reasonings of natural religion, that a faith, or belief, through the feelings, is conformable to the constitution of the human mind, or the "course of nature," and thence to sound philosophy. And this conclusion being just, the result ought to be good, because a mischievous interference on the part of men peculiarly incompetent, has drawn an absolute distinction between faith and philosophy, or has considered simple religious belief as opposed to the

current and reasonable order of human nature. As far as the term faith is used by the writers in the New Testament, when intending by it belief, its meaning seems too plain to have been misapprehended by any but minds which I will not here specify, as I need not point out the evil results to Christianity which have followed its misinterpretations. And the simple sense of this word sufficiently explains their urgency in enforcing a belief in the character and office of Christ, both on the Jews and the Gentile nations, as the indispensable basis of that new religion, under which salvation was promised to all men, on certain conditions. The "faith" of the former was the necessary preliminary to the abolition of the corrupted and condemned Judaism : and to the Gentiles it was even more indispensable, as on them fell the double task of renouncing religions which were utterly false as well as pernicious, and of adopting that which was purity and truth.

In concluding this needful digression, I might say to him who possesses unbelief from the want of what he considers sufficient proof, why is it that in the case of religion alone you seek for this to determine your belief, and why, not finding what you think satisfactory, do you say that you cannot and ought not to believe? This is not your general rule of action : and is there such a special exception in the case of religion, that you will not move till you have obtained that species of proof without which you must and do act, every day, in concerns of very great, as of minor importance? You are ever willing to believe much : is it not possible to will for this end also?

But lest I pass my proper limits, I must terminate this chapter by re-stating briefly the fundamental ar-

gument whence the existence of God is deduced. This is, not merely the necessity of a Creator to a creation, but of a Designer to a design: while in the chapters under this division, it will be shown that certain ends have been intended, and that they have been attained by means which unbounded intellect alone could have suggested and applied. Thence the fact of a Designer necessarily follows, or the Existence of God is proved.

CHAPTER V.

ON THE CREATION AND THE PROGRESSIVE
CHANGES OF THE EARTH.

WHILE it seemed expedient to reduce within as small a space as possible the examination of schemes of Atheism, so was it inconvenient to give there the direct, and I believe the only direct arguments which physical nature affords, against that hypothesis which assumes that the frame of the great universe had existed from eternity. And as that argument is included in the history of the creation of the Earth, the same chapter will serve two purposes. It is a proper commencement of the evidences of design, under the present division, since, as far as the earth at least is concerned, it is, itself, the inclusive design. As far also as it forms the answers in question, it is an attempt to prove, by facts, that God did actually create the globe of the Earth in Time: and, by consequence, the whole universe.

It is true that some recent philosophers have attempted to extract from geology, supported by mathematics, an argument for the Eternity of the Earth. As far as the latter science is concerned, I have answered it in the 39th chapter, and, here, I hope to find, in the very place where the poison was sought, in geology itself, the antidote, and the further answer. But thus have ignorance and presumption, under the pretence of philosophy, ever laboured, throughout all physical na-

ture to oppose, in some manner, its Author; while, as I shall often have occasion to show in the course of this work, their defeat has ever been most signal, under better knowledge than their own, or when the facts have been at length understood. Nor must name and authority be adduced to support these opinions, or to terrify those who possess neither. These are but the produce of a narrow circle of idolatry: the worshippers fail, and the idol falls: or he is seen no more, and is forgotten. Such has been the history of philosophers from the earliest days: it is Truth alone that stands, and shall stand, till the world itself shall pass away.

It is even on the new and little-known science of Geology that I must draw, for this and for far more of the evidences of this work: a science occupying a lofty place among the physical ones, and valuable for the proofs which it affords of the power, the wisdom, the beneficence, and even the providence of God. If there is a reader still ignorant enough to believe that it is averse to religion, or even to revelation, I should be here guilty of a grievous absurdity, were I not assured of the reverse, when I have thus made so large a use of it. But, in this place, I can neither satisfy such a reader nor teach him the fundamental facts necessary for understanding whatever is here founded on it: whence I must needs refer him to what I have specifically written on that subject, as a *System of Geology*, since I know of no other place in which he could find what he wants.

It has been said, even in remote antiquity, by some who have argued against the Eternity of the Earth, that as we see in it, as in all nature, not only a tendency to decay, but absolute marks of waste or wear, so ought

we to infer that it had a commencement. The argument is mathematical; it may be considered as depending on the continuous summation of infinitely small parts, or as an arithmetical progression. Or, an Earth of which the daily or annual waste is assignable, must have been utterly wasted, had it commenced, (the term is inaccurate, but intelligible,) in Eternity.

This argument has all the weight which a mathematical one must possess when it is sound in all its parts or assumptions; and which such arguments often do carry, unfortunately, when they are worthless or false, because some essential element of the calculation has been overlooked, or a wrong assumption made. In this case, no note is taken of a possible power of perpetual renovation; of that, in reality, which does exist, but was not known to those who thus reasoned. Yet, whatever may be the opposed value of this principle of renovation, the general assertion demands proof, in itself, before we can make it an element of calculation: or the obvious waste may not be a waste of continuous progression.

It is no blame to the inventors of this argument that it is not better; or that they did not adopt a form less mathematical, and therefore, if not so apparently convincing, more efficacious, as displaying the physical analysis of the question, though it cannot, and does not, pretend to mathematical accuracy. The history of the earth was then little known: and if Geology is still far from perfection, it has the power, now, of doing what it could not then have done; the power, I trust, of showing, from a train of physical facts and probabilities, that this earth actually was created, or made from materials which were not the earth we now see, in Time, and at a time which, though not assignable,

or even admitting of approximation, in a mathematical sense, does permit that species of indefinite conception, which, if such a phrase may be coined, may be called a metaphysical approximation.

If the present argument is derived from the same general view of the waste of the earth, it proceeds differently, and extends its researches much further back. That its general bearing may be comprehended, before entering on the details which might distract the reader's attention, if it shows that the earth will gradually expire, through its visible waste, so it traces backward to the commencement of that life, defining therefore what the other could not. But it does not stop there: since it shows that this Life sprung out of a former Death, similarly the termination of another long period of life, the commencement of which also it undertakes to prove. And further, continually retroceding, it shows that each anterior Earth, as far as it can trace any, was less various in materials, or contents, than each following one, successively; whence, by a method of exhaustions, it draws the general inference, that the first term in this series of diminishing values must have been the actual Creation of the globe of the earth, from materials which were not at least an Earth; if not by an act of immediate volition on the part of the Deity.

The general cause of the waste of the present Earth, ultimately, if hypothetically, to bring on its old age or decrepitude, is the action of water, through rains and rivers; as is more fully explained in succeeding chapters. But as the acting or possible compensations are there stated, I may pass by the consequence that may be inferred, and retrace to the commencement of those actions.

Before the circulation of the waters commenced, no alluvial lands, and scarcely even soil, could have existed; because these have been produced by the operation of the water. It was therefore an Earth of naked rocks and sea; remaining also to be filled with life: a state anterior to the history of "Creation."

And Geology shows that the rocks of this Earth which we may call our own, had been brought up from the bottom of the ocean, at some unassignable period, by means of subterranean forces, which it indicates with considerable certainty. It further proves that these had been consolidated from the fragments of former ones deposited under that sea; or, perceiving that the same thing is now happening from the waste of our own earth, it infers, with all the security that can be attained in physical investigations, that the earth which thus preceded our own, was a similar structure of land and sea, with mountains and with rivers, or with a system for circulating the waters of its ocean; and that it had continued to exist for a certain period, commencing exactly as our own earth had commenced, in a terraqueous globe of mere rocks and water, wasting, or wearing, as our own wears, and, at a certain period of that waste, subverted, for the purpose of renovation in the form which it now possesses, or did possess at the commencement of its present condition.

If, thus, it establishes one earth similar to our own, and preceding it, so does it prove another, anterior to that one and analogous to it, by the same train of reasoning, exerted on further observations of the same nature, upon the structure of the earth. And further, it continues to discover, by further retrocession, a third preceding earth, with still others beyond this; while of the number or probable number of these, my purpose does not call upon me to inquire in this place.

But the important general fact in this train is, that each preceding Earth, or mode of our globe, was less varied in structure, or contained successively, in retrogression, a smaller number of distinguishable rocks and materials; or, that if the last was less varied than the present, so was the one preceding less varied still; and thus retrospectively through the whole series. But as I have shown, in the 22nd Chapter, the exact nature of the advancement, I need not be minute here, as it is but to reverse the train, and to trace backwards. Or, generally, if there is an improving earth in advancing from the furthest beginning that we can ascertain, there is as regularly a deteriorating one, retrogressively to that beginning; the regularity and consistency of that train indicating a yet prior condition, or yet prior conditions, of greater simplicity, or less perfection, of which the terminal point ought to be something approaching to absolute simplicity. That we are partially checked, in trying to recede through this train, is nothing against such a view; when we consider our imperfect means of investigation, and the inaccessibility of the facts, beyond a certain point.

But I do not rest this argument on the retrograding simplicity of the Earth alone, as an uninhabited globe. The analogy which occurs in the gradual improvement and multiplication, or, reversely, in the as gradual simplification and diminution, retrogressively, of the forms and numbers of **Life**, presents not only all that support which analogy ought to do in the works of the Deity, but that further assistance which arises from finding that the two creations, **Life**, and the **Habitation of Life**, run a parallel and dependent course; singularly entangled, or acting on each other, alternately, in the nature of cause and effect.

Or, generally, the argument may be stated thus. That the race Man, with the other forms of life which inhabit the present earth, were created, nothing but the most absolute Epicurism denies, and that hypothesis has been already answered. And they were created to inhabit the present specific Earth; which also was renovated, or prepared, for their reception; having been specifically adapted, by various preceding and progressive contrivances, or improvements, for that purpose. In the same way, many of the prior states of the Earth possessed, each, its own system of Life; while, if we cannot discover that there was specific adaptation of the forms of that life to the nature of the habitation, in every case, the conclusion cannot be very unsafe, when we find, that when the Earth must have been an unfit habitation for terrestrial life, there appears to have been only a marine creation, limited in variety as in perfection of anatomical structure and vital functions: and when we see also, that with each improvement of the habitation, the forms of life improve.

If therefore there have been creations of life, commencing in simplicity, or imperfection; and if the same analogy, found also in absolute union, exists between the habitation and the inhabitants, then both should have equally had a beginning in the Will of the Creator; whether from nothing, or from pre-existent matter, is of no moment to the question before us. The only difference in the two elements of the analogy is, that in the case of the inhabitants, there are successive creations, while in the habitation there are only changes: but this, it will be seen, is a Necessity arising out of the very Design. And that difference vanishes, when we trace the history of the habitation, or when, as it recedes further and further from being

fit for the reception of life, we arrive at a point where its Creation was as necessary as in the case of life itself: and where, if we cannot fix the point, it ought to have taken place.

In another and simpler form, it may be stated thus. There are two parallel progressions, Life, and the means of Life, united, and mutually dependent. We trace backwards, through successive renewals, which are creations, because absolute renewal was in this case necessary, the first creation of life, or its absolute Creation: it is a series, as I may call it, commencing in unity. We also trace backwards through successive renewals, which are not creations, because creation was not necessary, a parallel or diminishing series in the means of that life, or in the nature of the earth. We arrive, successively, at those terms of the series in this case, which may be expressed by 4, 3, 2; is it not probable that there is also the term 1, if we could find it, or that term which would express the actual creation of the globe? It will be seen, hereafter, whether we cannot, in reality, arrive at that term, or very near to it.

How far the joint or interchangeable relation of cause and effect between Life and its habitation, or living beings and the earth, may give aid to this view, I may now inquire: the fact at least is of high interest in that great chain of analogies, moral as well as physical, which show the progressive nature of the Creator's designs.

If it can be proved that God has actually created any portion of the globe of the earth, using that term as it is generally used, to express the arrangement of new forms from mere matter, or ultimate elements, (the only sense in which even animals are created,) then may it not be inferred that He created the whole, though

He adopted different means in the one case from what He has done in the other ?

Now, that He has, in this sense, created a large portion of the globe of the earth, as we now see it, is certain ; while in reality, He is creating, or making additions to it every day. Let the term, however, not be misapprehended. The creation of the Earth is understood to be its formation from the elements, or from matter under ultimate forms, of which we know nothing : if it be so, that is the very act which He performs before our eyes, as He has performed it through all the receding states of the inhabited earth. And if He has performed, and does perform it, through the intervention of what He is admitted to have truly created, or Life, then can I not see that there is any fallacy in this view, difficult as it is to fix our thoughts accurately on the idea of Creation, or to define it to the satisfaction of all. Limestones have been formed from the elements, or at least from penultimate matter, or antepenultimate matter, if the reader pleases, by living beings ; and thus they are produced daily. If this is not a creation of a portion of the Earth, though not an addition of matter to the mathematical globe, I do not see in what sense the term can be used, as to the original production of the solid globe from matter, under some, or any other form. And if, in this case, He does, from matter under some form, liquid or gaseous, appertaining to that definite portion which He allotted for this sphere, produce a part of the solid globe, wherefore should He not, at some more remote period, and by other chemical means. (since Creation, in this sense, is Chemistry.) have formed the whole globe, out of a fluid, or a gas, or out of matter in some penultimate form, or, lastly, out of elementary matter ? And the probability from these

views alone, is, that He has done so; since the analogy is, throughout, and under all the views in which it can be placed, consistent and complete. We shall immediately see whether astronomy can give us any further light on this subject; but it is necessary previously to inquire into the question of Time; since the very notion of creation is involved in that of time, a period.

When Aristotle, or the philosophy which he adopted, says that the universe is eternal, but that it was created by God, the proposition, as I formerly remarked, involves a contradiction in terms so very palpable, that we can only wonder how it was ever made or repeated. It is plain, in the present case, that however remote may be the first creation of the globe of the earth, it is quite indifferent where that period is placed as it relates to Eternity, or the existence of God. With respect to our own period of existence, if it does not strictly bear on the present argument, it is of great interest as it relates to the solar system and the universe, and thence demands a notice here.

If to form a mathematical approximation is impossible, we can still acquire one of those indefinite conceptions which so often impose upon us with the semblance of a reality, and which, vague as it may be, is not without its value, though only an impression on the imagination; since it serves to produce one of the feelings so desirable in an inquiry of the present nature; namely, a deep sense of the greatness and power of the Deity. And if that most useful sentiment can truly be excited only by details, ever failing when we confine ourselves to mere words, so must I be excused an attempt at detail, which must be vague, but will not thence be less useful under the present purpose.

Knowing that the strata of an Earth to come are

forming beneath our ocean, from the deposition of those materials which the circulation of water brings down from the higher lands, we can find a mean or approximate measure for the time required to produce a given thickness of stratified sand or clay, the germ of a future rocky stratum. If we inquire, geographically, or historically, how long it has required to fill up a given lake, or an arm or portion of the sea, we may form, under one mode, a conception of the time required to produce any given thickness of a stratified rock. Or if we inquire how long a time was necessary to produce a given depth of peat, and then compare the densities of peat and coal, we can infer how long it must have taken to produce a coal bed of a given thickness, as, under similar observations respecting the growth and successions of living shell fishes, generating banks under the sea, we may form some idea of the time required to prepare a bed of limestone of any dimensions that may be assumed. On other grounds we may ask Geography how many years it has required to add a vertical or a horizontal foot to the Delta of Egypt, or to the plains of Bengal; what is the growth of Demerara, what the extension of the lands which the Mississippi creates, or the Po; and then compute, or imagine, what years or ages it has demanded to produce all that now lies between the bases of their generating mountains and the sea; the horizontal extent, the vertical depth, be it of that India alone which is the produce of the Ganges and the Burhampooter: for whatever be the time, these plains are formed of that Himalaya which the tributary waters of those rivers have brought down to produce them.

The imagination is alarmed at even the length of time required to deposit the visible alluvia of the earth

before us. But this is as nothing : our own earth cannot have existed long under its present form ; and we must recur to a computation based on the production of a single rocky stratum, the produce of the alluvia of a former earth.

If we examine the strata which are now the uppermost rocks of our own, the task will be to conjecture, from their thickness, how long the rivers of that earth must have flowed, how long must have been its duration, before there could have been deposited that enormous mass which we can measure and investigate : and what time also was required for the production, death, and successions of the myriads of shell-fishes, to whose previous life we owe our limestone strata. Geology must be consulted, that the reader may comprehend fully what I cannot here take room to detail : but if he whose imagination I would thus impress, has seen the Apennine or the Jura, knowing their thickness according to the order of the strata, as well as their geographical elevation, it may be left to him to conceive the time that was required before all this preparation was made for that Earth which we now inhabit.

Yet is this but one earth, one form of the globe, and one single period of time before that point which forms the commencement of Time as we know it : Man's time. Again, he must go through the same analysis, for there is yet a preceding world waiting for another investigation. It is the world of vegetables, or of coal, and he must recur to his studies or reflections on the subject of peat, and when he finds twenty or thirty beds of that substance condensed to the state of coal, each bed the produce of vegetables that must have been born, and flourished, and died ; and each bed separated by great

deposits, or thick strata, of sand and of clay, now converted to rocks; and, finally, the entire mass reaching to an almost mountainous depth, let him attempt to compute this integer also, and add it to the joint sums which he has already calculated or imagined.

And yet he has not performed the half of his task: he has added ages to ages, and there are ages more incalculable yet to come. The world immediately beneath the world of coal, is the next receding Earth which he must investigate; for, like all that come after, it is the produce of a prior one; and, as in those, rivers must have flowed for ages, as mountains must have wasted through ages, before it could have been even prepared, far less produced. If it comprises but two great members, since here the earth becomes more simple, even the sandstones of Scotland, with four thousand feet of vertical depth, and the limestones of Yorkshire, will give him measures on which to ground his computations, and form one other integer to add to the growing, yet even now incomprehensible heap.

Again however he must recommence his toil, for there now lies before him the almost immeasurable mass and thickness of the primary strata; rocks, like all others, if now much deformed or changed, giving incontestable evidence that they too, as well as their posterity, have arisen from the ruins of another world, or other worlds, still prior, and from actions which were entirely similar.

And if, here, the imagination has long lost itself, obscurity begins to involve the appearances through which further similar computations, as to still anterior worlds, might be formed: yet, prior states may still be inferred, as I have shown in the work already named, though it

would be of no moment were this denied, since enough has been done for the purpose in view. Nor, in this sketch, have I taken into account all the possible or probable periods, or lengths of time, which might have been occupied on each change: since it is of little use to add integers or zeros to a sum which is already beyond the reach of the human faculties.

Such is the time through which, at least, this globe has existed; be the modes of that existence what they may. And is this a consideration to be rejected by him, the student of creation, who desires to scan the power, the existence, of the Maker of all things? If such inquiries and such reflections ought not to produce a good effect on the mind, if they are not conducive to the elevation of the thoughts to God, and to the production of a due sense of His power and greatness, I know not where to seek them.

But I must return from this, scarcely digression, and it is to return to the question of the creation of the Earth; and, first, to the further analogies and observations, derivable from astronomy, which seem to confirm the views of geology; or rather, which allow us to infer still more, to recede one step nearer to the actual creation of this globe from primary, or penultimate, or unaggregated matter.

It would now be difficult to name the first who suggested that this globe was originally a gaseous sphere; but if it has prevailed from a time beyond discovery, it is now argued on securer grounds than formerly, from the nature of comets and the laws of the radiation of heat. From the analogy of some varieties in the former, it is further inferred that it thus became a fluid globe surrounded by an atmosphere, while mathematics confirm this, by showing that its figure is that which such

a fluid in rotation should assume. And if that fluid sphere should have become consolidated on the surface by radiation, just as the previous gas was condensed, then does geology come in with its proofs to show that the interior still contains, or consists of, this fluid matter, and that, by cooling, it forms the rocks, of which some constitute, not simply the lowest, but, in reality, the first produced rocks of the globe, and the first source of all the succeeding strata.

It is not within the purpose of this chapter to trace the geological history of the earth onwards, as it is not my office in this place to teach geology. I can refer those who may desire it, to the same work; it being sufficient for the object in view, that it is thus traced, as nearly as is possible, to its first creation, or arrangement out of matter, of some nature, and possibly within one stage of its absolute creation from nothing. It is then the first term of the series which I was seeking.

Nor is it of any importance that such creation, or formation of the globe, is not instantaneous. In truth, we know of nothing instantaneous in the works of God: the idea that it is such in any case, is easily traced to an unexamined prejudice, perhaps chiefly founded on want of reflection respecting the actual proceedings of the Creator as described in the Sacred History. Yet even here, the idea of time, or progression, is distinctly stated: and wherever we examine His works, as I have more than once remarked, in the physical world, whether on the greatest scale, or in the most minute detail of every mineral, stone, rock, vegetable, animal, we for ever meet that one analogy ruling: progression, time; slowness, to our own senses and ideas; as is no less true in the moral world, every where.

If geologists, and readers, whose studies have been confined to ordinary facts, and who know not what it is to reflect, hear of these statements with incredulity, or are even alarmed at such suggestions, a metaphysician at least ought not to fall into the same error. But a very simple consideration may convince the former that the whole difficulty consists in their own prejudices, at least, if not in their ignorance. Metaphysically, they are unacquainted with the meaning of the word Time, and with its nature; while Self, vanity under one of its forms, would measure the succession of events, and definite portions of such a series, by its own apprehensions and its own experienced portion. Man has his own portion assigned; so has the Ephemeron, which, born under the meridian sun, will expire at its setting. Could it be informed that the animal, man, which it sees full grown before it, had required ages on ages before he had arrived at that stature, and that for many ages he had remained utterly useless for all his intended purposes, slowly proceeding and improving under such an utter waste and misapplication of time, it would reason as we do ourselves in this case. Such—no, far indeed otherwise, and incomprehensibly otherwise, is Time in its relations to the Deity: we cannot even comprehend its meaning; while the scriptural expression so often quoted, is not simply a poetical, but a truly philosophical one, as far as it is possible to form any philosophical conceptions on this subject.

The general inference ought now to be apparent. The Earth as we know it, is not eternal, above all it is not eternal, under any solid or useful form; useful, as applicable to its ends for the place of Life. It has

been created in Time : and within a time not such but that we can, in some manner, conceive its commencement. And if animals are considered to have been created when they first came into existence, then also was the earth created when it first became a fluid and tangible body, or else when it first became a defined gaseous sphere. Either analogy may be taken, as philosophers please : but in strict conformity to the term creation as applied to animals, it is the former view which is the just one ; since animals are, essentially and ultimately, created from gas, as the solid earth was. But if the rigid metaphysical sense of this word is to be adopted, we must go perhaps even further back than the sphere of gas, while, at this point, all is, to us, as nothing. And thus does this view comprise both the Design of the Deity in the Creation of the earth, although the continuous design to its present condition would demand a far larger history ; and the argument in answer to the philosophy, improperly termed Atheism, which I promised.

But I may safely extend the conclusion which I have thus extracted from Geology to other planets, and to the entire solar system. If our earth has thus been created, so have these, and so has even the Sun ; or, the solar system arose by the will of God, in Time, or within a period which the imagination can at least look on without so utterly losing itself as it does when it attempts to contemplate infinitude of space or time. Whether every globe in that system was rendered what it now is, at the same period, is a question beyond the reach of investigation. Mathematics decide, that under the present motions, the simultaneous existence of every mass of matter now composing it, was neces-

sary ; but it cannot prove that this balance of motion might not have been a change from some previous one, in a system of bodies, nor that all the planets were rendered solid, or put into a state of preparation for a future living creation, at one period ; because, under whatever form the matter of any one existed, the balance of the general system would have been equally preserved.

It is further evident, that the same inference may be applied to the great universe ; and thus from the study of our own earth primarily, and by reasoning from the facts of geology, I have derived an argument respecting the Great Creation, which could have been found no where else. Yet here astronomy also confirms what, without this assistance, it would not have so satisfactorily inferred ; in pointing out, not only the loss of certain stars from the great system, but the appearance of new ones ; apparently satisfied that it has done both. The appearance of a new star is the appearance of a new Sun ; and of that, probably, as the centre of a new system of planets ; of a sphere, then at least, first rendered luminous ; supposing, hypothetically, that it might previously have existed as a part of the whole infinitude of the mutually gravitating bodies in the universe, in a dark, perhaps in a gaseous state. I need scarcely say that the eternity of matter is a purely metaphysical question, and it is argued on its proper grounds in a future place.

But I must terminate. Whether there are many for whose sake it was necessary to prove that the present system, and in its present form, had not existed from Eternity, I know not ; yet where there may even be a latent wish to deprive the Creator of His government,

the present views may be of use; or should not even that exist any where, no inquiry can be misplaced in a work of this nature, which tends to identify the Creation with the Creator, which can induce the mind to lift its views from the works of the universe to The Hand that formed all, and governs all.

CHAPTER VI

ON THE DISPOSITION OF THE SURFACE
OF THE EARTH.

IF it has been the plan of this work to point out examples of Design in every department of Creation, instead of confining itself to the usual narrow range, it seems especially necessary to attempt this in what relates to the structure and disposition of the earth. If this has been little noticed, it has not even been understood by former writers on Natural Theology; and it would be culpable to permit anything to be considered as a work of chance or imperfection. That a writer of such eloquence and ingenuity as Burnet should have declared this belief, is not a small additional reason: since such opinions spread, even among those who may never have heard the name of their author.

I shall not quote an estimable man for the purpose of displaying his errors more distinctly: while I only repeat what has often been pointed out, when I commence by saying, that it is to the existence of mountains we owe the springs and the rivers so essential to all life, and even, in a great measure, the very rains by which they are fed, and through which vegetation exists. It is very widely through the influence of mountains, or elevated lands, that the clouds are caused to fall in rain: and here also we may remark the subsidiary provision made by this law. Such lands become speedily drained and quickly dried, to the obstruction of their

vegetation: and it has thence been ordered that the vapours should collect especially upon and around them; while in thus primarily supplying themselves with the needful moisture, they also effect its distribution far and wide, through the aid of the winds.

If philosophy has not yet proved that electricity is here the immediate agent, it is easy, in any mountainous country, to witness the operation of a mountain, not merely in collecting the existing clouds, but in forming them from an atmosphere apparently free of all moisture. A transparent current of air begins to deposit vapour, as soon as it approaches the summit, increasing till the whole becomes involved in a cloud, as low down as the relative specific gravities of this vapour and the air permit. Often also such a cloud appears to be fixed, though a strong wind is blowing: but in this case, that which had been precipitated on the windward side, is dissolved on the leeward; explaining the apparent mystery of rest in the midst of motion. But the more frequent result is a progressive addition to the cloudy atmosphere, until the whole sky is obscured and descends in rain. And thus also, when the high land simply attracts the clouds which may be sailing through the air, its influence becomes a frequent source of rain, not on itself alone, but on all the surrounding country.

But the wisdom of this provision will be rendered more impressive, by considering those parts of the earth where extensive plains refuse almost all vegetation: while the contrivance for watering such countries through the winds, does not affect the general deduction. If we look at the great, arid, and almost barren deserts of Asia and Africa, it is but true that they only require mountains to render them what the equally extensive plains of South America are. Could we erect Chim-

borago or Ætna in the Sahara, a wide tract would immediately become fertile ; since, sands as these plains now are, and barren as they may be, nothing is wanting to them but water. The rock is that of Cheshire, and the soil is essentially the same: it requires but a succession of vegetation to render it, not merely as fertile, but a thousand times more productive. Or, in as far as its barrenness may arise from the presence of salt, the cause of its brackish though rare waters, the rains of a few years would wash that far away from the lands, and convey it to the sea.

And if in a future Chapter (xx.) I have pointed out the means by which Providence is daily enlarging the extent and increasing the fertility of the land, it is easy to see, that in one year, in one day, and by means through which He is ever producing vast and similar effects, He might convert, not the Sahara alone, but every desert on the globe, into habitations for man : render the sands of Africa what the declivities of the Atlas are, and cover the salt plains of the Caspian with the wealth of Caucasus. The volcano is the power in His hand : He has employed it in the Southern Ocean, almost before our eyes ; but it has ever been His agent in this work, since thus did He form the hills and build the mountains : and by the volcano, terrific as is its power, and destructive as it may seem to those who do not scan His ways, might He produce a new world in the wilderness, for the ever enlarging races of man. And who can decide that this is not within the Creator's plan ? Had man this power, he would, thus instructed, produce a volcano and erect a mountain in every desert on the face of the earth : while he cannot be wrong in thus reasoning, since it is by the past conduct of God that he

can alone judge of the future, as it is also his duty thus to inquire, under the views of natural religion.

If the water which supplies the spring and the river might not have existed without the mountain, so, much more certainly, would not the spring itself: while geology must be called in to explain one of the inferior designs, comprised under that wider one which formed the rocks and distributed the mountains; since this is not merely a mechanical arrangement, like that under which the superficial waters are collected to flow in rivers.

Those repositories and conductors of water are the produce of at least two very different dispositions in the solid substances which form the earth; while we cannot refuse to either, intention as well as wisdom, unless we deny all foresight and all final causes. That effects so valuable and so necessary are merely the result of accidents implicated in other arrangements, is but a minor degree of the same aberration of judgment which adopts a whole Epicurean system: nor can a sound reasoner be satisfied with such a solution, abstracting all religious considerations. That the several mechanical arrangements of the earth are not symmetrical and definite, like those of the animal structures, or the works of man, and have therefore an air of carelessness and neglect, does certainly, to the unreflecting, give them the appearance of accident; and thence it becomes more necessary to explain them, that the design may be seen and felt.

The arrangement for the end in view, which is most obvious in England, depends on the stratification of rocks in parallel beds. A bed of chalk or clay, covered by one of sand or gravel, forms a single pair of strata;

and the lowest of these is impermeable to water. Thus the waters which pass through the upper, will rest on the lower one; or, whether in this simplest case, or in that of a more numerous collection, the same effects will follow from the presence of fissures as from that of porosity. And it is obvious, that if water is thus re-positated for use, and preserved from waste, so is it equally protected, in its transit to distant points, from that evaporation which would dissipate a superficial stream.

If he who digs down to such a repository of water finds a well, it is evident that such a well could not rise to the surface, in a land of horizontal stratification. The inclination of the strata becomes the remedy: and if other valuable results are implicated in this arrangement, we cannot doubt that this is at least one of them, foreseen and ordered. Let the pair of strata here assumed, be elevated, and it is obvious that the water will rise, or flow, under a pressure proportioned to the vertical elevation, while the consequence may be a deep and springing well; or an open spring, should any fissure in the upper stratum afford exit to the water.

But omitting the springs of obscure origin, as not belonging to the present inquiry, there are rocks, such as granite, which are not stratified, as there are also strata incapable of transmitting water in this simple manner. Yet is this great end not neglected: it is attained in a different way. Such rocks include systems of fissures; and thus equally become the conductors of water and the seats of springs, easily traced to these causes, in mines and in mountainous countries.

In all cases, the further we can ascertain a train of causes and consequences extending backwards, the more effectually do we infer a plan, founded on foresight, and

executed through a special preparation. In this instance, the original cause, through which this and so many other effects of the wisdom and goodness of the Creator are produced, is overwhelming in magnitude and extent of action; being no less than the total disruption or destruction of an earth, and the creation or arrangement of a new one. Be the other effects of this what they may, it is to these revolutions that springs owe their existence; for thus were both the fissures and the elevations of the strata produced. Will it be said that these, or even that the former, were necessary, not intended consequences? It is often difficult to answer this, as to the works of creation, so as to satisfy those who prefer denial or doubt: yet the mere metaphysical argument should suffice. Accident is but that of which we know not the cause: and it is especially thought accident, when we see no effect or purpose. In the present case we see both: and in all, as our knowledge extends, we discover that what we were used to consider accident, is part of some design, and is productive of good and specific effects. It is our ignorance which is in fault when we fail: here at least we are informed; and hence the conclusion of a special design, for an intended purpose, is inevitable. Yet we can also find an answer here, on purely physical grounds. It was not necessary that there should be any fissures, because there are many rocks without them. It was not necessary that any fissures should be open, because many are so filled as to exclude the passage of water. And similarly, it was not necessary that the slightly inclined upper strata should any where be of such a nature, or so disposed, as to retain or transmit it, since that is very far from being a general occurrence.

I need not dwell on that great and obvious conse-

quence, which is partly implicated in the existence of springs, and partly dependent on the mere drainage of water along the surface. To point out the value of a river, or of a system of rivers, is superfluous. But let it be remembered, that but for that design which planned and raised a system of mountains, Egypt would be without its Nile, a barren and uninhabited desert; that the interior of English America would now, and perhaps for ever, be a wilderness of forests and marshes, if it were even that, inhabited by wild animals, and by men without civilization or the hope of it; that the wealth of commerce, with its enormous effects in the general improvement of man, would have been as nothing, compared to what it now is; and that without the power which rivers and their results give to internal, as well as to external communication, even the agricultural affluence which now exists would have been cramped within very narrow bounds. The canal itself is dependent on the river; and but for the mountains of Switzerland and Germany, Holland and its wealth could scarcely have had an existence. And for all this, as for far more, the earth, man, is indebted to what has thoughtlessly been esteemed a deformity on that earth's surface; and further, to that subversion or destruction, which, while deemed by the same persons a result of the Divine vengeance, an act of punishment, a pure and unmitigated evil, is not less striking as an act of wisdom and beneficence than of incomprehensible power.

But geology can point out so many other important consequences flowing from that design which covered the surface of the globe with mountains, that even all the preceding great results might be neglected, without affecting the general conclusion. In these is laid that

great fundamental provision through which is produced the soil that forms the home of vegetation and the foundation of life ; as, through them also, it is provided, that what is incessantly carried away, yet removed but to produce similar good in other places, shall be renewed. And if it is to the system of mountains, or the elevation of land, that we owe the descent of the rains and the whole machinery of the circulating waters, so does this, as a primary and useful effect, become the immediate cause of the renewal of the soil ; renewing also, as it removed. Thus beautifully, and often thus simply, are the trains of successive causes and effects laid and implicated all through creation.

Considering therefore, under this specific and limited view, that mountains are mere provisions for eventual soil, stored up by the Creator for the production and the perpetual renewal of the agricultural surface, we find that they are formed of the earths whence those soils are produced, but, under a subsidiary provision, condensed into the form of rocks. It is an obvious, as it must have been an intended consequence, that the supply of those earths is gradual, or proportioned to the wants ; while a long duration of that supply also follows, from this established durability of the whole system by which the waters of the globe are circulated. And to this power of resistance is opposed one of destruction : slow, as it ought to be, in consonance to the general intention, yet certain and unfailing : the whole presenting that nice and beautiful balance between the active and the passive powers, which, while it ever produces the intended results, excites our admiration, under its apparent difficulty, the ostensible rudeness, carelessness, and irregularity of the proceedings, and the unfailing useful effects.

The initial proceeding depends on that great agent, chemistry, to which so much more has been committed : but I must confine myself to a single chemical action and a simple case. In the basaltic rocks, a large portion of iron is combined with indurated clay, while this substance is the parent of the most fertile soils. That iron is united to oxygen, under a definite bulk ; but when exposed to the atmosphere, it absorbs carbonic acid, forming rust, and thus increasing its dimensions, so as to disintegrate the compound of which it forms a part. The texture of the rock becomes therefore destroyed, or is reduced to clay : while this decomposition is necessarily gradual, and must also proceed as long as the rock shall last, or a mountain shall remain. But that which chemistry has commenced, is continued by mechanical power ; that power being the descent of water, under the force of gravity ; while the prime design, consisting in the elevation and distribution of the land, determines the nature and extent of this action. And thus we perceive more distinctly the beauty of a design, which elevated the mountains far above the level of the plains, that the force of gravity might act readily in the distribution of the earths which the rocks are ever producing, and that it might also continue to act through a long coming period.

If the naked rock was first covered with soil in this manner, thus is the existing soil for ever renewed, as it is for ever removed. And if every shower washes down to a lower level than that of the upper ones, the same effects, on a larger scale, are seen in the turbid enlargements of rivers, where the act of deposition is familiar, as its consequences are experienced by every possessor of lands situated in their vicinity. And it is plain, that under such a system, the upper lands would soon become

naked and barren, were it not for the chemical provision which I have pointed out ; since it is under this power, chiefly, if not solely, that the rocks constitute the fountain of a perpetual supply. The effects of frost indeed must be viewed as mechanical : but I need only name a fact so familiar, as I need not also state the other chemical causes of the decomposition of rocks.

The production and renewal of soil are, however, far from being all of the effects resulting from the great design which laid the mountains : effects intended, as they are attained. I have indeed described those in a future chapter (xx.) : but the purpose of the present one demands at least a notice of them here. Hence is the earth enlarged, by the formation of alluvial plains and the exclusion of water ; and hence also is its fertility perpetually increased : since these are the points of rest which receive the best transported soils from the upper lands, forming those tracts of supereminent wealth which are so well known all over the world. Still further, so admirably arranged is all in the system of creation, that we trace, in the same Design, provisions made, not only for the welfare of the present earth, but for the creation, or resuscitation, of a future one ; of many future worlds. If it has been said, that although matter is perpetually changing its forms, nothing is changed but for the sake of renovation, the present case offers a beautiful illustration, and on the most magnificent scale, of that great law which seems to have placed the stamp of a future eternity on the works of God, and has perhaps tempted injudicious reasoners to view creation as equally eternal in the past. If the plant dies but to give life to other plants, if man himself is replaced by man, through his successive generations, so does a whole Earth waste and die, that another

and a better may arise from its ruins. Even now, the germs of a future earth are preparing beneath the ocean, to rise in new beauty when He shall speak the word; again probably to die, yet that it may give birth to a better and a fairer. And this too is a portion of the Design, under which the present mountains were laid; as, but for that contrivance of profound wisdom and inconceivable power, so thoughtlessly contemplated or so ignorantly condemned, not even the globe which we inhabit could have had an existence. From the moment when it first sprung forth from nothing, its formation has been intrusted to mountains; at every successive stage, the mountains of a preceding earth have generated a new one; the mountains have been His agents and servants in the work of creation; but it was His wisdom that planned them, and His hand that formed them.

If views of the utility of mountains, so extensive, and so demonstrative of design and wisdom, have almost superseded the necessity of further illustrations, I must still point out some other uses, various in importance; as some of them might possibly also be referred to contingency rather than design. I must however leave the question of contingent results to the feelings of others: being satisfied, myself, that there can be no contingency under boundless knowledge and wisdom.

It is an equally important and extensive consequence of the system of mountains, that, through them, the Creator has effected an equalization of temperature between the equatorial and the polar regions of the globe. This is one of those examples of Divine wisdom which especially deserve notice, from the unexpectedness of the means by which the end is attained: means not to have been devised or foreseen by man, and founded on

a chemical law, on one of His peculiar contrivances, of which this is the chief use, and may, for aught we yet know, be the sole one.

From the very nature, or necessity, of the earth's position and motions, the distribution of light and heat to its several regions must have been unequal; and hence the tropical portions, exposed to a more nearly perpendicular sun, are hotter than those which approach to the poles. Thus, if the equatorial climates are not uninhabitable, as the ancients supposed, they are still often inconvenient dwelling-places for man, numerous as are the compensations that have been provided. Yet the wealth of their vegetable produce causes man to brave them: while, unquestionably intending this, it remained for the Creator to invent and apply one great compensation, as a remedy for that arrangement of the earth's form, position, and motion, which was inevitable, and which would otherwise have defeated His intentions.

This has been effected by the appointment of mountains to those regions, in the first place; adding to that a subsequent contrivance, or law, namely, that a certain elevation above the sea shall produce the same diminution of the sun's heat as a certain distance from the equator does; or, that a small vertical line shall correspond to a large horizontal distance from the main point of the solar action. And it is a further contrivance of wisdom, that a very small vertical altitude should suffice; since, had the law of the vertical diminution of heat been materially different, mountains of an inconvenient altitude would have become necessary. I need scarcely perhaps say, what is well known respecting this law, namely, that if a certain curved line be drawn round the earth, touching it at the poles, and departing

from it at the equator, that line, which philosophy has defined with tolerable precision, will represent a continuity of the polar climate, or of the never-thawing temperature of water.

Thus has the Creator ordered: and knowing this great fact, man might have suggested the remedy which produces such extensive and valuable effects on the great American continent; or he might have proposed the chain of the Andes as the means of producing, in one narrow spot, all the climates of the globe. But the Design of the Creator would be proved by the very suggestion: while if we are still ignorant of the essential and fundamental invention, in this law of heat, or if the highly improbable effect is, that the nearer we approach the sun, from the general level of the earth, the less is the heat, we must equally admit profundity of invention, under wisdom and power. That this law, or this restriction on the ostensibly inherent properties of the sun's rays, was made for this sole purpose, we cannot indeed affirm; but though other purposes should be served, the general conclusion would not be affected; knowing, as we do, that under the designs of the Deity, many ends are often obtained through one invention or law.

I may proceed to a great system of uses derived from the same design, coming under the particular cognizance of geology. And if uses imply a final cause, and therefore an intention, while the means of attaining them, or the invention, is also apparent, I need not repeat the conclusion as to designing Intelligence.

A large portion of the rocks of the accessible earth is disposed in strata, following, or piled on each other, in a long succession, while many different substances occur among these, and certain orders of arrangement

also exist among them. Geology easily proves that these strata were originally formed in a horizontal position ; as, seeing the present succession, in new positions, it also knows those which at first occupied the lowest places in the total mass. Now, had those rocks remained as they were first deposited, a very few, or, in many places, but one alone, could have been found at the surface ; and thus our knowledge of the structure and materials of the earth would have been very limited, with the consequence of diminishing the range of uses we now derive from it. If it is through the system of mountains that we have attained our present information, the largest portion of that is derived from the elevations and displacements of the strata.

The specific evils that would have followed a horizontal position are easily understood. Slate could not have been reached, except through a shaft traversing all the strata above it : and thus also extreme labour and difficulty would have attended, or perhaps impeded, the working of coal, with evil consequences that need not be pointed out. Or rather, man might never have known, or even suspected, the existence of those valuable substances, as of many more, without which he could never have been what he is, and not even the moral being for which he was designed. Under the wisdom which erected the mountains, they occupy every possible angle : the interior structure of the earth is disclosed, to depths which no human labour could ever have reached ; the surface of the soil is the bottom of the mine ; and through comparatively trifling labour, we command the materials which have been prepared for our use, as our knowledge enables us to calculate our plans with accuracy, and to discover even that which is invisible.

It is a subsidiary good effect of the proximate cause

which elevated the mountains and displaced the strata, that it has formed two useful products, in the unstratified rocks ; thus enlarging the general view of design under the contemplation of final causes. Granite and its value are too well known to require more than a bare mention. And if the basaltic rocks are especially adapted, in every manner, for the production of soils, so do we find that they have been created after even the latest marine strata, by a separate and peculiar process : brought up from the depths of the earth in a state of fusion, and placed in positions where their stores of eventual soils could most easily be brought into use.

If we are ignorant whence the metals come, why they are limited to certain places, and why confined, most generally, to fissures in the rocks, our ignorance can never form an argument against an intention on the part of the Creator, nor our incapacity to discover His plan, a reason for believing that there was none. If such are their places, we ought to conclude that the fissures were prepared for their reception : and they are the produce of the same causes which elevated the strata and produced the mountains. To say that these disturbances also bring the metals within our reach, is but to repeat what I have just remarked respecting the working of strata.

If I thus terminate the most perfect class of proofs of the Creator's design in the formation of mountains, I may still point out some uses, or ends, which cannot perhaps be considered as primary ones, yet which, under the general theological argument, must have been intended. And if not thus rigidly ranking in the class of proofs, such views are still valuable in directing the reader to a just contemplation of nature, and of the ever-ruling Parent of the universe.

If He might have created all plants to grow, indifferently, on all soils and in all climates, He has not done so: and though we cannot discover His reasons, we cannot but believe that they were good; so that we can still inquire of the useful ends attained through the facts which we ascertain, under the same conviction of a design for good purposes. Botany informs us, that through the variety of soil, climate, exposure, and other circumstances, which mountains afford, He has incalculably enlarged the variety of the vegetable world, and thence its utility. And the same science shows that He must have acted upon a designed system, when it defines the regions, in vertical elevation, which are selected by particular tribes or families: equally commanding them their places, in this case, as in that of meridional climates. The details of this distribution I cannot afford to give, even in the most general manner: but I must still note, as an essential part of the total design, that variety of food has thus been produced for variety in animals; while, under a further continuation of that design, such animals have been appointed, with special attachments to such food, and with equal attachments to the lands and the climates themselves, under all their singularities; while if to us these attachments often seem very unreasonable, as in the cases of the Chamois and the Ptarmigan, the animals thus commanded have also been furnished with peculiar provisions for inhabiting them and surmounting their difficulties. These are the adaptations which, for ever, through all creation, mark intention and design; though we must not say that the mountains were formed purposely for such ends.

There is yet perhaps a design connected with the vegetable world of the mountains, though I suggest it

with the same hesitation as I have done much more that my predecessors have passed without notice. Man commences by occupying the lower and more convenient lands, and, blinded by his ignorance or his avarice, destroys what he scarcely knows how to renew, while it is indispensable to his existence. The utter and merciless destruction of forests in his first movement ; and had it not been for the mountain, sometimes also for the marsh, defying his endeavours, or refusing him an adequate return of wealth for his labours, not only would many parts of the world have been utterly denuded of wood, but we might also imagine a time when his increasing numbers would almost exterminate the forests of the earth. Has not the mountain, the parent of water, the source of the soil, been also appointed as the nurse and the guardian of wood ? The agent of that Power which permits man to range widely through the great field of wickedness, folly, and self-destruction, but which has yet said, Thus far shalt thou go and no farther, lest he destroy the very system on which his existence and destinies depend, lest he defeat the purposes of his Creator.

May I not also point out the sources of pleasure to man which exist in the Design before us, did I even omit its uses towards remedy or health ? It is a part of the Creator's plan to appoint means for pure pleasure, apart from mere utility ; as is evinced in the endless colours, forms, and perfumes of flowers, though we should limit ourselves to this part alone of nature. And that man may not always, or not often, derive pleasure from the preparations thus made, in the beauty, the grandeur, and the variety of mountain scenery, is no argument against the intention ; since, in his race as in himself, he is an improving and a pro-

gressive being, trusted largely to his own will and his own exertions, and most distinctly told by every fact around him, that if he would gain he must labour, if he would understand and feel he must study and learn. As well might we say that the pleasures of the imagination had not been appointed, because these too are the fruits of culture, as that the landscapes of nature were not intended to add to man's pleasures, because uncultivated man is insensible to them. And, if we rise beyond the petty localities of Dutch art, almost the very existence of landscape is involved in the system of mountains, or the irregularities of the earth; while it is those also, chiefly, which furnish to art that poetry of painting through which the pleasures derived from the scenery of nature are reflected back to us, enhanced, as they are multiplied. And if it is given to the beautiful, the endless, the never wearying combinations which constitute the wonderful world of landscape, to elevate the affections and purify the thoughts from the ever surrounding influences of moral evil,—if, in looking on the fair face of nature, we feel the unceasing conviction of a kind Creator's presence, shall we believe that He did not foresee this also, and doubt that He intended what He foresaw? I should be grieved to think thus; for then too must I believe that He cares not for us, that He takes no interest in him whom He has placed here to toil through a few short years of existence.

Will it be giving way to the wanderings of imagination, to deduce a still further moral design from the same arrangements? All must judge as it pleases them, but it is matter of historical testimony, too uniform to be questioned, that there is a peculiar character attached to man as the inhabitant of mountains; as the immediate causes are also not difficult to assign. With

greater longevity, firmer health, and superior vigour of body, there is peculiar energy of mind, producing moral qualities long acknowledged and often discussed, with political effects which history has amply recorded. It has shown us, what moral science has equally inferred, that while it is the effect of wealth, above all when attained through little exertion, to degrade the physical and moral condition of man, so has that degradation repeatedly occurred in the flatter, and therefore the wealthier tracts of the world, followed by the loss of political liberty and the ruin of political communities. It also informs us, that while the mountain races, preserving their moral and physical energies, preserve also their political liberty, so has it been the destiny of such races to expel the degraded communities of the more fertile portions of the earth, or, in some manner, to restore them to the condition whence they had departed; while, becoming in turn corrupted, it is their fate to yield, in rotation, to other conquerors of the same origin. Were moral ends so great not in the contemplation of Providence?

I must end. I am not about to criticise a man who must ever command respect; since it was under the heat of an hypothesis that Burnet committed the oversight which I have already noticed, with the much more unaccountable one, of imagining the paradisaical state of the earth to be that uniformly level condition, which I have pointed out, in a future chapter, as the natural death of our globe, viewed as the seat of life; since it is incompatible with the continued existence of, at least, animals. I make the following and final remarks, for the instruction of those who have been misled by a speculative and gloomy fanaticism, united with that ignorance of the ways of God by which it is so

generally accompanied, to misrepresent His conduct, and detract from His wisdom and goodness.

Anatomists have often reasoned wrong, by referring to the interference of bones and muscles, and to analogous imaginary causes, portions of the animal structure which display distinct designs, and for important ends. As the errors of ignorance or oversight, these are pardonable: scarcely so however, even by mere science, when they flow from a neglect of the First Cause, or a disdain of the final one, their best guide. But they to whom I allude, asserting that the ruggedness of the earth's surface, the disruptions of strata, and the existence of volcanoes, are the proofs and the consequences of original sin, have done far worse: assuming to pronounce on the intentions of the Deity, from facts which they did not understand, and attributing to His anger or vengeance proceedings which display the strongest examples of His most adorable attribute: thus misrepresenting His designs in the physical world, and making their own ignorance the measure of His wisdom.

Superfluous proofs are not so useless as sciolists in criticism are accustomed to pronounce. I may add, from another department, what has been overlooked by an ignorance incapable of estimating the preceding facts, obvious as it is to the slightest reflection.

If the sandy deserts of Asia and Africa had not formed part of the original intention of the Creator, He would not have produced an animal so peculiar and so admirably fitted to them as the Camel; as, to those deformities of the earth's surface He fixed its affections. How the same intention must be inferred from the not less singular plants created to inhabit the same soils, is equally obvious. Had the rude rocks, the cleft strata and disrupted mountains of an imaginary ruined earth,

not been within the plan of Providence, long before man had perpetrated his first crime, the beings which were appointed to inhabit and prefer those ruins would not have been made. Had it not been intended that the most vast and repulsive of the earth's deformities should occupy the regions of perpetual barrenness and desolation, the plants which select the limits of never-ending snow would never have existed: while the Chamois and the Ibex equally prove, that it was the Creator's intention to produce, even from the beginning, and long before innocent man was placed on this globe, the rudest ruins and the most sterile and repulsive spots by which its surface is formed.

CHAPTER VII.

GENERAL VIEW OF THE ANIMAL AND VEGETABLE
STRUCTURES AND FUNCTIONS.

THE subsequent chapters, which treat of some mechanical inventions in the animal and vegetable structures, in proof of a designing intelligence, might have been sufficiently plain to any one, though standing alone: but they are followed, in future divisions of this work, by others, referring to the same beings, of a more intricate and abstruse nature, which would scarcely be clear to an ordinary reader without some previous knowledge of the anatomy and physiology of the organized creations. These are not subjects of popular reading: and even he who may have sought in technical works, will probably find, that although acquiring much knowledge of details, he has not gained a very intelligible notion of the general bearings and principles. To those however I must often refer hereafter; under views and in language also not to be found in technical writings, for which I shall offer no apology to this science or its cultivators, since it is my duty to make the uninformed reader understand whatever is understood, without regard to phraseology or hypothesis.

If for that reason I here premise a sketch which could not but be slender and brief, so was it necessary for the sake of one of the chapters, at least, in the present division. There is no evidence of a design more satisfactory than to trace the adoption and the pursuit of

a general principle; following the latter through its details or variations: the intelligence of man is proved in the same manner, as, when in the highest degree, it is the perfection of philosophy. And this is what we perceive in Creation. A law, or a rule, or a general principle, is adopted, or fixed: while, departing from it, but not renouncing the fundamental plan, the details are completed under specific variations. Thus discovering an execution, which, however diverse in the separate parts, always conforms to the general intention, we not merely prove a design, but infer the unity of the intelligence which thought and which executed: a Creator, foreknowing, to conceive and plan; wise, to adapt; and powerful, to effect.

But to examine all creation in this manner is not necessary, were it possible: its evidences are required for many purposes far more needful, while this would be to produce proof, even beyond superfluity, of that which, in reality, scarcely requires to be proved. I have therefore confined myself to a very small selection: choosing forms, as the most intelligible, and also limiting myself to a few of those which occur under the two leading plans for animals and vegetables. The detailed cases of the mouth and the feet, in the former, did not require this previous sketch of the animal and vegetable systems: but it was needed for that wider view of details which is given in the 12th chapter, as well as for the many subsequent ones to which I have already alluded: while it is also, in itself, relevant to the present question; since, if explaining the general principles of the animal and vegetable contrivances, it is an example of Design, as it is, further, the leading design in this case.

There is such an involution in the mutual action and reaction of the several parts or circles in an animal, that

it is not easy to fix on a point from which to commence. The percipient and willing, the circulating, the nutrient, and the motive systems, are all mutually dependent: and without the whole, in whatever degree or manner some may occasionally exist, there is no animal. Yet the first of these is the chief one: because, in the first place, to feel and enjoy is the purpose and end of the whole invention, and because further, the life, through which all action is carried on, resides in that system. The nervous system therefore is essentially the animal. Mind, or soul, are equally awkward terms to apply universally: but our language has no single one more convenient than the former; and to adopt the term consciousness is no improvement.

Yet this is not the best point from which to commence. The organization to which mind is attached, and without which we believe that it cannot exist in the inferior animals, though concluding differently respecting man, depends on a circulation of some kind, and that upon a nutrient apparatus: and here is the most convenient point at which to begin, because the motive powers, of whatever nature, are subservient to this, or to the circulation and its various results. As far also as the inferior races are concerned, this system is not only the most conspicuous, but appears sometimes to constitute nearly the whole animal, while never dispensed with, under some form, even in those which have, somewhat carelessly, been supposed to pass into vegetables. And in these cases, there being no prime mover for the circulating system, the structure probably resembles that in plants; while, as the nervous system cannot be displayed, it is probably also of the same nature as it is in this set of organized bodies. An animal of this kind is therefore, corporeally, a stomach, and little more: while

in rising somewhat higher in the scale, it gains organs of motion for feeding this stomach, and successively, limbs for locomotion, chiefly for the same purpose. This therefore is the fundamental structure, as far as the mechanism alone is concerned : or it is the abstract and essence of an animal of which the fundamental, and often almost the only business and enjoyment are, to eat ; though the nervous system is still the ultimate portion, beyond this, since, as the seat of sensation and power, it is truly, or metaphysically, what I called it before, the animal.

Though I commence with the nutrient system, I need not describe it, since its general structure and offices are well known, and it is not a pleasing subject. But I must notice the manner in which the food enters the circulation, as the distribution of what is required for replacement or repair. Certain glands, which anatomy will describe, and I need not, unite their chemical products to that which the chemical solvent in the stomach has extracted from the food ; and the final result is a fluid resembling milk. There is but little information in this knowledge : but physiology can say no more, though it would say that in many more and other words : it is a department of chemistry not yet understood.

To convey this fluid to its destination, there is contrived a very intricate, and but imperfectly understood structure, the lacteal system of vessels ; which is, however, but a portion of that absorbent system which pervades the whole body. Being scarcely known to those who are sufficiently acquainted with the mechanism of the veins and arteries, it is proper here to say, that a single vessel of this nature is a slender tube, provided with numerous valves, similar to those of the veins, so as to prevent the fluids from returning ; but that the

orifice where the action commences has never been seen, and the manner in which it propels its contents may be conjectured, but is not known. The duty of the orifice is analogous to that of the roots of a plant; while as the offices of this system are to return also into the circulation every effused fluid, certain portions of secreted ones, and also, as is believed, every part which is expended and demands replacement, those orifices should exist in every point of the body. This is very difficult to comprehend; but it is not the only difficulty of a similar nature in the ultimate parts of the animal structure. It is that minute division of mechanisms, with that apparent contest of many different ones for the same place, which will appear much more striking on some future occasions. As soon as the small branches can be seen, they may be traced uniting into larger ones, occasionally passing through glands, of which the uses are unknown, until the whole terminate in one large trunk, the thoracic duct, conveying its contents into a vein, the subclavian, and thus to the heart and the circulation.

Such is a sketch of the whole process of nutrition, chemical and mechanical; and the volumes which it has occupied can teach no more, though popular readers may be surprised at such a statement. I have described it indeed as it occurs in the larger animals: but we must believe it to be universal, because the digestive organs are so, and because no other mode of supplying the body is conceivable.

It is in the circulating system that the visible differences in the vascular mechanisms of different animals begin: but as it was more convenient to reserve an account of the separate anatomical arrangements of certain tribes, to the place where those are described, I

shall here confine myself to that which is common to the superior races, classed by natural history in a manner which I need not at present specify, and generally termed perfect; with no great propriety, since everything is perfect which fulfils its ends, and since, if simplicity constitutes perfection, as philosophers maintain, a medusa is a more perfect animal than a man.

Every one knows the general existence, forms, and arrangement, of the heart, arteries, veins, and lungs, or gills; and these unite to form the circulating system. In this, the heart is the basis: while the arteries, in the first division, or circle, of the two which constitute the whole, spring from it by one trunk, proceeding, under continued ramification, to all parts of the structure, till we can trace them no longer. And as we must believe that the ultimate ones are everywhere, from the nature of their offices, this is a repetition of the difficulty already pointed out in the absorbent system. But whatever these unknown ultimate branches may be, there are assignable ones, through which the arterial vessels are connected with a similar and parallel system of veins, gradually uniting into one trunk, and ending in the heart; which, I need not say, is a hollow muscular organ, divided into cavities for expulsion and reception, and provided with certain valves, as are the veins, throughout. Thus the blood circulates in a continued round, of which the heart is the centre and the impelling force; while, in that course, it receives the nutriment already mentioned, and supplies all the necessary wants of the body, in replacement and in secretion.

The blood itself is a chemical compound, differing materially from the nutriment which it receives; but what is known of its composition would not enlighten the general reader respecting the offices which it per-

forms, since it has not enlightened physiologists themselves. And this is equally true of everything which is performed in this great laboratory, the chemistry of which is not understood. It is not known how replacement and secretion are produced ; and, except that we trace a certain chemical procedure in the lungs, yet not even then understanding how it acts, or how it is effected, we do not know how the nutriment is converted into blood ; while we must confess that the entire chemical system, from the food to the blood, is as operose, and involved, and circuitous, as it is unintelligible. They who have read volumes on these subjects may perhaps think that I here speak unadvisedly : but in all the sciences there are many volumes that teach little, as there is a conventional language which passes for knowledge ; encumbering, not enlightening him who desires to understand, and knows in what knowledge consists. A subject really understood can be made clear to every one, as it does not always require technical phraseology to do this : but I am willing that the physiologist explain, in any manner that he may choose, what I abandon.

I have described one circle in this system, but there is a second. The heart is a double organ, and the secondary circulation is through the lungs in land animals, and through the gills in aquatic ones, under that exception in the whale tribe, which it is sufficient thus to notice. An entire system of arteries and veins pervades these parts, under similar connexions with each other and the heart. Thus the blood which has returned from the body in the first semicircle of the veins, goes forward through a second semicircle in the lungs ; being venous blood throughout it, though the vessels themselves act the part of arteries : returning in

the venous semicircle as arterial blood, to be forwarded in the first arterial semicircle to all parts of the body, and again returned by the associated veins. It is by that action of, or in, the lungs, to which I have just alluded, as, similarly, in the gills, that the venous blood becomes arterial : while all that we truly know of the cause is, that atmospheric air must be inhaled, or in the latter case, water containing it, and that carbonic acid is exhaled. Whenever it shall be proved that the azote in the air is useless in this process, the favourite oxygen may be substituted for the word air ; but not till then.

If the nutrient system is a chemical laboratory, far more is the circulating one : but there is a system of appendages attached to it which must first be noticed. Those are the glands : it is the glandular system. Many purposes besides repair are needed in the animal body. Omitting those required for the nutrient system, since their specific uses are not understood, there are noxious or superfluous things to be excluded, cavities to be moistened for the purpose of diminishing friction, hinges to lubricate, air passages to be protected, the skin to be preserved in a soft state, the eyes in a transparent one, and much more ; as, in particular cases, poison, wax, silk, musk, and so forth, are to be formed for special purposes. And all these things are produced from the blood, by the intervention of the organs in question ; of which all that we know is, that they consist of small vessels, continued from the arterial system and thus accumulated ; while, though the blood appears to return in the usual manner through veins, the peculiar substance required appears, as if in the interval, and is found in another vessel, or vessels, the ducts of the gland. Of other bodies, somewhat resembling glands, and termed such, very improperly,

when they have no ducts and secrete no fluid, we know nothing but that they exist; such is our knowledge, even now, of the animal structure. Of the mode in which glands act, or what is their intimate arrangement, we know very little. The vascular mechanism we approximate to, in some cases, and we presume on it in the rest. Of the blood, we know that it is a compound, containing all the elements which recombine to form the new products: whence we know that the processes are chemical, and that every gland is a laboratory, or a chemical engine, as the separate ones have different chemical powers, and, generally, definite as different; always so, except under disease. The modes of operation have been conjectured: but as conjectures are not knowledge, I need not here state these speculations.

The last portion of the animal structure is the nervous system: as it is that without which the whole would be a dead mass. Be it as imperfect as it may, in any animal, it is still the beginning, and the end: the seat of life, the source of motion, the chemist; the sentient, the enjoying, the portion for which all else exists. Where there is intellect, that is its place: it is the seat of reason, as it is the ultimate organ of all perception, and it is equally the seat of what is termed instinct. It is the source of voluntary motion through will, as it is of unconscious and unwilled motions. It is equally the seat of the affections, and of the moral feelings, where those exist: it is the seat of mind. Ceasing to act, as it does from various noxious causes, and as it does from defect of nutrition, since, like all else, it demands a supply of food for the renovation of its mechanism or its energies, mind disappears, the chemistry of the machine stops, the ordinary extra-

organic chemical actions take place, and the sequel of death is decomposition. In the current language, the body is returned to its native dust; but, in philosophy, it is returned to the great circulating laboratory which carries on the unending process under which life is for ever renewed through death, under which destruction becomes the source of new organization.

With the nature, the philosophy, the physiology, with the mysteries of the nervous system I might have said, we are unacquainted; for it is all a mystery. Interior anatomy, sources of action, mode of action, causes of power, sources of failure, mode of supply, causes of exhaustion, dormancy under partial insensibility and inaction, disorder, operation of the causes of disorder, of all this and of more, we are utterly ignorant: it is pure, absolute ignorance. The visible forms and distribution are nearly all that we do know. And of what we imagine ourselves to know, the knowledge is almost entirely negative. It is the seat of thought and sensation, because they do not exist unless it is present and in a sound condition: but even this indirect knowledge is little, since it is not the seat of those unless life be present; while life is not the nervous system, however this may be its place. In the same manner, we know that it is the conductor between the body and the mind, the medium of sensation and motion, because if its continuity is intercepted, we cease to feel and to move: as it is but thus also that we discover it to be the prime chemical power. In being the source of motion, we can see that it increases the corpuscular attraction of the muscular fibre; as it is thus that it appears to be the chemist: while the knowledge of that fact serves only to increase the mystery; since there is a great effect, or, when we know that corpuscular attraction, in all other substances, is permanent,

with a slight exception as to heat, a very striking one seen to be produced by a very inadequate cause, or almost no cause; since not even will is always present to produce it. The attachment of life and mind to the nervous system is perhaps the greatest of all these mysteries; but that of muscular attraction is scarcely less.

It is easy to understand, that like all other organizations, it must require repair through the circulation; but independently of this, its power, simply, whether that relates to corporeal or mental action, is repaired in the same manner. That power is exhausted by each kind of exertion; and food conveyed to it by the circulation, restores the energy: while it also languishes under a languid circulation or a defective supply of blood. That it also occupies more blood than its share as a corporeal solid, occupying that, even as glands do, is a further proof that something in support of its power is thus supplied to it. Yet we cannot discover that it secretes anything or circulates a fluid; often as this has been asserted or imagined. But no supply of blood will induce this power to act with the whole of its energy continuously. That portion which is necessary to continue the vital actions of the body, never fails except under peculiar circumstances, till all fails together: but as far as it is necessary to the action of mind, and to the motions dependent on that, it is subject to temporary cessations, which cannot in any manner be deferred beyond a certain time, but which, in the natural state of the body, are periodical. In this state of partial cessation, or torpor, being sleep, all indications of the presence of mind disappear, even as if death had occurred, if at least we except the involuntary vital actions. It is an error to suppose that the mind acts in sleep: that state is passing away, or has not fully taken place, under dreaming.

This has always been a popular error, under sufficiently obvious causes and connections ; while even the greatest names in metaphysics have persisted in entertaining and discussing the same false views of the nature of dreaming, as theologians have thus sought to prove the immortality of the soul ; forgetting, very strangely, that the same condition occurs in the inferior animals. There is no difficulty in the theory of dreams, as there is no mystery : superstition and hypothesis united, have obscured that which a few words would render quite plain, were this a fitting place.

But this power is suspended, even more remarkably and perfectly, under highly marked failures or diminutions of the circulation : since even the vital actions cease, or become so feeble that they cannot be discovered. Yet this state cannot, except in very rare cases, be rendered so durable as the more partial one which forms sleep : if the supply of power through the circulation is long delayed, death is the consequence. The nervous energy is also diminished, even to its destruction, by mental actions or emotions : as it is also subject to be augmented by those, independently of aid from the circulation : while lastly, there are certain chemical compounds which act directly on it without affecting the organization, producing disorder and death, as this also follows from the transmission of electricity in excess.

The external anatomy is as simple and easy to trace as that of the vascular system ; failing us only as it does there, under the ultimate process of the ramifications. In the class of animals here under review, termed vertebrate, there is a brain within the head, with a main branch passing through the spine ; while smaller branches arise from both of these, distributed to all parts of the body ; in some places uniting into a net work, particularly where they supply the vital

organs, and occasionally connected with enlargements or small bodies of similar matter, termed ganglions. That the brain is the centre of power, there seems no reason to doubt, since it is the basis of all the nerves; and thence it is believed to be the essential seat of mind: but of the uses of the other peculiar distributions in the net works and the ganglions, we are not yet rightly informed, though a few probable inferences have been drawn. But we must remark here also, and for the third time, the inexplicable fact of the joint existence of a nervous ultimate branch at every point of the body; since there is no part without its life, its action, and its chemistry. The internal anatomy is simple, as far as we can see it, and explains very little: nothing respecting the action of this power, or the relation between the brain and the parts which depend on it. The material is soft, peculiar, and appears in the form of a solid fibre, while the union of fewer or more of these under an investing membrane, forms nerves of different sizes. In the brain and the ganglia, there is an additional structure, which is even less understood; while the colour of the substance is grey, as that of the other is white. There is no sensible difference of any kind between the nerves which transmit sensation, and those which communicate motion; but there are separate nerves allotted to those distinct offices, or, sometimes, separate fibres within that which is visibly one nerve: as these distinctions are also traced in the spinal marrow and the brain. Nor are the nerves of the peculiar senses seen to be of a different nature from those of ordinary sensation; though that must be inferred from knowing that their offices are not interchangeable.

Such is our meagre knowledge of the nervous system. It has often been said that man possessed a brain

larger than that of all other animals, in proportion to his bulk. This is not the fact. But it is larger than in the far greater number; while, among those, if we find very small ones, as well as great inequalities, so are there such inequalities in congenerous animals, where no apparent reason can be assigned, and no visible effect follows. No known consequence results from the great size of this organ in the canary bird and the dolphin; the former exceeding man in this respect: nor is it true that the intellects of men possess a relation to the sizes or proportions of their brains. Many small birds have brains as large in proportion to their bulk as Man; among them are the Sparrow and the domestic Cock. The same may be remarked of some of the *Quadrupedi* and others; but the part which *does not* give origin to Nerves, and is therefore probably a Mental organ, is far larger in him than in them. If there is an hypothesis termed Phrenology, it has not yet thrown much light on this obscure subject. But the vulgar phraseology, rather than opinion, (since there are no opinions without ideas,) which considers the "nerves" as a sort of metaphysical entity, a nothing, an imagination, may now learn what those nerves are: a large portion of the solid, tangible body, the only feeling, the only enjoying, and the only suffering part; the prime cause of all healthy action, and therefore the most important, if not the exclusive source of disease. And learning too that they are the living animal, it may possibly now discover, that the actions of the mind on the body, or of the body on the mind, are not the fantasies of weak intellects or morbid imaginations.

The implicated and mutual dependence of the four great divisions of an animal body on each other, has thus become visible. Commencing with the nervous system, it cannot act without the circulating; as this

ceases without the nutrient, which, again, depends for its supplies on the motive portion of the organization. Yet neither of the latter will perform its duty without the nervous system: they are supported by that which they support. This is a maintaining power sustained by the forces which it generates: it is the nearest practical approach to the unattainable perpetual motion: did the circulating system demand no supplies, it would be perfect. Supplied with the means of repairing waste and replacing expended force, we do not well see why this machinery is not a perdurable piece of mechanism: but experience teaches us what this contrivance does not: and the end of age is death.

If I pass over what I intended to omit, I have only deferred noticing the organs of the distinguished senses. The system of life and motion is perfect without them, as it might also be maintained by food: but the animal mind would be imperfect, or would not be formed. And that animals can exist under imperfections and deficiencies of these, we know among the inferior races: existing also perfectly for all the intended purposes. They are well known, in the present division of animal forms; and what they are elsewhere, is not now a question before us.

The more apparent machinery of the animal body must be examined more particularly hereafter. It is sufficient now to say, that there is a framework of bones, provided with joints and moved by an attached system of muscles; forming the trunk with its limbs, under their various forms, from the hands of man to the fins of a fish: although, in some of the inferior tribes, there is a hard skin, forming a kind of external bone, by giving attachment to the muscles; as, in others, even that is wanting, so that all the parts are soft. Whatever the parts and the muscles are, the nervous power puts them

into motion, by increasing the self-attraction of the latter and thus shortening them. In the case of those motions which concern the maintenance of life, including, with the heart and lungs, the minute actions belonging to secretion, and more, this power acts without the consciousness or the will : in the other, the will intends an end merely, and the power moves the necessary muscles ; which, though termed voluntary, are no more under the will than the former, since it does not even know of their existence. It is almost superfluous to add, that it acts thus through sensation, or through recollection and comparison : as these questions must also be discussed hereafter.

It should now also be superfluous to say, that the animal machine is a complex chemical laboratory : an automatic one ; yet such, only under the principle of life, which is the directing power, or the Chemist ; having, for its immediate agent, the nervous energy, communicating through the machinery of the nerves, with the muscular fibres of the ultimate vessels, as the actual operators in this work : while the directing power itself only finds and maintains its place through the chemical labours of that engine which it sets in motion.

If the animal acting machinery, thus sufficiently sketched for the present general object, is a very mysterious contrivance, throughout, the prime mysteries consist in the nature of life, and in the mode of its attachment to that which, without it, is a dead and immovable machine, however ingenious and intricate ; as it is one which falls to pieces without the presence of that principle. This is taken away, as it is given ; we know not how, in either case : it is an ignorance not exceeded by our ignorance of its nature. It is given before the organization is ready ; for that is produced by it ; and it is taken away while that is still perfect. It is even a less

difficulty, that it should be restored to the dead body, than given to the scarcely inchoated machine; as far as we should reason on this subject: and the only answer to such an inference is, that this does not happen. It is for the reader to consider how this applies to certain historical facts which philosophy has viewed as difficulties, or somewhat more. These are, admittedly, out of the "course of nature," but they are not opposed to the "laws of nature." It is a great mystery to find that life is attached without action: to the egg at rest, or to a completed organization, incapable of acting for want of water, as is the occasional fact in some of the inferior animals.

But I must cease on a subject which will occur again. Yet let not unnecessary mysteries be added, by supposing that the chemistry of life differs from that of death. Great names mislead: there are not two chemistries. Under life, the elements are kept in those conditions of motion and change under which they continue to be, or to reproduce, the chemical compounds and the organs to which life attaches itself: when this departs, these motions give way to others, because those elements are no longer moved and changed as they were before. It is as where the chemical element which prevented the extra-organic decomposition of the animal compound, when present, suffers that to occur when it is abstracted. There is an organic and an extra-organic chemistry: but these are only different modes of proceeding under the same great power; the chemistry is one.

In the vegetable creation, we know infinitely less of the interior anatomy; and the physiology is equally dark as in the animal one. The exterior anatomy is obvious to every one: but as, in this case, I need not reserve the inferior races for a separate examination, I may here sketch the general facts which relate to the

whole. In the class termed most perfect, there is a root by which, most generally, the plant is fixed in the ground, sometimes on other plants. There is also a stem, commonly ramified and bearing leaves: and, most commonly, there is annually produced a flower, or more, of very different characters in many plants, but always containing, or essentially connected with, the seeds. The stem varies, in being more or less woody and hard, and in containing little of that fibrous matter in proportion to the softer vascular and cellular parts; while there are many intermediate conditions; and it is most commonly under some reference to this, that the sizes and statures differ, as do also, very extensively, the durations of life. I may here also notice, that if some maintain their places in the ground independently, others demand support from surrounding objects, and are provided with peculiar organs accordingly. The trunk is covered by two barks; the inner one being vascular and active, the outer sometimes inert, as an epidermis, and sometimes an apparently dead substance; while these extend over all the ramifications and the roots. Within these, there is sometimes a cellular and tender substance, the pith; as they are occasionally also hollow, and simply lined with it.

The leaves spring from the stems and the branches, most often by a footstalk, which, in the deciduous plants, has a distinct joint, allowing it to separate. Generally, a leaf consists of a framework of fibres, ramified and reticulating from a main trunk which is also the footstalk; covered on both sides by a skin or bark, often different on the two surfaces, and containing, within, a peculiar soft structure, the exact nature of which has not been ascertained, and which, in the succulent plants, contains much fluid; as, in these also, the fundamental portion of the leaf differs. The anatomy of a flower is

more complicated ; while it also varies materially, both in the general construction and in the essential parts. It has commonly a stem, like the leaf, bearing, most generally, a flower cup, of a material and structure which seem to resemble those of the leaves, within which is the flower, of a peculiar internal structure, tender, and for the most part coloured. Under a variety so very great that the details of botany must be consulted for them, these parts enclose, or support, the filaments, with their anthers, containing a globular dust, of spheres enclosing some kind of fluid, and the seed vessel, or the seeds without a capsule, bearing the pistil with its stigma ; while the numbers and forms of these latter parts also are exceedingly various. At times also there are certain superfluous parts, termed nectaries, though not always secreting honey ; while it must further be remarked, that there are some flowers which contain only filaments, as others contain only pistils ; the latter alone producing that seed to which these organs are always attached.

As in the animal creation, there are structures less perfect than these ; and, for those, the ordinary classification of botany will here suffice, deficient as it may yet be. The ferns may be viewed as leaves, though sometimes attaining the stature of trees : they bear no flowers, the parts which serve the purposes of stigma and anthers are obscure, but the seeds are always conspicuous, on the leaves, or on a distinct leaf. The mosses may be sometimes viewed as mere leaves, at others as minute shrubs, as in both of these tribes the arrangements for root, stem, bark, and leaf, do not essentially differ from those in some of the more perfect plants. The flowers are also obscure ; but the seed vessels are always remarkable, and are generally elevated on stems, prolonged after their production. The subaqueous imper-

fect plants are almost always rooted ; and consist of leaves alone, or stems bearing leaves, or stems and branches, or stems alone, which are often mere fibres, without leaves. Being sometimes transparent, they display many highly complicated but unintelligible internal structures. The flowers are obscure, uncertain, or have not been found ; but they produce seeds, sometimes within their substance, at others in seed vessels. If the lichens, forming another tribe, are chiefly terrestrial, the limits between this and the former are not well defined. The general anatomy is also sufficiently similar, except where they approach the fungi ; towards which division also the boundary is either not well marked, or is not known. They produce peculiar parts at times, which are thought to contain seeds ; but if these are but ill proved, still less proof is there of the existence of any flowers. The fungi are the last, under so great a variety of external form that I must again refer to the works in every person's hands. It is difficult to compare them with any of the preceding, except a few of the lichens. They root upon almost every thing, and are frequently parasitical, while soft, spongy, perishable, and often very quick in growth ; though, in other cases, as durable as many of the last tribe. Like many of the fuci, they produce their seeds within their substance, without known flowers ; and these are also often very abundant and conspicuous.

Respecting the internal anatomy of plants, there has been much writing, under no small labour : but there is abundant contradiction, and, as yet, irremovable obscurity. There are known to be minute and parallel vessels, passing through every part of a perfect plant at least ; and some of them are also known to be formed of a single spiral fibre, though as many as four are sometimes met with. There are also cells, or there

is a cellular communicating texture ; while it is asserted that the inferior tribes are chiefly or wholly composed of this. Mushrooms and Lichens appear to be entirely cellular ; yet how do they act without vessels, which have not yet been traced in them ? The sum of our knowledge seems to be this, as the rest is of little value. Of such knowledge it is easy to write a volume, but not a page. There are cells of various shapes, passing into tubes, often communicating, of which the spiral shaped seem to be really air-vessels, and probably are a sort of lungs. The differences of the several cellular textures are not known : in truth, no one of them can be understood. Arteries and veins cannot be distinguished ; though a fluid which ascends and returns or circulates, demands both. It is believed, but not known, that there are vessels for air, acting the part of lungs. It is known that there are secretions, but the secreting structures are not known : the anatomy of the essential parts of the flower ought to be remarkable, but we are equally ignorant of it. There are absorbents and exhalants, because there are absorption and exhalation ; there are nerves, because there is sensation, and because there is chemical action ; and there are muscles, because a vessel could not otherwise convey a fluid which is not urged by a prime force, nor act as a chemical organ ; and because the parts of plants move under sensation. But of all this we have found nothing : such is our knowledge of the internal anatomy of plants : while, as usual, that which cannot be seen must not be believed to exist ; at least if it does not agree with the hypothesis of the day ; as that hypothesis too can see what is non-existent.

Our knowledge of the physiology is similar. There is no want of insulated facts ; but there is considerable want of confidence in them : while, under much

contradiction, and a want of connection in these details, not much is worth repeating. Generally we are sure that the plant, like the animal, is a chemical laboratory, forming compounds out of elements, under the guidance of life. And whatever be the minute vessels and their actions in the latter, they ought to be the same, or similar, in the plant, even to the minute details. As far indeed as chemistry must be deemed consistent in its causes, there ought to be identity in some cases, because there is an identity in the chemical products. The aphid and the flower equally form honey from the sap, the ant secretes malic acid as well as acetic, and the apple secretes the former. Wax is produced by the bee and the myrica, musk occurs in both classes; as does manna, in one insect at least: and oil is the noted produce of each, sometimes under scarcely differing varieties. And that all these chemical actions depend on life, it is needless to say; since they cease when that departs, and death is followed by decomposition. It is also indifferent, under this view, whether we admit plants to possess sensation or not: because the same actions are performed in the animal body, without sensation, consciousness, or will. But this important question is reserved for a fitter place and a fuller examination.

As there can be no parallel drawn between the total proceeding in plants and in animals, for want of the needful knowledge of the former, I can do little more than notice their nutrient system; while even that is as obscure as it can well be. We are not always conscious of our ignorance, till we attempt to explain to the more ignorant. There is no stomach, nor anything analogous, at least as the primary receptacle of food, whatever may be supposed, rather than proved, respecting the functions of the leaves. Vessels ascend-

ing from the root, and proceeding till we lose sight of them, convey water, to all the parts it must be presumed ; and if we see the flow from an incision, so do we know that the force of the circulation, and the quantity circulated, are often considerable : while we can see the act of ascent and the return in the *Chara* as well as in the *Caulinia fragilis*. The motion of the sap may also be traced in *Chelidonium* and *Ficus* ; but the opacity of the vessels in the great mass of vegetables prevents us from seeing anything. It is believed, but not proved, that the water undergoes no change in the ascending vessels : it is inferred that this takes place in the leaves, and that they, in some manner, convert the food into the sap, or blood of the plant ; while it is certain that the loss of them puts a stop to the formation of new parts and of the usual secretions. What mode of respiration, if respiration it can be called, takes place in the leaves, is as obscure as all else ; further than that we know of the inhalation of water, and of the exhalation of oxygen and of carbonic acid under different circumstances ; nor does it appear how this aids in the digestive functions of the leaves, if it does. It is probable nevertheless ; in which case, the functions of respiration and digestion are allotted to one organ in plants, whereas, in animals, they are divided between two.

The apparent food is water, absorbed by the roots, or by the leaves from the air. But the quantity of carbon in plants cannot be accounted for from this food, nor from any conceivable quantity of carbonic acid, or any mode of carbon dissolved in it. This is not even explained through the carbonic acid in the air. We are equally at a loss respecting the azote of the pungent plants and the fungi, unless they obtain it by inhalation. But it is really fruitless to form conjectures at present, respecting

the true food of plants, though air and water are the apparent ones. The whole continues obscure, even to the real use of manures: nor are their true relations to the atmosphere or the matters contained in it, known, further than as I have already noticed those. That some take up earths from the soil, is a fact of no peculiar interest under the present views.

If I mentioned that the harder and larger trees or plants were commonly the most long lived, this is a circumstance in their physiology which deserves some further notice. The longest animal life that has been observed is, I think, in the tortoise: but, probably, a life of two centuries is rare, even in this animal. One century would be more safely considered as a general maximum; but even this extent of duration is confined to a few: the average, for even the longer lived animals under this extreme, is incomparably less. The possible or existing extent of duration among plants, is not known: but one of a thousand years has been sufficiently often ascertained; as there are an immense number which far exceed the longest term of human life. The annual plants, which are, in reality, summer lives, find their counterparts in the insects; while there are minute parasites at the very bottom of the scale, whose lives may almost be compared with those of the ephemeral ones, though I am not aware that there is any fungus, however small, whose life is equally limited. And further, there have been conferred on all the more perfect and durable plants, as on some also towards the lower part of the whole series, great powers of resisting injuries and of disregarding mutilation; while, being gifted with capacities of almost interminable reproduction, the separated parts, under many different modes, are also empowered to continue the original life: it is a progeny without seeds; as, in some, there are also

representatives, or posterity, produced in such a manner as to detach themselves. On these and other facts appertaining to plants, I must enter further hereafter : the present slight notice was not the less indispensable in this place. But it is proper also to remark, that the parallel facts in animals occur at the very lowest parts of their scale : whence, as from other things, a fanciful gradation between plants and animals has been sought or maintained.

In animals moreover, there is a definite bulk, varying within very narrow limits : but in plants, the licence with respect to size is very great ; and the variations depending on the supply of food, or other obscure circumstances, influencing their chemical actions ; as they are sometimes consequent on reproduction, or excess of production, in limbs or parts, where there is no defined general form, as there is in animals. Similarly, under this power of reproduction, there are formed new leaves and flowers to replace those which have been destroyed ; and, especially, great energy is displayed by the plants of a summer life, in ensuring their continuance through seeds. In these there is a very close analogy to the animal egg : the remarkable differences are, that the germ is more fully formed, so that it is a minute visible plant, and that its investments constitute a regular organization, becoming temporary leaves in one division of this department of life.

The further details of this, as of other matters, must be reserved : and I may terminate this general sketch of the imperfectly known physiology of plants, with an equally brief notice of their dormancy and their hybernation. Many sleep, visibly, by closing their flowers, and by retracting or folding their tender leaves ; as some do this also under adverse states of the weather. In all that have been examined some change of chemical

action takes place, indicated by the exhalation of carbonic acid instead of oxygen, as already noticed. Of the hybernation and the cessation of the nutrient actions in animals, the examples are rare, except in the case of the larva of insects; where, however, those of the second animal, as the progeny of the parent, are going on. But in all the plants of more than a summer life, this is universal in the colder climates; as the leaves also fall off, in all but the few known as evergreens: the plant putting on the semblance of death, yet retaining a dormant life, while the buds for the future flowers and branches, which were produced during the activity of summer, continue in a torpid state, waiting for its return. Finally, it is not well proved that plants can generate heat, though there are facts which render it probable: but they have greater powers, nevertheless, in resisting cold, than the animals which produce it; though the means by which this is effected remain as obscure as nearly all else.

This sketch, slender as it is, will suffice for the present limited purpose, in the plant as in the animal. Difficult as is the anatomy of the latter, that of the former is infinitely more obscure; though the power of examination, in the living as in the dead organization, is unlimited, and the subject has not wanted industrious and able investigators. I must regret that it should now appear to be less understood than it had perhaps been supposed by those who had read with little care and much belief: but under the objects here in view, nothing but knowledge is useful, while here, as elsewhere, there is nothing safe which is not Truth.

CHAPTER VIII.

ON THE MECHANICAL STRUCTURE OF ANIMALS.

IF, in commencing the illustrations of mechanical design with the animal machine, I do not indulge myself in much minuteness and extent of anatomical detail, the cause will not be sought in ignorance, at least, of this branch of natural history. I cannot be unaware of the field which it affords, nor unfitted to enlarge on such a subject: but the reasons against thus indulging seem to me unanswerable. To most persons, anatomy is a repulsive portion of natural history, or it cannot at least be adequately examined without exciting disagreeable associations. Its phraseology also is not always easy to understand; while, being practically inaccessible to the multitude, it seems especially unfitted for a work on evidence which all ought to be able to verify. In this case moreover, as in most others, the needful kind of knowledge cannot be acquired from minute technical details; while to attempt instruction in this manner, is to confuse the mind of the reader with fragments which can neither be combined nor generalized, and are often not understood at all. It requires minute and extensive knowledge to generalize: and while it is the duty of the writer to do this himself, it is he alone who can do it to any purpose. Broad views, references to familiar objects, language divested of technicalities, these are what the writer ought to study, and what the

reader requires. He must think for his reader, as that reader would think: and if he fears that he may thus be supposed ignorant of his subject, he will not be judged thus, by those at least who have studied the art of teaching.

If the animal structure is a mechanical contrivance, an automaton, united to a chemical laboratory, and put into action, both chemical and mechanical, by an unknown force called life, in some cases influenced by the will, in others not, it is only as a mechanical contrivance that it is now to be examined. The purpose is, to investigate, as far as is generally intelligible, and is necessary for the present argument, the mechanical resources displayed in this automaton, excluding the moving force: and to show, chiefly by a comparison with human contrivances, that it bears the marks of ingenuity and design, or is the work of an artist, who had certain objects in view, and has accomplished them in a perfect, or at least a satisfactory manner. And the result will be, to convince every one in the least versant in mechanics, first, that the Great Artist intended what he did, and next, that He effected what He intended, through reasoning on the laws of nature: while I use this expression that I may the better compare His works with those of man, who learns to estimate, and even to imitate those works, by reasoning on the same grounds, through that portion of the same faculties which he has received.

In this automaton, which I have here limited to the vertebrate animals, motion, in various forms and degrees, and for various purposes, was to be provided for, after form and stability. It was to be a ponderous mass, of a determinate and persistent form, in the first place. The basis therefore of this structure is solid, hard, in-

flexible ; and it is formed of parts adapted to each other with a view to the several motions that would be required. This is the framework of bones, or the skeleton. What that is in man, and also in horses, at least, is known to most persons, in a general manner : though anatomical investigation is required to understand its design and purposes.

Though the bone is of a stony hardness, it is a living substance : it grows, it can be repaired by its own powers, when injured or broken, and the more its services are required, the firmer it becomes, as if itself possessed a reasoning faculty. While it is strong, it is also tough, or tenacious : and its tenacity is peculiarly distributed in the directions in which that is most likely to be assailed. In some cases, it is a hollow structure, or a tube : while mechanics demonstrate, that with equal weight, this is the strongest manner in which such matter can be disposed : and when the tubular form was inapplicable, the same ends are gained by a cellular disposition.

But as a more minute investigation discloses much varied ingenuity in this fundamental portion of the animal machine, I must note a few more of the circumstances most easily understood. The cellular disposition is very remarkable in its details ; but does not well admit of description, otherwise than by saying, generally, that it is such as to present the greatest strength where the greatest force is exerted against it ; marking, like all else, the foresight, or foreknowledge, of the Artist. It will appear most remarkable perhaps, to most readers, in birds, where the cells are filled with air, and where the union of levity with strength is very striking, though far outdone in the structure of a quill-feather. But it must always be remembered, that a great

part of the whole problem, in all animals, was to unite gravity, as a resisting force, to all the other required qualities ; and that even a bird must possess weight, that it may perform the whole of its various functions. I may also point out how extreme strength has been united to levity in the breast-bone of this tribe, where so large a surface was required to lodge the muscles of flying. The quality of the thin plate differs from that of ordinary bone ; approaching rather to horn, in toughness and elasticity ; while the edges are strengthened by an enlargement, answering the total purpose as well as if the entire bone had possessed that thickness, and exactly resembling the expedient of an artist in metal, when he applies a wire round the edge of a thin plate. In the long bones, I may also notice the ridges by which they are strengthened, where strength was most wanted ; though I must not enter further on this class of details.

Even thus far, there are strong marks of design : they will be more apparent in examining the general framework of this automaton. The spine may be regarded as the true foundation of the whole machine, and as bearing all the other parts ; though it is more usual to consider the pelvis in this light. And the ribs form the first portion of the superadded framework demanding notice. Of these, the prime office is to enclose the heart and lungs ; partly as a defence, partly as a means of enabling the latter to execute its peculiar function : and the secondary one is, to give support to one set of the instruments of motion. The upper end of the spine supports the skull, itself a very complicated structure of several bones, but easily divided into three portions, as far as its office is concerned. It is a case to contain the brain ; and, exteriorly, it pos-

esses cavities for the three senses of seeing, hearing, and smelling; comprising further a joint and a separate appendage, to form the machinery of eating, the mouth, including the fourth sense, taste.

What remains of this framework consists of two pairs of organs of motion; together with a peculiar portion, forming the immediate support of one pair, and serving some other purposes. But in this further general view, the fishes must be excluded. In man, the organs in question are the arms and the legs; in birds, the wings replace the arms; and in quadrupeds, there are only legs. But in all, equally, different as are their offices, the fore extremities are supported on the ribs by means of the shoulder blade, and generally without any bony connexion, as in the majority of quadrupeds; though in some of these, there is, as in man, such a connexion in the clavicles, while, in birds, there is another in the fork, if indeed this part does not in reality represent those bones. This foundation is followed by six, or sometimes fewer, tubular bones, placed longitudinally; the remoter ones being multiplied laterally, in most cases, for the purpose of forming hands and feet, while they are further attended by some shorter bones, as in our wrist joint, on the details of which as they concern the several animals here classed together, I need not here enter. The hinder or lower part of the spine supports, or, if otherwise viewed, is supported by, a solid structure of arched work, the pelvis, firmly fixed to it: and to this, as to the shoulder blade, is attached the same number of tubular and other bones; forming our legs, and those of birds, with the hinder ones of quadrupeds.

If, omitting certain limited peculiarities, and under the present broad view, all refinement, such is the ge-

neral structure of the chief terrestrial animals, no moderate length of description will teach a general reader how well it has been designed and executed for its offices; and I need not make a fruitless attempt. Nor is it easy for any but an anatomist to examine and estimate the mechanical beauty of the skeleton as it demands and deserves. Besides the almost inevitable disgust arising from various associations, and some of these very injudicious ones, we are so accustomed, in the works of art, to regular curves and angles, and to polished and orderly surfaces, to the work of the turner and joiner, that it requires considerable habit, as well as reflection, to perceive, in the framework of bones, the mechanical beauty which it really possesses.

Omitting much, I must therefore inquire of the provisions for rendering this automaton movable; since, in those, the art, or design, will perhaps be most easily understood through description. Yet not without a brief notice of the contrivance displayed in a part so apparently simple as the skull: though I must almost limit myself to the human machine, since it is impossible to frame a description applicable to this part in all animals.

The structure of the bone itself is not less remarkable than in the case of the sternum of a bird. In this receptacle of the most important organ of the body, it consists of three distinct and different laminae, though anatomists generally enumerate but two. The external one is tenacious and tough; the next, of a cellular structure; and the last is extremely hard and brittle, differing from every other bone in the body. It ought to be inferred that some special end must have been intended by this peculiarity: and a little consideration will show, that the whole, as it now is, forms a more complete de-

fence against all assaults, than if the whole structure had consisted of even the strongest of these substances. And it will also be seen, that in the peculiar union of form and structure, there is that kind of design which implies a foreknowledge of the injuries to which this part of the body would be exposed. The peculiar strength against external injury which is produced by the spheroidal shape is obvious; though it is not mechanically correct to refer to the principles of the arch; as an eggshell also offers the best illustration. The advantages derived from the dovetailed sutures of the outer plate and the smooth joinings of the inner one, can scarcely be understood without inspecting the parts themselves. The additional strength conferred on particular parts, by means of ribs, or thicker portions, is easily conceived; but the most interesting circumstance here is, that it is rendered especially strong, where, from the falling of the animal, man, the chances of injury were most frequent. And as further marking this foresight, the whole skull has been rendered flexible and elastic in infants, up to that period when the danger from ignorance and from want of power to walk firmly has ceased.

I cannot afford to be more minute on this part; and it would be endless to go through the variety of contrivance found in the skulls of other animals. But it requires only an examination, united to a knowledge of the mode of life or functions of the individual, to see that there is no want, or purpose, which has not been provided for by some variation or specific contrivance, perfectly adapted to the necessary end. An example of this is noted hereafter, in the case of the owl: and it must suffice here, as a mere specimen of these contrivances, to remark that the skull of the elephant is en-

larged by the addition of cavities, so as to give better insertions to the muscles, without inconveniently increasing the weight of the head.

To proceed with the provisions for motion, in the animal machine, it is almost superfluous to say, that in works of art, the motions of parts on each other are performed on hinges: and hinges have been similarly provided in the bony structure; some of them being such as man can imitate, while others are inimitable. I may commence with the latter; though the structure of the spinal hinges must be examined to be rightly understood. But I must premise, that in all the subsequent cases, the descriptions are made so general as to apply equally to man and the analogous quadrupeds, or, that they include what is termed comparative, as well as human anatomy; while, where any peculiarities require that the human structure should be specified, that is done.

The spine offers an especially difficult problem: nor would it be easy, if indeed it would be possible, for a mechanic, with all the advantages of the pattern before him, to construct a piece of machinery adequate to all the objects required. Great strength, united to a certain flexibility, was necessary, together with security against injury: and it was required also to procure a foundation for the ribs and the pelvis: a flexible joint was wanting for the head to move on: there was to be a tube for the passage of the spinal marrow, an organ peculiarly tender and important: and, to add to all this, numerous points of insertion for muscles, generally of the nature of levers, were essential.

All this is effected in the most perfect manner; and he who shall examine it as a mechanic, will admit that it is the work of an Artist, whose resources, if I dare

use such a phrase, he may well envy. A strong column was required, as the leading point, and there is therefore such a column, as the basis of all; forming also a portion of a cone, broadest at the base, and conspicuously so in the human machine, where the necessity of this strength below, and of an extenuation towards the head, is obvious. But as this column was also required to be flexible, it is divided into many separate parts, commonly about twenty-four, apportioned, in certain numbers, to the region of the loins, the ribs, and the neck: in each of which, different degrees of strength and flexibility were necessary. And as lightness was also equally necessary, the matter of these segments is not a solid bone, but a cellular structure, affording equal strength, or even greater against certain efforts, with far less weight; and doubtless also adding to the general elasticity of the whole spinal column. It is plain that the strength required for this column did not permit the tube for the spinal marrow to be placed within it: and it is therefore so contrived, that the projections required for giving firmness to the structure and restraining dangerous flexion, and also for affording insertion to the muscles, should, by their union, form this canal. And thus, if this complicated problem is as difficult a one as could well be conceived, we find it has been solved in the most perfect manner.

This must suffice for that general idea of the spinal column, which is all that I can here pretend to convey: but I must describe the nature of the hinges more particularly, while it is easy for any one to examine this in the spine of a fish. The connexion between two proximate bones has no resemblance to any hinge in mechanics, but is formed by the intervention of an elastic flexible substance, attached to both bones; thus admit-

ting all the requisite motion, but preventing the possibility of separation or dislocation, except from its rupture, or laceration. There are many cases in which art does profit, and would gladly profit still more widely, by such a hinge; imperfectly as it can construct a similar one.

If I pass by the various accessory hinges formed by the several projections of the spine, as not to be understood by description, that which has been contrived for the motion of the head can be thus comprehended. The problem was to move this backwards and forwards on the neck, in the first place, and to give it, in addition, a certain extent of rotation. A mechanic will see that no single hinge but the ball and socket could have effected this double object; and any anatomist will decide that such a hinge could not have been adopted in such a place. The work is therefore executed by means of two: the one, of which the head itself forms a part, being a plain, yet somewhat peculiar hinge; and the other, which lies between the first two spinal bones, consisting of a vertical pin working in a socket. But he who will investigate this contrivance more minutely, will not require that further description which another could not understand.

I proceed to the ribs. They were to be firmly attached to the spine, yet so as to admit of some motion; and the joint is simple accordingly, while possessing no peculiarity requiring notice. But there are few contrivances in this automaton more simple and beautiful than that by which it is so managed that the cavity of the chest, which they form, shall be alternately enlarged and contracted for the purpose of respiration. The problem was, to enlarge a cavity formed by a series of arches: and the obvious mode would have been, to

make them loose at the summit, and to pull the flanks outwards. But such a structure might have wanted firmness; and though it had not, no muscular power could have been easily brought to bear in this direction. The expedient is as efficacious and ingenious as it is simple. The arches are not at right angles to their common base: and therefore any force which brings them into that position, must enlarge the cavity which they enclose; while there is abundant footing for muscles to act in that direction.

This contrivance presents also another remarkable peculiarity demanding notice, as it serves many useful or necessary purposes. The bones of the ribs are not attached to the sternum, but are separated from, and united to it, by intermediate cartilages, of considerable elasticity. Hence the whole cavity is elastic, with the following various results: adding another example to many more, noted in this work, where more ends than one, and often very different ends, are gained by one invention, and that commonly a very simple one. Violence, endangering fracture, is thus resisted: and thus also flexures of the body are permitted; which could not have occurred had the ribs consisted of bone throughout, since the whole framework was necessarily of a slender nature. And lastly, the elasticity of the cartilages forms a dead force for the purpose of expiration; thus saving muscular power: a principle applied in other parts of the animal body, as in the claws of cats and the nictitating membrane of birds.

Before describing such other animal hinges as may here require, and admit of, description, I must notice that which is common to the whole, namely, the provisions for the correction of friction and the facility of motion. In works of art, this is effected by polishing

the rubbing surfaces, and by the use of oil or water. In animal bodies, there is a peculiarly smooth, and also elastic substance, cartilage, covering the summits of the moving bones where they are in contact, together with an apparatus, or gland, by which a lubricating fluid is constantly secreted. And as these hinges are secured by a ligament, forming a case round them, since the pins adopted by art for this purpose would have been both inadmissible and insufficient, it follows that not even these cartilages, smooth as they are, are in contact, but that the weight is supported, as it is in the human knee, for example, and the motions performed, on a fluid. It would be difficult to conceive any contrivance more perfect than that of an animal joint: inasmuch that art is glad to imitate it, as far as it can, in its oil boxes for wheels, as, in Bramah's planing engine, by supporting a heavy weight on confined water.

But I must here also point out the very singular structure of the cartilaginous plate which connects the spinal bones: it might not have been so well appreciated before. Though termed cartilage, it bears but little resemblance to that of the detached and hinged joints. There were to be no rubbing and separate surfaces: and it is therefore an elastic connexion, compressible, and capable of being stretched; resembling Indian rubber more nearly than any other substance. Yet even such a substance, if of uniform quality, could not have performed the requisite duties; since the motions between two proximate bones required some conformity to that which a ball and socket would have permitted. I do not believe that any mechanic could have devised such an expedient as the existing one; while the execution is probably hopeless; as it has never also been attempted, though probably from the ignorance of

mechanics respecting its existence in nature. The interspinal cartilage is fluid in the centre, and becomes gradually solid; being also flexible and elastic towards the circumference. And the fluid portion being incompressible, or sufficiently so for the purpose, as the exterior becomes gradually more compressible, the effect is the same as if the centre were a convex unyielding substance; or it is, virtually, a shallow ball and socket. I know not that the animal machinery presents any contrivance more singularly unexpected and ingenious: and in a fish, where great flexibility of the spine was required, the depth of the cavity in the vertebra renders this mechanism a very perfect ball and socket.

If the hinges belonging to the extremities of animals are not at all included in the ball and socket and the common alternating hinge, these are the chief; and they are applied in the same manner as they would have been by any mechanic, though under variations which might not have occurred to him. Some of these variations, and their uses, require notice.

In our own shoulder joint, a very free movement of rotation was required; and the socket is proportionally shallow, while the needful firmness is secured by means of ligaments. In the thigh, a less extensive rotation was wanted; but greater firmness was indispensable; and here, the socket is deep. Every thing is foreseen and arranged accordingly: and hence, further, since great force was to be exerted against this joint, with the necessary hazard of dislocation, it has not been intrusted to the strength of the enclosing ligaments alone. The art of the mechanic has not yet been able to compass what is here done: the ball being fixed to the socket by a strong central ligament, so managed as not to impede

the motion, in giving additional security. It requires the attention of an anatomist and a mechanic, to appreciate all the advantages derived from the oblique position of this joint ; but this at least is easily intelligible. As the neck of the bone lies obliquely to its length, the effect is, that whenever the whole weight of the body is brought to bear on one thigh, the pressure is sustained on a general axis passing through both portions : while the peculiar obliquity which has been adopted, remedies what might have otherwise been a defect, when it was necessary, for freedom of motion and for a lodgement to muscles, that some angular position of the neck should have existed.

Of the hinge joints generally, I may remark, that they differ from the corresponding hinges of mechanics, in being furrowed instead of plain : and the obvious intention of this is, to prevent any lateral sliding. In mechanics, this is effected by means of the here inapplicable rivet, or else by shoulders : but in our ankle joint, the latter expedient is also adopted. In these joints also, whenever the extent of motion naturally inherent in this construction would have been greater than was expedient or necessary, the restraint is produced by ligaments : and when the singular strength and positions of those which control the knee joint are considered, we cannot doubt that design and art presided at the construction.

Not choosing to encumber the reader with anatomical details, I omit certain plain joints, like those of the wrist ; as they do not add much illustration to the present argument. But I must notice the singularly ingenious contrivance by which the hand is rendered capable of being turned upwards and downwards. There is nothing analogous to it in art ; and I only regret

that words will not make it very intelligible. The fore arm consists of two bones ; and one only of those is concerned in the hinge joint of the elbow. At this place, the second bone has a rotatory motion on the first, by a sort of circular hinge ; diverging, along the axis of its rotation, from the first or fundamental bone, and, at its other extremity, fixed to the wrist hingewise, while that point forms a sweep round the opposed one, which has an analogous circular joint on the ulna, or fixed bone. Other contrivances for reversing the hand might be imagined : but I doubt if any mechanic could suggest another that would have answered every purpose consistent with the necessities of the case. If so, this is the perfection of resource, as it is the proof of design. Whatever may be the wants, the ends are attained : and in such a manner, that our reason and science approve of the contrivance, and say, This was the work of a perfectly intelligent Artist.

It remains to examine the structure by which these parts are put into motion, together with such details as peculiarly display mechanical ingenuity or resource ; as it must not be forgotten, that the only object here in view is to show that the animal automaton has been constructed on truly mechanical principles, by an intelligent Artist.

Man is the comparison. I must commence by observing, that the same principle which is applied to the motions of puppets, is adopted in the animal automaton. Mechanics possess but two modes of moving such a structure ; namely, the shortening of strings of communication, and the disengagement, or evolution, of circles or other curves, through wheel work. We cannot pretend to control illimitable power : yet we cannot conceive how the latter method could have been adopted in

the animal machine. The machines of human art are formed of separate parts, adapted and caused to act on each other : and this, which may sometimes appear an advantage over nature, is, in reality, a defect, arising from the necessity of using large masses of ready compounded matter possessing certain properties. But in the organized structures, the matters themselves are formed by the chemistry of the animal ; whence the obvious necessity of a continuous connexion, or dependence. If some of the results of this necessity should be considered as defects, the metaphysical answer would be, that these also are necessary defects, but only inasmuch as the reverse would be a contradiction, and therefore only, an impossibility. But the physical truth is, that this necessity, if it be such, has been adopted for, or with, an advantage of the most conspicuous nature : since it is through this connexion that the materials, and the forms both, are kept in that constant repair which offers so remarkable and valuable a contrast to the perishable machines of human art.

How perfectly and simply the natural machinery answers its purpose, will presently appear ; though the moving force is one which nothing but unbounded power could have applied. This part of the question I must however reserve to a more fitting occasion : at present, where mechanism alone is concerned, it is sufficient to say, that the strings of communication have an inherent power of shortening themselves, at the will of the animal, and, in some cases, without its will. In a mechanical automaton, they must be shortened by an external force. The ingenuity consisted in placing these strings in such a manner, and of such numbers and powers, in the animal body, that all the required

variety of effects should be produced by their shortening. An ingenious mechanic, could he command the contraction, might, with the present framework, effect much of what is done by the muscles ; but it would require much study to find the means of doing it as well. Yet were it well or ill done, the value of the argument is the same : that which it requires an artist to do now, was originally the work of an artist : that which is admirably done, must have been the work of an admirable one.

But there was more to be done than simply to approximate two points ; and thus are there many collateral ingenious contrivances in the muscular system. A string, for example, from the shoulder to the wrist would have bent the elbow : but in this and many other cases, such a contrivance would not have answered all the required purposes ; while it was necessary also to preserve certain forms in the total machine, not only for the sake of beauty, but utility. Extent, rapidity, and power, were to be superadded to mere motion ; and, for these, peculiar contrivances were required ; as it also demanded specific exertions of ingenuity so to dispose all those strings, in the given space and form, that they should not interfere with each other's actions or places, or with the expedient shape of the animal, or with its functions or wants. And all this, with much more, is so accomplished, that no description would suffice to convey a notion of the perfection and beauty of the workmanship. It requires indeed a philosophical anatomist, one combining a knowledge of mechanics, and of art in addition, with a perfect knowledge of universal anatomy also, to estimate the perfection of these moving structures, to value the difficulties, and justly to admire how they have been surmounted.

Could it possibly be true, as it has been said, that there should exist an anatomist who has not seen the hand of an intelligent Creator in the muscular system, supposing that he had also seen it in nothing else, then must all attempt at conviction through the works of creation be hopeless ; since it is more than the renunciation of evidence ; a moral aberration, or a diseased condition of mind.

As it would be useless to examine the details of the muscular system, without those references to the facts which are here impracticable, I must limit myself to a few remarkable examples of mechanical contrivance ; premising some needful observations on the general structure of these organs. I may also note, that in the human body, the number of muscles is reckoned at four hundred and thirty-six, while in many of the inferior tribes, as in some insect larvæ, they often amount to five or six times that number.

A muscle, popularly termed flesh, consists of fibres, sometimes collected into bundles, and attached, in different modes, at each end, to the two parts which are to be approximated. He who will bend the elbow, and lay his hand on the inner part of the upper arm, will feel that it enlarges and becomes hard. This is the contraction of that muscle ; which, being fixed to the shoulder at one extremity, and to the upper part of the fore-arm at the other, produces the effect in question, by approximating those two points. Such is the principle of all the animal motions : the will being the remote moving force, yet without knowing what it does ; as some, yet mysterious influence, transmitted through a nerve, is the immediate one.

The simplest conception of a muscle, is that of a bundle of fibres, terminating, at each end, in a tendon

which is fixed to a bone ; and its action and effects are the simple one just noticed. But the penniform muscle is an example of higher mechanical resource, as it is also applied to the gaining of more than one end. This, in one form, is easily examined by any person, in the large claw of a lobster. The object here, was to give great strength, while, at the same time, a limited motion was sufficient. It is evident that if any fibre possesses a given power, that will be increased in proportion to the number of fibres ; and this is the contrivance in question. Many short fibres are caused to act on the broad tendon laterally, where but one could have acted longitudinally ; and hence the known power of this tool, as its use is to crack the harder shell fishes. But there are cases also, where the penniform muscle is adopted for the purpose of gaining velocity in the moving part, if at the expense of force of action : though the principles of this could scarcely be comprehended without those illustrations which I cannot here give. It may however be understood, by a simple diagram, how a greater extent of motion, though but with an equal contraction of the fibres, can be produced by this contrivance, or by that which is equivalent, the diagonal crossing of muscles, as in the ribs ; which can even be brought into contact in this way. It is an example of the composition of forces : and he who will draw an equilateral triangle, and then conceive each side shortened to half its length, will perceive that he has brought the apex into contact with the base, when an equal shortening of the perpendicular would have produced but half the extent of motion.

Before pointing out the few instances of mechanical contrivance in the muscular system, which I have selected, I may notice one general fact implying design.

This is, the steady relation between the possible motions of a joint, and the places and actions of the connected muscles. An anatomist, viewing the muscles, would pronounce on the nature of the joint; or, seeing this, would decide on the action of the muscles: than which, no stronger proof of intention could be given.

It would be a reasonable expectation, to find the power of the lever adopted in the muscular system; and it exists accordingly: as it is sufficient to quote one familiar example, in the hind leg of a dog, though I might add many more, besides the heel and the elbow in our own framework. But if it has been remarked that the predominant levers are disadvantageous ones, it has been forgotten that there is a design in this also, independently of the necessary preservation of a convenient form. In our fore-arm, for example, a rapidity and extent of motion in the hand were requisites as essential as the lifting of weights: and thus a small extent, and, equally, a small velocity of contraction in the muscle, suffice to produce a great effect of each, where those effects were wanted. Man is compelled similarly to renounce the same mechanical advantages, when he is in want of velocity, as in the case of a ship's braces: but no real sacrifice of force occurs in the case of the animal mechanisms, because the muscles are calculated to compensate the mechanical disadvantage, as, for this end, the resources of the Creator are ample.

Whatever ingenuity the combinations of muscles towards producing a single effect may display, they cannot be understood by mere description: but I may point out the solution of a difficult problem by means of one muscle: partly because of the simple ingenuity of the contrivance, and partly because it is easily examined. It was required to turn the head round on a pivot: and

he who does not know how this is effected, will be troubled to discover where he should attach the two ends of a contractile string for this purpose, within the present surface of the human body. But the result is attained by that muscle on each side of the neck, which can be seen in action when the head turns; though at an extreme disadvantage as far as the resolution of forces is concerned.

But there is perhaps nothing in the mechanism of muscles which appears to us so striking as the trochlearis of the eye; from its resemblance, both in the invention and the execution, to a work of human art; while I have more than once remarked, that we most easily admit of invention, ingenuity, and design, when we make ourselves the standard of comparison. And the application is not less interesting than the contrivance. Not to refine unnecessarily, the problem was, to roll the eye over a greater space than could have been done by any single muscle proceeding from the rim of the socket to the back of the globe. And it is solved by attaching the one end to the bottom of the socket, passing it through a ring on the edge, and then reversing it to its attachment at the hinder part. Anatomists will see why I ever suppress what is unessential to the specific purpose here in view: to present too many ideas at once, is only to confuse the general reader.

To pass from purely mechanical contrivance in muscles, there is one great and wide example of resource in the muscular system, which it would be unpardonable to omit. It can scarcely be termed mechanism, though the attained end is a mechanical one; while it is the surmounting of a difficulty which would have been hopeless to the most ingenious of human mechanics.

Were the trunk and the hinder extremities alone, of

a horse, or other quadruped, given to such an artist, and he were desired to supply a foundation for the anterior ones, how would he betake himself to it? The ribs offer no base: and still more would he despair when he examined the firm foundation provided for the hinder legs, since he must feel that it was his business to provide another scarcely less firm. Yet is this effected as easily as it is securely, and without bone or joint: speaking as a mechanic, I might almost say that the foundation of the anterior extremities is on nothing, the weight of the body borne by nothing: for the matter of the muscles does not give the support. The foundation is in muscular power; on spirit rather than on matter. There was a difficulty to be overcome, because a firm and bony base was incompatible with the other offices of the trunk at this part. But the Creator knows no difficulties: the inconvenient bone is dispensed with; and a soft and tender mass, apparently incompetent to such a task, performs this duty.

If I have remarked that the muscles are so disposed as not to deform or encumber the limbs, this is nowhere so remarkable as in the hand and foot, or in the extremities of animals generally. The chief muscles of the fingers are placed in the fore-arm; those of the toes in the leg. In the fine lower limbs of a horse or a stag or a bird, there are only tendons: we can conceive how shapeless such animals would be under another disposition. And in the muscles of the fingers and toes, there is also one of those contrivances which are so useful in this argument, from their resemblance to the efforts of human ingenuity. It was difficult to make two sets of tendons pass to two rows of joints, without clumsiness or interference: and, to avoid this, one set passes through the other. Human mechanics have

adopted the same expedient in certain moving engines. If we also possess another contrivance used in the animal body, so has the great Architect of that structure adopted it as the best remedy for a contingent evil, and also as a mechanical expedient to gain an end. The tendons which pass the inner angle of the leg and foot would have started up when in action, and they are therefore tied down by a ligament. Thus also is the desired effect produced without any waste of force ; which must have happened had the construction been such that the muscle must have straightened itself before acting on the intended part, as, under its present powers, it would not have been long enough for such a purpose.

The power of a muscle is a subject on which anatomy throws no light, nor is it a question of mechanics ; and I must therefore reserve it to a future chapter (xxx.). But I ought not to omit here, what relates to the strength of tendons, having already noticed this quality in bones ; since each of these may be viewed, with sufficient truth for the present purpose at least, as consisting of dead materials, depending for their strength on their aggregation or composition. It is plain that the tendon demanded strength to resist the greatest force which the muscle could ever exert ; and this is the fact, under certain casual and familiar exceptions. That the material is a strong one, we know ; while this is one among many more things, which we cannot explain ; but in addition to this mysterious constitution, we can trace a mechanical contrivance in the interlacing of the fibres, giving a greater collective security to this connecting cord.

The illustrations thus derived from the general structure and leading contrivances of the animal automaton, might suffice for the purposes of the argument in view ;

but it will be useful as well as interesting, to select some further special instances of contrivance, in proof of a designing and intelligent Artist. These I shall take, whenever they may offer, with even less of order : confining myself also to those which are most easily made intelligible by description, or most easily verified.

In the human muscular system, the knee-pan (patella) is a contrivance as simple as it is rigidly mechanical ; being often adopted, under some modifications, in our own machines. Should we attempt to open a door by a rope attached to its loose edge, and passing, in contact with its plane, towards the hinge, the difficulty, with the waste of force, becomes sensible almost by intuition, or before trial. Let the angle be enlarged, by passing it over a projection on the frame, and the object is accomplished with comparative facility. Such is the use of the patella with respect to the leg and its extending muscles, though the disposition is different ; while the large heads of the bones serve the same purpose in other cases.

The bones of man and quadrupeds, although hollow, are filled with marrow, and are therefore heavier than if they were empty ; whatever the uses of this substance may be. But it was desirable to make birds as light as possible ; and therefore the same classes of bones in them are without marrow ; containing air only. This is an instance of a deviation from a leading principle, for a special end : and nothing can better mark design than such deviations ; as they will be displayed on a much wider scale, on future occasions.

If the contrivances already pointed out be purely mechanical, the animal machine includes an extensive system more immediately belonging to hydraulics, though comprising mechanical contrivances also. I

must therefore turn to this ; though confining myself to the common and known principles of natural philosophy, that I may the better compare them with our own works, and thus more tangibly point out the intelligence displayed. Yet I am here compelled to extreme brevity. The very principles of the motions of fluids, under all the circumstances in which they are engaged, are but partially understood : and if the vascular system, in all its niceties, can only be known to an anatomist, so is it difficult to convey adequate notions of the facts, by mere description, to those who have not seen them. But as far as we do know the laws of hydraulics, the same knowledge and resource are displayed in the vascular as in the purely mechanical part of the machine ; while there is, doubtless, much of ingenious contrivance which our ignorance does not allow us to appreciate ; as we are further defeated in many of our attempts, by that union of a living force, in the muscular portion of the vessels, with the elasticity of their materials, which we cannot compute, as we cannot imitate it.

The contractile power of the heart is the prime mover of the fluid circulating through the system of the arteries and veins : but, whatever physiology may have disputed respecting an additional circulating force, in the muscular power of the vessels themselves, there seems no reason to doubt this result, among others, when there is no force but this through which the circulation in the absorbent vessels can be carried on. And there is believed to be a third force, of an auxiliary nature, in the elasticity of the arteries. But not to refine on a subject somewhat too abstruse for a popular work, it is evident that the elastic force, if not the muscular one also, is at least a moderating, or an equal-

izing power, as far as the action of the heart is concerned: as will be plain on considering what would happen if the circulating tubes were unyielding, or, if yielding, unelastic; each of which conditions actually occurs in certain diseases, and with destructive results.

The collective enlargement of the ramifications of the vessels, as they proceed from the trunks, is another compensation, intended to remedy the progressive loss of force, so familiarly known, and so obvious in itself, that I need not dwell on it. But, in the system of the arteries, where the object is to protrude the fluid from a trunk into branches, the angles of ramification are more obtuse than in the veins, where the fluid is received by large branches, or trunks, out of small ones; as the reasons are also apparent on a slight reflection. In some of the minute details, the provisions are far more remarkable: as, when different forces in the trunk are regulated by the mode in which the branches leave it, and when, above all, we see, that if, on a demonstrated principle in hydraulics, the force should be so great at a given point, that the fluid would pass an opening made at the more usual angles, without entering it, the angle of ramification is then so disposed as to prevent this defect.

The heart itself, with the great vessels which depart from it in the human body, indicate the same wisdom of contrivance, though demonstrated in a somewhat different manner. It is so placed that its exit is upwards, though the destiny of the larger proportion of the blood is downwards: while the ascending channel is also rendered as free as possible, and the other is checked by that incurvation termed the arch of the aorta. And the reason for this disposition is to be sought in a design to compensate the force of gravity,

which is a retarding power to the ascending force, and an accelerating one to the downward flow. Physiology has also noted one case of ramification, displaying very marked judgment, or thought, with which I may conclude these scanty, but sufficient remarks on this particular subject. This is, the point at which the thoracic duct, possessed of little force, discharges its most important fluid, the supply of nutrition, into the circulating system. The selected place is the angle formed by two large venous trunks: and hydraulics show that this is precisely the point of least resistance, or of no resistance; the only one where this prime fluid could have found its constant way into the general circulation without any hazard of a check.

I may proceed to the valves of the vascular machinery; which, though belonging to the hydraulic system, are contrivances of common mechanism, and will probably therefore be more interesting and intelligible to general readers. These often present examples of that contrivance which is always especially satisfactory, from resembling our own efforts of ingenuity. The necessity of valves to prevent the return of water once raised, is familiar: and the object, in the animal vessels, was precisely the same, though the construction is different. Yet it is not so purely an animal contrivance that we cannot imitate it; though we might not indeed make very durable or effective valves on the principle adopted for those of the veins and lymphatics. Let the reader conceive a tube, with two or three pockets, such as the watch-pocket of a bed, attached to the inside, so that the loose edges shall meet when they are filled. This is the valve; and it is perfect in its effect: the fluid which has passed over the attached bottom filling the pockets on any attempt to return, and thus bringing

the edges together so as to close the aperture. It is by this contrivance, abounding most where the protruding force is least, that the motion of the contained fluids is facilitated: that which has once passed a valve, can no longer press on what is coming behind.

But if this is the predominant invention, I must notice a variation of it which occurs in the first great valve that follows the heart, where it was necessary to prevent the blood from flowing back on that organ, or resisting its efforts, as it is the only valve in the arterial system. There was here a peculiar want, from the peculiar force to be resisted: and it is in cases like this, all through nature, that we are most struck with the thought and contrivance that have been exerted. The general structure of this valve resembles that of the veins, but it consists of three pockets, and is also fixed into a ring which forms a contraction in the artery; for the apparent purpose of resisting the peculiar pressure which must occur against the base of the valves. For the sake of additional strength, and also to prevent them from closing up to the sides of the artery, under the great pressure of the blood, so as to defeat the whole object, the edge of each valve is surrounded by a tendinous thickening. And further, as three segments of circles, such being the edges of the valves when in use, could not meet so as to close a cylinder, the centre of each is provided with a projection, so that the effect of the total valve is complete. And lastly, let me remark on this great valve, that the place chosen for the insertion, and the contraction of the artery belonging to it, is precisely that where a fluid, thus forced into a pipe, undergoes a contraction, from the different velocities of the sides and the centre of the current: so that what might, at any other point,

have impeded the flow of the blood, is here without evil effect.

It is quite superfluous to urge the proofs of perfect knowledge and minute foresight here displayed : but I must also notice the valves of the heart itself ; though no description can render this contrivance very intelligible. The object was to check those communications between the different cavities of this organ which would have defeated the purposes in view ; and as the forms of the parts rendered the preceding construction inapplicable, a new one has been adopted. This, since I need not distinguish the different valves, for the present purpose, consists in a single valve, so shaped as to fit the parts, tied down by stays on one side, to prevent introversion, and these again attached to small muscles which serve to regulate their action, or to give additional restraint, in case of the occurrence of unusual pressure. Here, as in the case of the skull, even the possibility of accidents has been foreseen and provided against ; as has indeed been largely done throughout the body, in many ways, and especially in the provisions for repairing injuries or disorganizations. And, to the remarkable contrivances for preventing injury to the framework of animals, but above all to the brain, through the shocks contingent on their motions, I may now direct the reader's attention.

It is probable that the familiar fact of a table standing on four legs has led to the general impression, rather than belief, that a quadruped possessed the same kind of solid stability. The framework indeed forms a firm structure ; but were it of such a nature, the shock of a heavy body, such as that of a horse for example, coming to the ground in a leap or a gallop, would split or break some of the bones. But, be this the case or

not, there is something in the nature of the brain, or the nervous system generally, through which a sudden shock, or jar, suspends or destroys its powers; or the animal is stunned, paralyzed, or killed. Thus a blow, not only on the head, but, as was less to be expected, on the lowest extremity of the spine, will sometimes kill a man; while the same effect may happen from a similar shock to a remote part of the body, though no visible injury has been done to any part of the organization: just as a fish or a serpent can be killed by a blow which gives a shock to the whole spine.

Now it was necessary to remedy this defect, by preventing the occurrence of such shocks in the ordinary movements of the animal; while if other collateral objects are attained at the same time, I need not distract the reader's attention with them. And, for this purpose, one general principle has been universally adopted. There are no two bones of any bearing extremity, which stand perpendicularly to each other and the ground; so that the weight of the animal is never supported on a solid bearing; as is visible in a dog or a horse. And if this deviation from the perpendicular is particularly remarkable in the hinder extremity, the reader who recollects what was said of the bearing point of the fore extremity as compared with that one, will be ready with the reasons. While the pelvis is a solid bearing, the scapula stands on muscles; and these form the best of springs. The former could have been no other; partly because of the peculiar action of the hinder extremities, and partly from the other offices which it serves: but a compensation for the scapular bearing is found in the extremely oblique position of the thigh bone to its base, and in the reverse one of

the next, or leg bone. It is plain that the great force of pressure behind, is exerted against muscles: the bones in question rather giving places for their right attachment than constituting the actual support of the animal. Even in the fore extremity, where the bones are more nearly perpendicular, though the arm is still very oblique in many, the pastern joint will show what the true bearing is: and in some horses, the most careless can see that the whole weight is borne on that elastic ligament at the back of the joint which is commonly called the back sinew. Thus the quadrupedal animal is everywhere supported by springs, which are either ligaments or tendons, or muscles in action: and it is the same in the human body, though the deviation from the perpendicular is not so striking, as it is overlooked by common observers.

To trace the provisions against shocks in this particular mechanism, I must first refer to the description of the spine already given, where the intermediate cartilages form a collection of springs, conducive to this end among others: while additional elasticity is gained by those curvatures of the column, under which the general line of the spine is still a perpendicular one. And there is a peculiar beauty in this arrangement, which is not obvious at first sight. Notwithstanding the flexibility of the spine, the first attempt at flexion would produce some shock, from the sudden change of forms; while, under the present arrangement, that movement is but the continuation of a change already commenced. At the base, that curvature is also applied to the same purpose in another manner: the column being so placed on the pelvis, that the weight is borne, not on the extremity, but on the side; while, as it is longitudinally covered, both by ligaments and muscles, the pressure is

exerted on many bones instead of one. It is the case of a bow, resting on its convexity, and bearing a weight through the tenacity of its membranous lining and its string. And as the object of all this care is the brain, I may remind the reader of the spongy plate of the skull, as a portion of the provision against shocks; while the interior thick membrane, called *dura mater*, together with the skin and the hair, combine towards the same general end. And I may also point out the simple and effectual contrivance which, by inclining the bony partition of the human nose from the perpendicular, has guarded the brain against injury from a blow on that peculiarly exposed portion of the face. And, that special contrivances, deviating from what was most to be expected, have been made against an inconvenience which was only contingent, and yet probable, is a proof of foresight, as well as of ingenuity, which cannot be disputed.

But this does not include the whole of the provision against shocks, either in the human or the quadruped machine; and therefore we know that it was not enough. The remainder of this beautiful provision is found in the feet; but I shall only notice two or three remarkable cases. A dog walks on the ends of its toes, and the spring or elastic bearing is found in the flexor muscles and in the ligaments. In a man, the contrivance is entirely different; since the body must be supported on the whole foot, on which the leg bone must also bear in a perpendicular direction. The bones of this part form an interesting arch, or a sort of vault: and there is a ligamentous arrangement beneath, bracing the whole together in such a manner, that, as is familiar, the two extremities alone of the longer arch can touch the ground, while the pressure is borne in the middle. A weight placed on the middle of a braced bow, will illustrate this ingenious contrivance. And this whole piece

of mechanism, simple as it appears, and accustomed as we are to undervalue the uses of the numerous parts which it contains, derives its flexibility and great strength, with much of its elasticity, from that very multiplicity, consisting in not less than thirty-six bones, through which also the foot is enabled to restore and preserve the vertical balance, especially in walking, and by very slight efforts. And the great weight placed on the ankle bone is not borne on a solid base, even at the first point: since the astragalus, to which it is fixed, is suspended on a ligament, like a wedge, between the neighbouring bones.

But the construction of the foot of a horse is still more remarkable; being one of the most ingenious and unexpected pieces of mechanism in the animal structures, and scarcely yielding to any but that of the Be-
roes, in regularity, and in complexity of parts under simplicity of design. The hoof contains a series of vertical and thin laminae of horn, so numerous as to amount to about five hundred, and forming a complete lining to it. Into this are fitted as many laminae belonging to the coffin bone; while both sets are elastic and adherent. The edge of a quire of paper, inserted, leaf by leaf, into another, will convey a sufficient idea of this arrangement. Thus the weight of the animal is supported by as many elastic springs as there are laminae in all the feet, amounting to about four thousand; distributed in the most secure manner, since every spring is acted on in an oblique direction. Such is the contrivance for the safety of an animal destined to carry greater weights than that of its own body, and to carry those also under the hazard of heavy shocks.

I might here have noticed, further, the contrivances in the nature of stays, by which the brain and other important parts are retained in their places under

violent motions; but the details are not adapted to general readers. And having thus pointed out what seemed to be most important and most easy of comprehension, on the general subject of ingenious design in the animal structure, I may proceed to notice some specific cases of this nature, where either the contrivance and the workmanship are remarkable, or where a peculiar end is gained by an unusual invention. And if it is our common fault, the consequence of ignorance or inattention, that we look even at the most obviously ingenious contrivances about us as if they were mere matters of necessity, the selection of a few instances in which the existing construction was not necessary, and is peculiar, will teach us to appreciate the invention, and to admit that it was an invention for the end which is attained: and the more so, when the evils which would have followed from its absence are rendered apparent.

The general principle of construction in the necks of all the mammalia is similar; and the number of the bones is always seven; yet their forms are varied, and they are longer or shorter, according to the peculiar wants of the individual. As instances, we may contrast the necks of the elephant, mole, camelopard, and deer. If these variations are so extensive, that I must needs refer to works on comparative anatomy, an example or two will serve for the present purpose. In long-necked animals, such as the horse and the camel, and much more strikingly and extensively in the birds, the spinous, or hinder processes of the vertebræ, are made short, so as to permit of flexion backwards: and it is sufficient to see a swan, to be convinced, not only that it was necessary for it to possess a very different power over its neck, from a man or a dog, but that a provision has been made for that very purpose.

In the great majority of these cases, the neck is con-

structed from bones and muscles, with the necessary ligaments for securing the former; and to those, the weight, as well as the motions of the head, is intrusted. But in such an animal as the ox, it is easy to see that to support this would form a very severe duty for the hinder muscles. This was foreseen; and it is remedied by the adoption of a singularly strong, elastic ligament, by which the head is supported, with little exertion on the part of the animal. It is a dead force applied, as in other cases already noticed, where a living one would have been a wasteful expenditure of muscular power.

I must not here omit an ingenious and simple contrivance to prevent compression of the spinal marrow in long-necked birds, the necks of which are necessarily very flexible, where, of course, no restraint from spinal processes is admissible; the cavity in each of the vertebræ is doubly conoidal, the base of each cone being opposed to the other, so that it bends at the joint easily, without compression.

There are many birds which sleep on the branches of trees; and these offer but a narrow base to animals of such a construction. Did the claw not embrace the branch closely, they must fall off; and this could not be done by the action of muscles, since these are inactive during sleep. The expedient adopted to correct this defect is as simple as it is ingenious. The flexor tendons of the claws are made of such a precise length, that when the upper joints are bent by the weight of the body, those parts close of themselves, and the firmer as the inertness of sleep causes it to weigh harder on the limbs. This construction was not necessary for the other purposes of the animal: fulfilling this alone, we cannot doubt that it was thus intended. It is a refinement on this beautiful invention, that in the stork, which can sleep on one leg, there is a more gratuitous

contrivance, as if adopted for no other purpose than to demonstrate the resources of the Artist, since there is no apparent reason why the birds of this construction should not have slept on two legs, like other fowls, unless it be that the support is firmer when all the weight rests on one. In this case there is a peculiar projection in the metatarsal or hock joint, by which a sort of partial dislocation is permitted, so that the bird is enabled to stiffen the limb at will. This confers the exact security required : and when the use is no longer needed, the joint is replaced by a peculiar exertion of the muscles. Among the fishes also, in the Siluri and the Gasterostei, there is a similar contrivance, for another purpose : the first spines of the pectoral fins being moveable at the will of the animal, so as to become fixed by means of a hook in the upper bone which enters a hole in the lower one, and thus fitted for the purpose of attack and defence.

The gannet is destined to feed on the fishes which swim beneath the surface of the water ; not, like the gull, on those which frequent or approach it. And being unable to swim under water, as the divers do, in pursuit of its prey, it plunges from aloft into the sea, and with such force as to sink thirty or forty feet, or more. Such are the velocity and weight, that the blow would probably kill the animal, were it not for a contrivance, forming so singular an exception to the universal structure, that we can neither question the design nor avoid admiring the invention. The skin of the breast is detached from the body, excepting along the ridge of the sternum ; and the animal has the power of inflating it, so that the body becomes inclosed within a temporary bladder, the elasticity of which prevents that shock which would otherwise be deadly. And this contrivance serves also as a buoy to bring the

bird and its prey up to the surface : since, at the depth to which it sinks, and without the power of submarine swimming, it would otherwise be drowned. As an analogous contrivance, for the more ordinary purpose of general levity, there is, in the eagle, the stork, the lark, and some others, a provision for inflating the skin of the neck and shoulders, in addition to the air-cells of the bones, formerly noticed ; thus producing an extraordinary buoyancy in the cases where it was most needed.

The secondary office of a bat's legs, in forming a portion of its wings, renders it almost impotent on the ground ; and its dwelling-places demanded the power of perching. Man contrives a hook on which to hang such things as the ground will not conveniently receive, or he attaches the hook to the object itself. This has been done for the bat. It has two hooks, and it hangs itself up to rest : and here at least, he who doubts the design and the Artist, must deny his own ingenuity and inventions.

The air-bladder of fishes is a peculiar contrivance for an especial and indispensable purpose ; and, for the present argument, it has the advantage of being as intelligible as it is philosophical. The want of it would have been, not merely inconvenient, but fatal, to the greater number of fishes ; since they could have quitted the bottom of the sea but for a short time and space, and by considerable exertion ; as is the case with the flat fishes, which, being destined to live on the ground, apparently do not require this organ. To facilitate the motion of a fish in water, it was expedient, if not indispensable, that its specific gravity should be assimilated to that of the medium, because its moving organs are constructed for progression alone, not for progression and buoyancy also, as in birds, and because

its muscular powers are feeble, from the peculiar and defective nature of its respiration. And as its own specific gravity is necessarily greater than that of water, it is equalized by the volume of air in the bladder, which is also placed so as to render the heaviest part of the animal the most buoyant, and thus to preserve its erect position. And as it was convenient that the fish should range on different levels, it has the power of contracting and expanding the bladder, so as to vary its specific gravity : as it can also supply this receptacle with air through its organization. It is supposed that there are exceptions, however, as I have noticed in another place, though these are perhaps fewer than is commonly believed. Doctor Hancock finds the air-bladder in the mackerel, and it exists probably in all the family of Scomber ; also in the Pleurometer and in the Lamprey ; it is very thin in these and in many others, and from bursting when the pressure of the water is taken off, it is not easily found. And in the flat, ground fishes, where the air-bladder was less necessary, and seems to have been withheld, the power of quitting the bottom, and of ranging for a short time on a higher level, so as the more easily to transfer themselves from place to place, has been facilitated by rendering their tails horizontal instead of vertical ; and further, as is very striking in the rays, by the great breadth of the lateral fins. Thus, as in the birds, these become organs of buoyancy, as well as of progression : while, in the Cetaceous fishes, the same form of tail becomes an aid to that insufficient levity, which, under the want of an air-bladder, is produced by the inflation of the lungs and by the large proportion of oil which they contain. I may here also notice the beauty of structure in the fins of fishes that are used to produce lateral motions. That of the apparently simple ray is of two semicylinders with an

elastic intervening substance, giving strength, lightness and elasticity. These also, especially in the caudal fins, separate at the base, so as to increase the strength, having projections for the insertions of the muscles; they are moreover rendered more flexible by short joints, especially at the ends, and by ramifying, in addition.

These last examples are on a large scale, including whole tribes in creation: I may return to some other specific and limited cases.

The tongue of the woodpecker is one of those. It departs from the general principle by which this organ in birds has been constructed, because this family has been destined to feed on insects which it must extract out of deep holes: and it is therefore a sort of spear, provided with barbs. Still more remarkably, the muscles by which it is protruded are peculiarly formed, and coiled round the trachea in a very ingenious manner, that they may execute this office with an adequate force. If it rather belongs to the next chapter, I may here also notice what it is convenient to separate for this purpose, in the peculiar structure of the bill: because the bearing of two contrivances on one end, especially indicates an intention in view, and that intention executed. This engine is wedge-shaped, and provided with a central ridge, for the sake of strength; while the elasticity of the os hyoides adds to the general power of the parts. And when we find, that two of the toes, instead of one, bear backwards, and that the tail is rendered stiff, so as to be an assistant in climbing, the whole forms a combination, which we can as little refuse to consider as the result of thought, directed to the purpose which is executed, as any machine of human construction in which we know the artist's intention.

Similar food, under different circumstances, was destined for the chameleon: and he who should compare

the sluggishness and awkward construction of the animal with the activity of its food, would determine that it could never succeed in securing a prey. But the Creator of all things is never at a loss. That sluggishness and form were part of the plan : and the activity of the tongue is a match for that of the food, careless of the rude animal to which it belongs, or unable to distinguish that which is so often undistinguishable by ourselves from the tree on which it resides : while, for this purpose, it is believed that a peculiar structure of the skin, with a power of inflation superadded by means of its monstrous lungs, enables the animal to vary its colour, so as to increase the power of concealment. The total contrivance is as complex as that of the former case, though entirely different ; and the reasoning is the same. And if the motion of the tongue has the rapidity of lightning, such is its mechanism that we can scarcely analyze its action, while it is inimitable by us, even when ascertained.

In another department, the trunk of the elephant is an expedient to supply a defect or serve a purpose, so familiar that it is sufficient to name it. The mouth of the whale is less known, and it offers an instance, equally, of ingenuity and foresight, together with what is always striking in these investigations, peculiarity or unexpectedness, since it has no exact analogy, either in the contrivance or the use. Comparing it to human inventions, it is a shrimping net ; while no one could have divined that the largest animal of creation should have been commanded to seek its food among the smallest ; that millions should be daily destroyed to support one life. So, however, has it been ordered : and had the whale been condemned to swallow all the water which it must draw into its mouth together with its prey, the inconveniences which would have fol-

lowed are obvious. To prevent this, it is provided with a singular piece of machinery, consisting of a series of flat hoops, meeting from both sides of the mouth into arches, and carrying ranges of bristles, which form a strainer, and also a kind of net. The water is thus rejected, and the mass of shrimps is delivered to the throat.

The stomach of the camel offers another of those special contrivances, where the purpose, and the means of attaining that, are so perfectly adapted, that the design has been universally admitted. It was created to live in a land of little water; and thence is it not only patient of thirst to a degree which appears almost miraculous when compared with other animals, but is furnished with the means of carrying water for future exigencies. This contrivance consists in certain appendages to one of the stomachs: and the mere mechanism, or superfluity of structure, is sufficiently remarkable under the present argument; though it is nothing when compared to that breach of a universal law, without which this would have been unavailing. Every similar cavity has an actively absorbent surface; and water, in particular, would disappear in a short time in every analogous one that we know. But it is ordered that the water receptacles of the camel shall not be absorbent, or shall not at least absorb water rapidly; and thus is the perfection of this design evinced.

In the insect races, there is a very general case, where inconvenience or evil would have followed, as in the elephant under other circumstances, had there not been an analogous special contrivance made, to encounter a peculiar difficulty: while it is one of the examples of that continuous system of adaptation of means to ends which pervades the whole of the Creator's plans. I allude to those insects in which the mouth is a proboscis, as in the bee and the butterfly. The food of these ani-

mals was to be found chiefly in the deep and narrow tubes of flowers, and being fluid also, it could only be obtained by suction. And if the means are provided accordingly, they are further varied in modes beautifully adapted to the several exigencies, but of which any attempt at description is here impracticable: while if I must refer to books of natural history, it is but to regret that they have not sufficiently explained, by adequate representations, what words cannot describe.

Among partial cases, the snout of a hog, vulgar and familiar as is this object, offers a contrivance of the same especial nature, similarly destined for an especial end; as that end is proved, in this as in every instance, by other facts in the construction of the animal, and by its implanted instincts. This instrument is a plough, and a most effectual one; while its action and uses are familiar to every person.

If I study no order, where, unless I made a complete progress through the whole range of animal mechanisms, order could serve no purpose, I may now point out a few miscellaneous facts in the skeletons of animals, where peculiar contrivances for especial purposes exist; while it is the department of anatomy most accessible to general readers. Such are, the long spinal processes of the withers, or upper dorsal vertebræ, in the animals of long necks, like the camelopard, where the purpose of giving a lever to the muscles is apparent: such is the wide head, or trochanters of the thigh bone in a hare, intended for the same purpose; and such the great dilatation of the fork, with the strength of the humerus, in the swift and other birds of strong flight, with the lengthened sternum and peculiar position of the legs in the divers. Thus also the purpose of flying in the bat, and of rapid digging in the mole, demanded unusual muscular power in the anterior extremities; and thence,

as in birds, the breast bones of these animals have been enlarged and modified accordingly. If I also notice the remarkable proportions of the bones in the extremities of the elephant, there are many other cases, on which I might not easily end, where the adaptations of the contrivances to the objects in view are equally perfect.

As a special invention, not a mere modification in this department of anatomy, I may here name that additional bone in the heads of some families of serpents, which, being attached to the skull by peculiar muscles and ligaments, serves for that extraordinary dilatation of the mouth which was indispensable to their allotted mode of feeding. The marsupial bones in the opossum race offer another instance of the same nature. In this case indeed, as in many more, we must first refer the want, or the necessity, to the Creator's will, whether the purpose be the display of resource and variety, as inquired of in the 25th chapter, or any other, unknown to us. But it being granted that the young required the protection which the pouch affords, the invention is perfect, as it is also one of those pure inventions for an unusual end, which excludes all chance, and even all hypotheses which unite a sort of limited casualty to a general intended plan; since it is an exception, and not a deviation or modification departing from such a fundamental design.

Under the mere question of evidence, the proofs of intelligent intention, with corresponding execution, have long exceeded all necessity: yet where more than simple proof is intended, I may continue to select some more of the cases likely to excite most interest and to be most easily understood. The organ of voice in many birds is an example of a peculiar mechanism which ought to be interesting to us; knowing what the effects are, and having adopted the same principles of construction for

the same purposes, long before it was known that Nature had thus applied it. In ourselves and the quadrupeds, the larynx is placed at the top of the windpipe; but in those animals, this fundamental organ of the voice stands at the bifurcation of that tube, and with the same effect as follows from placing the reed mouth-piece at the lower extremity of an organ-pipe. The science of sounds knows, though it cannot explain the facts, that the musical tone in these cases arises from the action of the vibrating reed on confined masses of air; varying according to their lengths, and also to some other circumstances which it has suppressed because its hypothesis could not explain them. Thus is the trachea contorted in many birds, as in the swan, for the purpose of prolongation, as in our French-horn; or provided with cavities, or dilatations, which the constructors of musical instruments have not yet thought proper to imitate, as this science has not attempted to investigate what their effects are, or ought to be.

In this race also there is a contrivance, which, though among the most minute, is perhaps one of the most striking examples that occur in nature, of a special provision made for a special end; since the want is temporary, almost momentary, and the invention itself is destined to endure no longer than it was needed. As has often been said of the eye, if there were nothing else in nature to prove intelligence and design, or a peculiar intention followed by its execution, this alone would furnish a complete proof; affording the further assurance that every thing had been foreseen and provided for, even before the embryo was planned. I allude to the horny point on the beak of a chicken, with which it is supplied for the purpose of breaking the shell to procure its release, and falling off a few days after the birth. Truly was it said, that even a sparrow was an object of the

Creator's care : and literal must be that truth, when, for this senseless and unborn creature, there has been made a provision so peculiar and minute, the want of which would have rendered all other cares useless. And does He not also watch over the life which He has thus wrought for? If He does not, where does that care cease, or why should the Power which thus cared that it might produce a living and enjoying animal, abandon it when the end is not even yet attained? To assert this, would be very inconsequential reasoning in any other case : and yet it is the reasoning of those who deny the providence of God.

If I proceed to notice some other miscellaneous examples of contrivance in the animal creation, where, with a purpose to be served, there is something peculiar or unexpected in the mechanism, or in the philosophy exerted, the variety is such, that the reader's attention will be sometimes solicited to one mode of contemplating the object, sometimes to another ; while, to do justice to some of these, a separate chapter would scarcely suffice.

Why a shell fish, as an exception to a very wide rule, should require the power of buoyancy, we do not yet understand, but may presume that it was destined to seek its food at the surface of the sea. But knowing the weight of the fish and its dwelling, we should not easily conjecture how such a power could have been imparted, without an air-bladder, as is given by means of that organ to the ordinary fishes ; especially when we find that it has been conferred on animals of this nature, reaching to four feet in diameter, and of corresponding weight. The familiar *Nautilus pompilius* and fossil *Ammonites* will render this contrivance intelligible ; being divided into cells by transverse partitions, perforated for an apparent general communication ; while

the living animal inhabits only the foremost, advancing at each annual addition of a new one, and the remainder being empty. Thus it is rather the possessor of a floatable machine than its inhabitant, bearing no proportion to its apparent house; while the total mass is of a specific gravity nearly equivalent to water, and is further preserved such through the whole growth, by increasing each new cavity, in a steady proportion to the increasing weight of the animal: a problem, as mathematicians know, of no small difficulty. But it still remained to give to the animal the power of varying the weight of its machine, that it might sink to the bottom or rise to the surface at pleasure; a far more difficult problem than in the case of the fish, because the bulk of a firm substance like a shell was unalterable. And this is done by means of that muscular tube, the siphunculus, which traverses the whole shell, and, by filling itself with water, or the reverse, serves to vary the specific gravity to this end; under a nicety of calculation not less remarkable than all else.

A far simpler example of mechanical ingenuity is found in the varied, yet always beautiful construction of the hinges of shell fishes; which, as being more easily compared with the expedients of human art than almost any thing in nature, are particularly deserving of notice under the present inquiry. Any one can examine what cannot be described; and he who does so, will be convinced that these are the works of an intelligent artist. But there is here what human art cannot imitate. As in the ligaments of the joints of bones, there is a flexible connexion instead of a pin: but the case was a far more difficult one, for this was to be fixed to a dead substance, a stone, as that is attached to a living bone. Or if this expression, rigidly taken, be disputed,

there is still a great difficulty overcome, when we find the closing muscle of an oyster so firmly united to the shell, through that minute portion of animal substance, in which, as a species of skin, the earthy matter is deposited. And I may also remark, that the elasticity of the ligament of the hinge serves to open the shell: being a substitute for that muscular power which we at least could not find the means of applying, as it is also another example of the adoption of a dead force in lieu of a vital effort.

In a very different department of animal life, the egg presents a very ingenious piece of mechanism, yet constructed from such materials, that although we could easily have suggested the mathematical principle, we should have decided that the execution was impossible. The embryo of the chicken is almost a point; and on whatever side the egg may lie, it is always uppermost, because it was necessary that it should be exposed to the greatest heat of the sitting parent. The simplicity of the machinery cannot be exceeded, and the effect is perfect. We are ready to decide that it could have been attained in no other manner: limiting the Creator by our own narrow knowledge, and ever forgetting that we know nothing but what He has taught us. The yolk is a sphere moving on an axis and floating in the white: and he who should desire that a sphere might always present one point of its equator uppermost, would make its axis eccentric. Such is the mechanism of the egg; and every one can examine and verify it.

Of similarly accessible subjects, there are few pieces of mechanism in the animal anatomy more easily examined than those in the membranous wings of insects which are folded under wing covers. Let the hinges, the foldings, and the strength, be examined, as if they

were works of human invention ; for this is the way to acquire a just notion of the contrivances of the Creator, wherever the comparison can be made. Any coleopterous insect will furnish a subject : but among our own, the wings of the earwig are especially remarkable, as well for their elegance and symmetry, as for the beautiful mechanism by which they are packed in so small a space. A fan made from the palmyra leaf will convey some idea of this admirable invention.

Were I to describe the endless remarkable pieces of mechanism in the legs, jaws, antennæ, stings, egg-ducts, and other parts of insects, I should prolong this chapter beyond convenience, and must therefore refer to treatises on natural history, at least for what they have done on this subject. But, wishing to point out such things as are of most easy access to all, I may notice some circumstances in the mechanism of the lobster ; especially as many of those are widely applied in other cases than in that animal.

That which is most obvious to examination, is the back part of what has been commonly called the tail. That it has been copied, as far as it could be, in plate armour, is a sufficient warrant of its having been the work of an artist ; yet he who examines it, must not fail to remark the superiority of its pivot joint to our own rivet. The real tail is not less worthy of examination ; and the antennæ constitute one of the most beautiful specimens of the Creator's art (if I may so speak) in the whole range of anatomy. And let him who may admire that workmanship which we may envy without ever hoping to approach it, not fail also to remark, with this prodigality of mechanical power, that wastefulness which can construct all this to last for a few months, and then to be abandoned without regret. So much,

and far more than this, can boundless power afford to waste. Nor is the mechanism of the claws less beautiful; though he who would know their accuracy, security, and strength, must examine them for himself; while the most able workman that mechanics have ever possessed will not be disappointed in the examination.

But if every part of this extensive tribe of animals, resembling the insects in so many particulars, is a study in itself, I must especially point out one contrivance for solving a problem which would have been deemed impracticable had we not seen it done daily; as anatomists have hitherto been unable to explain it. As I have more than once had occasion to say, when that which we would willingly do, and cannot, is effected, and by means, the simplicity, the philosophy, and the perfection of which we acknowledge when they are discovered, we cannot doubt that the work was that of One who has communicated to us a portion of that knowledge by which He has, Himself, acted.

It was useful, or necessary, that these animals should have the power of parting with a limb by a voluntary effort; while there is also a provision for supplying a new one. When we examine the strength of the whole structure, and especially of the joints and ligaments, and recollect also that this was to be done by the power of muscles, while not able to conceive where a fulcrum could be found for this purpose, or how any muscles could be brought to act in separating a limb from the body, when their office is to approximate attachments, the problem will be readily pronounced impracticable. He that will imagine this of his own shoulder, will see the full difficulty: yet it is effected. I do not think that any mechanic, however ingenious, could contrive the means of doing, in any manner, what is here done

by the action of two insignificant muscles : as it cost me no small trouble to ascertain it, even with the machinery before me. If I cannot make it very clear by a mere description, an examination of the facts, with this explanation, will leave no difficulty. In the joint but one from the body, there is a ring in the shell, of a different texture from the remainder ; and by inserting the point of a knife into it, the limb flies asunder. But no muscle is torn ; since, unlike all the other joints, their insertions are so managed that there is a space filled with inorganic, and consequently, insensible mucus ; so that this apparently severe operation is even unattended by pain. This is the basis of the contrivance ; while there are two muscles, a flexor and an extensor, which, arising from the body, pass through the first joint, to be inserted in this second one, contrary to the rule in all the others, and just beneath the ring in question. When the limb is extended, the ends of the first and third joint are brought into contact in two protuberances made for this purpose, so as to exclude the intermediate one ; and while the extensor muscle fixes them firmly, the action of the flexor, at a lever distance, pulls the phalanx asunder at the ring.

I may proceed to point out a very unexpected piece of mechanism for progression, in the feet of certain marine animals, classed by some naturalists in a division termed radiate ; and it will strike a mechanician even more than an ordinary reader, because, while the execution would be impracticable, so does art furnish him no clue to the intention. Any one can examine this machinery in the familiar star fish, the holothuriæ, in which it also exists, not being so accessible ; and it is therefore a convenient example, like the preceding. The legs, or feet, consist of muscular tubes, half filled

with water, and closed at both ends; the one half of these being within the body of this hard animal, and the other on the outside. When it desires to walk, the water is forced into the external half, which thus becomes a stiff tentaculum, or leg; and when this is no longer wanted, that water is forced back into the interior part, so that the legs become retracted close to the body, and are thus protected from injury, though there may be other reasons for this singular contrivance.

I shall terminate these examples of animal mechanisms, with one which exceeds, in its regular beauty, and in its conformity to human workmanship, every instance that has been produced by naturalists from the other parts of Creation. I cannot, unfortunately, refer to any figure; as this animal, though a native of our own shores, has not been described by any naturalist; while, if it bears a resemblance to *Beroë*, it demands a new genus, and a name which I have not yet conferred on it. The accurate resemblance of this machinery to a common mechanical contrivance of our own, is peculiarly calculated to impress us with the conviction of a perfect Artist, yet of one who, in addition to what we can do, has effected what is to us unattainable. It is the more surprising that so complicated a piece of machinery should have been lavished on an animal in the very lowest scale of sentient life, since it is, otherwise, but a medusa: while this mechanism may also be viewed as a superfluity, when this last animal swims as rapidly without it, by the mere contraction and dilatation of the margin of a body which is similar in both. It is as if the Creator had intended to display His power and resources; and if so, for what other purpose than for our contemplation?

In this animal, the shape is that of a cucumber, and

there are eight tubes, open at each extremity, which run longitudinally through it, near the outer surface. Each of these resembles a chain pump, with the saucers as truly formed, and as regularly placed, as in that machine; but with this difference, that instead of being strung on a chain, so as to advance in succession, they are hinged at one side to a cylindrical axis: the whole being as circular and exact as if it had been executed in metal by a watchmaker. And the process of swimming consists in causing all these pallets to act in succession, so as to drive a current of water through the tubes; while, when the animal desires an oblique motion, it acts with one portion of them.

I may now dismiss the subject of mere mechanisms in the structure of animals, much as I might have added to the examples, and much also as I might have varied the views under which they admitted of contemplation. But there is one almost universal organ, if not indeed under mechanics, which I must not pass by; so beautiful and perfect is it as a work of art, while constructed on those philosophical principles which we can appreciate, as we adopt them in analogous works of our own. It has often been said, that the eye alone is a cure for Atheism: and, certainly, if such a perversion of judgment does not yield before the examination of that structure, all proof or argument must be vain, since the fault is not in the reasoning faculty.

Though all my predecessors have indulged themselves in describing the eye minutely, it is better to refer to well-known works, than to follow them in these details; while any person of ordinary neatness of hand can examine a fresh ox's eye. It must suffice that I notice the chief circumstances comprised in the construction of this very remarkable organ; which, although formed of the

same general matters as the rest of the animal structure, differs from every other part, in its principal materials, as much as it does in its disposition and its uses. Under the present view, the eye must be considered as a pure optical instrument, and as if it had been made of the ordinary materials of a telescope; since it deviates in nothing essential, though including greater resource, and much more nicety of workmanship; and therefore far more perfect than any human instrument of this nature that ever was made, or, probably, ever will be. Abstracting its organ of sense, it is imitable by art, if imperfectly: and that organ, though the essential portion of the whole, is independent of the optical machine. As almost every one now knows, it contains the crystalline lens, resembling an object glass, most ingeniously supported in its place, so as to separate the globe into two parts, of which the foremost and visible one contains the watery, aqueous humour, and the posterior one the vitreous, which is apparently gelatinous; all of these being perfectly transparent. These produce that picture of the external objects which is figured on the bottom of the globe: and the camera obscura will convey a perfect notion of the action of the eye. And the picture is painted on the organ of sense, the retina; which, speaking without reference to the mind, sees that which is thus delineated on it, through what may be considered an exquisite sense of touch.

If it is fruitless to repeat, that if it was not an artist who planned and constructed this machine, neither can it be one who now makes a telescope or a camera obscura, the superiority of the Great Artist will be best seen by pointing out that which He has here done, and which the artist of His creation cannot imitate. The receptacle of the picture is a portion of a spheri-

cal shell, that the delineation may be perfect; and it is darkened by a brown matter, to prevent the effects of interfering light: two things which are indeed imitated in optical instruments, yet imperfectly. In the visible part of the eye there is a perforated curtain, which is also copied by a telescope, for the purpose of excluding superfluous or injurious light; but here, especially, the attempt at imitation begins to fail, since the iris can adapt itself to all degrees of light, and without any effort of the will, through a muscular apparatus, for which there seems no hope of substituting any adequate human contrivance. Our imitations fail still more, in spite of many efforts, and of partial success, in preventing that peculiar refraction in optical glasses, which is called dispersion, and is productive of coloured light; which, if it existed in an equal degree in the eye, would affect the real colours of objects. A very peculiar structure in the crystalline lens effects this purpose, at least sufficiently; and by other niceties also is remedied another evil, from which our optical instruments often suffer, called the spherical aberration: in the eye this is corrected partly by the form, and partly by the unequal density of the lens. Lastly, we are unable, without much contrivance, to adapt one instrument to near and distant objects both, and then only within certain limits. But the eye accomplishes this with perfect facility; though I must refer to anatomical works for the means, since they could not be understood without that full description of the whole anatomy which I need not give, and since there are also some specific and distinct provisions for this purpose in many animals. Thus perfect in all its parts is the Eye: and the practical optician at least will

know how to value what he so persistently labours to imitate.

I may now terminate this chapter. For the purpose of the argument before us, the examples enumerated are far more than sufficient; since any one is, in reality, an ample proof in itself, of a design and a Designer. And if I have hitherto selected such designs as we can best appreciate because we can copy or imitate them, or such as belong to simple principles, or laws, that we often apply in an analogous or a similar manner, the following chapter will take cognizance of Design under certain other variations in specific parts of the animal structure, where the thought exerted, with the corresponding fulfilling of a specific intention, are often even more strongly displayed. If that chapter might have been united to the present, the separation is at least a convenient one.

CHAPTER IX.

ON VARIATIONS, FOR SPECIAL ENDS, IN CERTAIN PARTS OF THE ANIMAL MECHANISMS.

THE present purpose is to exhibit and prove a Designer executing under a wider plan; adhering to a general intention, but modifying the details so as to meet peculiar exigencies. One object was to be gained, but the modes under which it was known to exist were so different, that unless the means of attaining it had been varied, the leading intention would not have been accomplished. To compare this, once more, with human plans and execution, under which this argument is always most striking, it is the loom which is made for weaving in general, but is modified for the production of particular textures. And if it can here be shown, that in adopting means to gain a general end in creation, all the requisite modifications have also been made in the fundamental mechanism, we must conclude that there was a Designer, foreknowing and intelligent; intending, knowing how to execute, and executing. But if he who reads for information in chapters like this one, is indifferent to those conclusions, he may at least learn from them the useful lesson of contemplating facts in masses, and under general principles; for this is philosophy.

So far are we from being deficient in facts for the general purpose, that they are oppressive by their numbers: I can but select a few, from the feet, the mouth,

the eyes, and the clothing of animals. There is no obvious reason, at first sight, for the great difference between the foot of a horse and an ox, but when we examine their separate destinations, the perfect adaptation of each construction becomes apparent. The horse was intended for hard ground and rapid motions; and the hoof is constructed accordingly, answering its end perfectly in the state of nature, and serving that purpose under domestication also, better than is generally believed. The place of the ox was to be in meadow lands and in river banks, its destiny to tread on soft grounds; and equally is this provided for, in the divided and spreading hoof, and in the dew claws. A horse sinks where an ox of greater weight can feed in safety. The sharp hoof of the goat is not less adapted for the rocky places and narrow footing of its mountain habitation; and the same general principle is extended to the sheep and many more, for the same reason.

The foot of the camel, reversely, is a broad, elastic, and soft cushion, perfectly adapted to those sands which every other peculiarity in its construction shows to have been its intended dwelling-place: while the union of all those circumstances forms so perfect a design in itself, under the intended destination of this animal, that I must notice the whole, before proceeding with the organs now under examination. The stomach I described in the last chapter; but with this provision, there is a singular endurance of thirst, and also of hunger: while, for this also, there is an analogous provision in the hump, which is an internal store of food, and is gradually absorbed to supply the wants of the system. While it is willing, moreover, or inclined to feed on those thorny plants of the desert which scarcely any

other animal will touch, it is provided against injury from them, by a tough cartilaginous mouth: as a power of closing the nostrils against sand, with an analogous provision in the eyes for evading its annoyance, complete a design, so perfect in all its parts, that no perversion of understanding can overlook it, or doubt the intention.

The rabbit was destined to dig and to burrow; but it was also to be enabled to run with considerable velocity. For these purposes, its fore legs are short and strong, with a powerful hand; while the long metatarsal bone is rendered a foot to rest on, as it is a leg for running. It can thus compress itself into a narrow space; while the length of the lever behind, and the great flexibility of the spine, enable it to make a much longer step than its size would indicate, and thus to contest with the speed of its far larger enemies. In the hare, the intention to afford concealment by crouching leads to the same construction, with the same effect; as I need not say, probably, that in all the quadrupeds, the act of running, as far as force is concerned, depends solely on the hind legs; the others forming little more than a resting-place. The structure of the hind foot in the kangaroo and its congeners, is an extension of the same contrivance with a somewhat different practical result.

Where digging without running was required, we find the singularly beautiful hand of the mole; as the whole animal presents that perfect design already noticed in the camel: the same degree of thought, but directed to a very different object. The legs are, all, extremely short, because longer ones would have been inconvenient, as well as useless; but there is a peculiarly shaped humerus, with a flat and long carpal bone,

which, while the hand is enlarged in breadth, allows the palm to be turned outwards: the body is so formed as to offer the least possible resistance, while free from all protuberances; and the density and smoothness of the coat render it as slippery as oil, while preventing it from lodging earth and sand. The eyes can be so withdrawn beneath the skin, as to be invisible, and thus to evade injury where they are useless; as their only use seems to be to give warning that the boundary of safety has been passed. And lastly, the singular shape and sharpness of the snout, while it forms a species of wedge, allows the animal to pursue its active prey into that hole which it forms so rapidly. It is an unexpected extension of the mechanism of the mole's hand, to find it adopted in so very different a department of creation as it is in its application to the mole cricket; yet under a variation which renders it a much more complex machine, well deserving examination.

The contrivance in the foot of a cat is oftener seen than remarked: the wants of the animal demanded a hand to seize, like the eagle; and this was to be combined with a foot for walking. Superficially viewed, the foot of the cat and the dog are similar, and both walk on the ends of their toes. But though the dog's foot had been more flexible than it is, the wearing down of the claws by walking would have prevented it from securing an object. To protect those, in the other animal, the last joint of each toe is reversed, when the foot is at rest or used for walking: being brought forward, with its long claw, when used as a hand for seizing, and returned to its place by an elastic ligament. In the lion, the same object is effected, but in a different manner, by means of a lateral motion, which, like the peculiar form of the last phalanx in this tribe, does not well

admit of description. Here too, as in all animals of similar strong claws, and in the teeth of the morse, we find a peculiar contrivance for fixing these organs firmly in their sockets ; a projection from it entering within the claw or the tooth, while that is embraced externally in the usual manner. In the cat also, ordained to prey by surprise, on animals of very quick hearing and rapid movements, the sole of the foot is peculiarly soft ; whence, united to the extraordinary flexibility of the whole body, that inaudible, stealing step, so well known ; while in the marten, the same object is attained by covering it with hair.

It belongs to the general subject of animal mechanisms, to point out the extensive use of elastic ligaments in place of muscles ; of which the other most familiar examples, noticed in the last chapter, are in the nictitating membrane of the eye, and in the ligament for suspending the neck, in some quadrupeds. This is a dead force, employed for the purpose of saving nervous power : the more costly muscular forces are used for the temporary exertions in all these cases, and the other for the more permanent actions.

Those examples of contrivance for the foot, in quadrupeds, are strictly mechanical : it is interesting to find a more abstruse philosophical principle adopted, and for an end which could not apparently have been attained otherwise. The rat and the mouse can walk, without difficulty, on surfaces not horizontal, by means of the sharpness of their claws, united to their great strength and small weight. The walrus, equally ponderous and inactive, is compelled to clamber over inclined and smooth rocks, in quitting the sea : and this object is attained by constructing the sole of the foot in such a manner, that it can produce a vacuum with the surface. But the interest attached to this contri-

vance is increased, by observing how it is varied in different animals, under the general principle. A human mechanic, in adopting this expedient, would probably have been content with applying the same contrivance to all: but in creation, the analogy of the several animal structures was to be supported. In the walrus, where the toes must have existed, the muscles enable them to form a vacuum, as it can be imperfectly done in the human hand; in the foot of the gekko, each toe has transverse cavities opening by slits below, which can be rendered vacuums by muscular action; but in the fly, which can thus walk on glass, against gravity, there are cushions, conforming to the general structure of insects, producing the same effect; as in the *Bufo calamita*, it is attained by means of tubercles, and, in different lizards, by cushions or scales.

The feet of birds offer a more complete general view of a regular system of variations applied to one principle of construction, and every one of these distinctly adapted to the particular destination or desire of the animal. It is also the department of this subject which a reader can study most easily; as a naturalist can, without difficulty, extend this necessarily narrow sketch.

If the most general purpose is that of walking on ordinary ground, so is the basis of this contrivance familiar, in the domestic fowl and in many other birds. But a considerable change is made, when it becomes necessary to climb trees, as in the woodpecker, and more. In these cases, two of the claws, instead of one, are directed backwards; and thus a support in this difficult position is obtained: while the foot of the parrot thus becomes a hand also. And the power of turning the outer toe backward or forward, appears intended to give equal facility in roosting and in seizing; while we see the utility of this double power very strikingly

in the owl. The talons of the falcon tribe are rendered hands, by furnishing the toes with long and curved claws. In the swimming birds, these are so connected by the web, that they become paddles, and thus are enabled to perform a double office. And in this case, as in that of the elastic ligaments just noticed, there is an evident intention to save muscular power; since the simple flexion of the heel joint is the only exertion required; the paddle shutting and opening by the mere pressure of the water. In the semipalmated birds, there is an interesting variation of this subsidiary contrivance. It is a sufficient paddle, in the coot and the water hen; while it also assists them in walking on soft bogs, and is not interfered with by asperities, as the entire webbed foot might be.

The length of leg, and the bareness above the hock joint, in the wading birds, is a variation for the sake of those which do not require to swim, or could not, because their prey lies in shallow waters. If the heron is a familiar example, I must also point out that serrature in the claws, which enables it to grasp its slippery and active prey; as the perfect adaptation, in the length of the neck and in that of the bill, ought not to be overlooked. It is a contrast to the bare-legged waders, to find the ptarmigan feathered, even over the feet; while the utility is equally seen, in the habitation which it has been ordered to choose for itself among the snow. It is not a contrivance, but a peculiar application, to find that the sea birds which lay without a nest, on smooth rocks, use the foot as a hand, to retain their single egg, in rising, lest their long wings should sweep it into the sea.

The feet of insects would alone afford matter for a long chapter: the works on entomology must be consulted for what I am compelled to omit; as indeed, except to readers familiar with those tribes, there is not

much that would be intelligible. In the lobster and crab, considering these as insects, the hands, which serve as feet also, are well known. He who should examine the former, would decide that the two were meant for different uses ; nor would he easily substitute a more efficacious piece of mechanism for that one which is used for cracking shell fish, as the other is designed to tear flesh. Smaller and finer hands or pincers are allotted to other kinds, as they often also are found in many of the feet ; though amid the species of this extensive tribe, whose habits are so little known, we do not often conjecture the uses. And in some of them, a pair of feet, or more, are flattened, so as to resemble lancets ; thus serving the purpose of swimming fins, as well as of feet for walking beneath the sea.

In the proper insects, the purposes served by the feet are very multifarious, and often exceedingly particular. Among these are, walking on a great variety of substances and surfaces, often under the more appropriate terms of climbing and jumping ; such as land, under all its forms, above the water and beneath it, water itself, smooth or polished planes of many kinds, leaves of all sorts and in all positions, at rest or in motion, fibres, or hairs, which must be embraced by the foot, and even their own spun webs. Thus also are they hands for seizing prey, in many different ways, for spinning, for digging, or for building, plastering, and more, in those which execute peculiar works. In all these cases, the constructions are equally various and perfect for their uses : the adaptations conformable to the destinations, as those are established under the compulsory instincts of the several kinds. As a few examples, out of hundreds, I may point out the brushes on the feet of flies, where the intention is decidedly marked, by their limitation to those which can be used as hands, the

comb-shaped feet of the spider, intended for separating the threads in spinning, those of the louse, designed for clasping a single hair, and the not very dissimilar one of the grasshopper, applied to the very different purpose of picking up ants as it walks among them, while placing them in its mouth at every step, without any apparent effort, or even intention. Looking at the great length of the legs, in the well-known fly which receives its common name from this circumstance, it would seem impossible that it should make its way among the long grass which it inhabits: yet that construction has been adopted for this very purpose, with a peculiar additional variation, departing also from a very general rule, through which the tarsus is formed of a great number of joints, enabling it to bend round and to embrace those narrow leaves. But, unable to occupy more room on this subject, I must refer the reader to entomological writings, or, what is infinitely better, to the animals themselves; abounding in collections, at least, if not always very accessible in Nature.

The mouth might afford room for a volume by itself; so widely has it been varied to suit the endless diversities of food, under a conformity, at the same time, to the peculiar structures of the several races of animals. So numerous and ingenious are the mechanisms and the variations, and so perfectly is every thing adapted to the several kinds of food, and the construction, powers, and inclinations of each animal, that if there were nothing else, this prime organ would alone suffice to prove the fact of design, and the wisdom by which it had been regulated. A more ample proof indeed could scarcely be desired, than that which is furnished by the teeth alone, simple as these may seem, and little varied as they probably appear to those who are not versant in

natural history. But that science has long known, that none of its arrangements were of any value, in which the forms and distributions of these, in the animals which possess them, did not constitute a prime object of attention ; while thus, not only the food and the mode of life, but many other particulars in the general construction of the animal, can be assigned, or conjectured with no small confidence. In this acknowledgment, natural history has given voluntary testimony to that which is here under proof ; if it has not always considered the Cause in the same manner.

The singular intermixture of hard and soft parts in the teeth of the elephant, points to the uses to which they are actually applied ; they are millstones for grinding the branches of trees. And in all cases where the food was to have been hard, the forms of the teeth have been constructed of a similar shape, if not of the same structure ; while, in conformity to their office, the construction of the jaw and the positions of the museles are made such as to perform the motions necessary for grinding ; as that mode of motion is not allotted, where, as in the fishes very conspicuously, there are no grinding teeth. The sun-fish indeed, feeding on shell fishes, possesses teeth of a similar kind ; while in the lobster, under a singular variation, they are placed within a strong muscular stomach. This is an example of a plan continued in a peculiar manner, under a retention of the mechanical principle ; and it is exhausted in the birds, where a substitute for teeth is appointed, by compelling them to swallow small stones, to be set in motion by the still more powerful gizzard, the muscular disposition of which is also peculiarly artificial. In this case also we see an instance of that fertility of expedient, of a difficulty unexpectedly overcome, which meets

us all through creation ; and of which I have pointed out many in the course of this work.

In the great family of Glires, of which the rabbit will serve for an example, there is a peculiarity, in the front or cutting teeth, equally bespeaking the uses for which they were intended, and to which they are applied. And in the rat, among others, there is also a remarkable provision for maintaining them in a state of perpetual sharpness, by applying the enamel to the fore part alone, whence, as the bony portion wears most rapidly, a thin cutting edge is always preserved. In the ox, and many more, where the upper front teeth are wanting, the work of gathering the grass is equally well performed without them ; while in this case we find that very remarkable provision of stomachs which belongs to the chewing of the cud. The reasons for this peculiarity, however, are not apparent : since it is not an answer to say, that the animal is thus allowed to fill itself in haste, that it may provide against disturbance from its enemies ; and it is equally plain, that it could have fed in the same manner under the teeth of the horse, as in that animal also one stomach performs the same office as four. The facts are so ; that is all we know at present ; but they do not justify natural history in laying down imaginary necessities of construction, and compulsory adaptations of different parts, under a peculiar form of animal ; as it has done on many other subjects in their structures, while even overlooking the exceptions to its rules.

To pull asunder the parts of animals, more than cutting teeth were required ; as grinding was unnecessary. Any one could have determined on the necessity of pointed teeth ; and accordingly we find them. The cat tribe displays this form in perfection ; the teeth hold,

as well as tear : in the dog and its congeners there is the same structure, under some variation. Man, it has been remarked, possesses all the three varieties of teeth ; and thence have been drawn conclusions which I need not repeat. The uses of the cutting and the grinding ones are evident ; but the pointed ones seem to belong to that analogy of structure which pervades whole races of different animals very widely, though the parts are of no use. Purely prehensile teeth are best seen in the fishes and the serpents : they seize the prey that it may be swallowed, but do not tear ; as, where nothing more was required, there are no others. The variations however are numerous, and often very beautiful ; very especially so in the shark, where they form that platform of hooks, so well known. In other fishes, they are often such as to resemble a wool-card : while, if sometimes fixed in the bone, they are, in other cases, attached to a membrane ; being occasionally also provided with muscles, so as to be capable of temporary erection. They occur, further, not in the jaws alone, but in the palate, and even in the throat ; so as to ensure the passage of the prey downwards and to prevent its return, as the cone of a mouse-trap does ; while, in the shark tribe, there is a perpetual succession of young ones, enlarging and advancing from behind, as the front ones wear out.

Passing from the teeth to the mouth itself, we find that as in the feet, there is system within system, or that there is a second set of varieties under each variation of the first order : the whole constituting a regular premeditated design, of no small intricacy, as it is a proceeding which pervades all creation. Natural History however must perform what I can only indicate. A mouth being nearly universal, while there is always at

least some substitute for it, there is a primary set of variations for each class of the animal constructions, as, beneath this, there is a subsidiary set, conforming to the wants and pursuits of the families or species. A few examples will suffice to explain this, and also to show the mechanical resources and the adaptations.

Such, in the quadruped, having two jaws furnished with teeth, is the breadth in front, in the ox and the horse, compared with the narrowness in the dog and the wolf: and thus the great length of jaw, in the fox and others, renders the mouth a powerful forceps, for the detention or killing of other animals. In the cat race, the shortness is compensated by the greater length of the teeth, and by the talons; so perfectly is every thing calculated. In the hog, the variation is even more striking; where the mouth, appearing at first as if obstructed by the protrusion of the nose, forms a scoop, following in the track which the former has ploughed for it, and thus seizing the roots which have been loosened or laid bare. In the mole, already noticed, the variation is different, as is the use. The rabbit, in its own large family of nibblers, the squirrel, using its teeth for a very different purpose, the shrew, acting nearly the part of a mole, the ferret, the weasel, and the vampire, sucking rather than eating, the elephant, and many more, will afford further illustrations which I cannot pursue: as in this division, compared with another, I may terminate with pointing out two variations under one peculiar sub-variety. The tongue was equally intended to secure the prey, in the ant-eater, and in the chameleon; but a slow movement was sufficient in the one case, and a rapid one was necessary in the other. They are given accordingly. The useful peculiarity in the mouth of the camel I have already noticed.

Since the heads of birds were to form a solid of small resistance, it is difficult to see what other, and sufficient mouth, they could have had; since it must also perform many of the offices of a hand, and of a very peculiar one also, in constructing the nest, in extricating grain, in cutting, in picking up minute seeds, in extracting objects from small apertures, and in much more. The general principle adopted is at least a very perfect one: but it required no small resource to vary it for so many different ends as have been attained by it. A mechanic, with the whole problem before him, in the several uses, varieties of food, and modes of feeding, might have tried, yet would scarcely have succeeded; but even to have tried and failed, will convince him that He who has not failed, intended to succeed in what He has accomplished so perfectly.

The basis of this form of mouth may be taken from the gallinaceous birds, and from that numerous and common race termed *Passeres*. In the domestic fowl and the canary bird, it is as simple a mouth as it is a hand; having nothing to do but to pick up food, arrange the nest, and prune the feathers; though it is also a powerful weapon for offence and defence. But in this simplest of bills, there are many varieties, according to the peculiar purposes required; being thus variations of a fourth order in the general design of a mouth. The black cock and the pheasant, the bullfinch and the lark, are examples which I need not extend: but it often requires a greater effort of thought, in mechanics, to make a small variation for a specific purpose, than a greater one; as an ordinary artist also is content if he succeeds in some manner. The Supreme intelligence alone neglects nothing, finds no difficulty, and effects every thing in the best mode.

The food of an extensive tribe, termed *Grallæ*, consists of worms or *larvæ* which reside deep in the earth, and would have been unattainable by the bills of the preceding birds. It has therefore been lengthened in the Curlew, the Woodcock, the Plovers, and others; while here also there is a system of variation in the lengths, according to the wants, from the Curlew which extracts the deep worm of the sands, to the ring Dotterel, which desires to go no deeper than the shallow hole of the jumping *Talitrus*. Thus far, even a human mechanic could have devised the bills of this tribe: but it required another power to produce a forceps of horn, capable of distinguishing a soft worm among the equally soft mud in which it was imbedded. The end of this engine is not horny, and is provided with nerves; so that it becomes a sensible finger as well as a hand and a mouth. It is doubtful if the most delicate human finger could feel the food of a woodcock where it lies. But there is even more of contrivance, if I mistake not, in this provision. The nerves are large, beyond all apparent necessity; utterly disproportioned to a nerve of touch in any other animal body. It was necessary that the point of the bill should be tough and firm; and the magnitude of the nerves forms a compensation for this.

The flat-billed birds, or shovellers, present another variation, with varieties under it; while some of them are of singular ingenuity. The convenience of this form, in the swan and the goose, feeding on aquatic plants and grass, is obvious: compared to the gallinaceous birds, it is as the mouth of an ox to that of a dog. In the duck, whose food is found in subaquatic worms, among other things, the variation is mechanically simple, but not so in the action. The materials are mixed up with

mud and water, and too minute to be separated by picking: whence the process is rendered a more sweeping one. The principle of the mouth is similar to that of the same engine in a whale. The teeth form a strainer; the highly sensible bill discovers the mud which is worth the labour, and an equally sensible tongue aids in separating what is wanted, and in rejecting the rest.

In the insect-eating birds, of small bills, there is a variation for a special purpose, which belongs rather to the true mouth than the bill, and must not be passed over. The swallows and the night hawk, feeding on flies, without picking, required no bill for that end; as it would also have been difficult to have taken their prey as they do, by such a mouth. There is therefore a wide mouth, into which this prey may be said to fly: while the bill is a superfluity for that object, but is necessary for constructing the nests, feeding the young, and pruning the feathers; as it also serves to complete the form necessary for penetrating the air.

The birds of prey offer another leading variation: the change from the straight beak is as simple as it is effectual for its ends; but the varieties under it are not very material, if we exclude differences of length, as in comparing the small hawks with some of the larger vultures. The purpose was to hold and to tear the flesh of animals; or, like the cormorant, to seize and swallow serpents, as that does fishes. Attending to the principle of incurvation in the bill, and not to the division of the birds themselves, I may join with these the bills of the parrot tribe, forming a hand for climbing and holding, under a power of motion in the upper mandible, which is, in itself, an exception to an otherwise universal rule: while although this portion scarcely

differs from the same part in the birds of prey, the under one is a scoop for feeding on fruits, as it is also a cutting tool. Here also I may notice the construction of the throat in the Indian stork, not easily described in words, through which air is admitted to the lungs when the mouth is stopped by the bulk of the prey.

As I need not proceed further in the same regular manner, I may end, in this tribe, with pointing out a few select cases, and without any order. The comprehensive bills of the stork, heron, crane, gannet, and others, intended for seizing and swallowing large fishes, or frogs, or serpents, are among these: and under those, the bill of the cormorant is varied by means of a hook, serving the purpose of detention, like that in the birds of prey: as it is, partially, by that extensibility of the lower part of the mouth which becomes the noted pouch in the pelican. And in these voracious birds, we must also remark that construction which prevents the epiglottis from being closed, and the animal suffocated, though the fish which it has swallowed occupies the whole throat and part of the mouth, sometimes even to protruding beyond it. In the raven, the sharpness, capacity, and strength of the bill, adapt it to that well-known prey which does not require to be detained. The cross-bill has often been pointed out among the remarkable instances of invention; while the perfect adaptation of this instrument to its office, in opening the cones of the fir, is equalled by the widely different forceps of the spoon-bill, where the great deviation from ordinary rules is more remarkable than even the adaptations of this, literally, pair of tongs, to the catching of frogs. The bill of the woodpecker was formerly noticed; and that of the humming-birds is a rival to the proboscis of the butterfly and the bee. Of the sin-

gular bill and horn of the toucan, natural history can as yet give no explanation ; but that does not prove that there are not uses for so peculiar a construction. We have often determined this of much more in creation, which an accession of knowledge has explained.

Though the variations in the mouths of fishes are considerable, we do not know enough of their food or their habits to permit of a similar examination ; and I can only therefore note a few single cases, after premising one general remark. This relates to the beautiful mechanism by which the most acute external figure, indispensable for penetrating the water, is united to the largest spread of jaws, for seizing the almost always entire and bulky prey. It was also needful that the mouth should open frequently for the purpose of breathing ; while, had it opened widely at those times, the resistance to the water would have impeded the animal's motion. Thence the peculiar structure of the jaws, in a hinge easily examined : under which, while the cod, for example, breathes by an aperture of much less than an inch, it can open the mouth so widely as to give passage to another fish of equal size.

I have already described the very remarkable mechanism of the mouth in a whale : it is a variation for a very peculiar end, which departs from all the general rules. In the grey mullet, a principle resembling that in the hog is adopted ; a tough snout ploughs the sand for worms, and the mouth follows. The analogy of the long bill of the *Syngnathus* to that of the Woodcock is striking ; and its use is probably the same. The Sand-eel feeds in the same manner, but not under the same provision : while, following its prey like the mole, and with at least equal rapidity, we must note that very peculiar adaptation by which it can dispense, like the eel, with

respiration, during a whole tide, if not more ; as in this case also, it cannot substitute air for water, as the eel and the carp appear to do. Of such constructions of mouth as that of the Gar, the Shark tribe, opening beneath, the Choetodons, scarcely opening as wide as that of the smaller quadrupeds, and more, natural history can give no explanation ; since, sometimes, it does not know the food, and, at others, can see no reasons : so that I need not dwell on that which cannot at present be elucidated. The machinery, without the uses, teaches nothing for the purpose before us ; so that although we do know that the Lampreys adhere to rocks, or other objects, under very peculiar contrivances in their mouths, it is a knowledge from which we do not learn what we want. We are equally in the dark respecting the very peculiar and exclusive mouth of the Spermaceti whale, where the lower teeth lodge in sockets in the upper jaw, although we know that it feeds on cuttlefish ; since we do not even see the use of its immense teeth for such a purpose, far less that of this very singular contrivance.

The system for the mouth in insects would admit of a sufficiently extensive classification, but it is no longer necessary, even had I space, to examine it in the same manner ; as I shall also pass over every other tribe of animals, partly for the same reasons which induce me to be brief on this one, and partly because we are very insufficiently acquainted with their habits and their food. In the present, I shall simply note a few remarkable variations, which he who reads for the sake of natural history alone, can easily pursue in the books on this subject.

One of these constructions is in the dragon fly, the most tremendous of the animals of prey, if the insects

which it devours can see it as we should see a beast of prey, equally disproportioned to ourselves, and equally powerful. The form of the jaws ought however to be examined, as is easy ; since description is comparatively unavailing. The mouths of the marine crustaceæ are also accessible, and present very complicated machinery, equally demanding and deserving examination ; while, if the adaptation to the uses is by no means clear in these, it is very obvious in the former animal, as it could not be more perfect. In the sucking insects, forming one principal division of mouths, the designs are as perfect, under many varieties, as the mechanisms are admirable, in the invention and the execution. In the butterfly tribe, it is a long proboscis, of a very peculiar anatomy, because the food lies in deep and narrow tubes : it is shorter when the animal is so small that it can enter the tube, as in the bee ; as it is also differently constructed. In the house fly, it is a muscular trunk, not unlike that of an elephant, provided with two lips, because the food is superficial : offering another instance of the adaptation of one mechanical contrivance to two very different animals. If there is a hard substance to be first penetrated, the trunk is formed accordingly ; as in the *Aphis* and some of the *Hemiptera* ; yet under many variations. In the various gnats, and others, in the *Diptera* of naturalists, the penetrating apparatus is often exceedingly complex ; consisting of lancets, amounting to five in the common gnat, of which some are also serrated.

Though I desired it, no description can convey an adequate idea of the various mechanical contrivances in the mouths that are used for sawing, cutting, biting, breaking, and grinding, and in those which possess forceps to detain : while many different tools, as they may truly be called, are often united in one insect.

Nor do plates represent these things in a satisfactory manner. He who desires to understand them must examine them, as he can easily do in the larger spiders, in caterpillars, grasshoppers, beetles, and in the mole cricket, cockroach ant, and hornet, with us; and the mantis, phasma, locust, and others, sufficiently common in collections.

These are, in reality, matters for a book; as they also belong to specific treatises on natural history. That is not here the object; and I even think that under the present views, an excess and minuteness of detail are productive of evil. A work thus indulging, ceases to be that which was, or ought to have been, intended. It becomes a storehouse of facts, without even the merit of being a scientific and orderly one; as it is far also from being a philosophical treatise. It is an evil which has happened already, and will happen again, as long as he who writes possesses only one subject, or a favoured one: unable, in the one case, to quit it, and, in the other, not knowing where to stop. A reader is thus tempted to read for mere information, which he nevertheless obtains only in disjointed fragments; but the far worse effect is, that his mind becomes a passive recipient of those facts, and no reflections, probably, of any nature, are excited. As to the present high object, it is in vain that the writer attempts to remind him of the purpose under which he would fain imagine that he collected all this matter, by interposing an occasional remark. If, fortunately, the phraseology is not that from which men avert the wearied ear, it is too apt to break in, with little connexion, or to interrupt a train of ideas of a very different nature; so that it either excites no attention, or is felt as an untimely interruption, to be passed over.

Though there are some variations in the organs of the only two senses which require peculiar mechanisms, among the different tribes or species of animals, the eye is the only one which admits of any remarks ; since we know little of the ear. The nictitating membrane is of this nature ; forming an interior and third eyelid, for excluding too strong a light in some animals, and for protecting the eye against injury in others. It is moved by two muscles, one of which is a pulley, even more ingenious than the trochlearis ; and returned, as I already remarked, by its own elasticity. It is a perfect instance of a special superfluity under a general rule, to remedy a contingent evil ; and it is thus among the proofs of a watchful beneficence. In fishes, there is no eyelid ; because the eye does not require moisture or wiping, it is said ; but we do not well see why they should not have the power of excluding light, which they now can only do by sinking beneath its reach. There is indeed an exception in the ray, if the fan-shaped curtain within the cornea is intended for this purpose : while we do not know why this tribe alone should possess so peculiar a contrivance for excluding light. But in these animals, the purpose of the spherical form of the lens is as well known as it is obvious ; so that I need not dwell on it here.

In birds, there is a peculiar variation for an important end, consisting in a provision for adjusting the eye to varying distances, rapidly. In ourselves, this is a slow operation ; as few also are possessed of the power of perfect and extreme adjustment. Birds demanded both these powers ; and some, such as the falcon tribe, to a high degree, for obvious reasons. For this purpose, there is an interrupted bony ring surrounding the ciliary

circle, which reaches from the bottom of the eye to the edge of the lens ; and the adjustment seems to be produced by the greater power which this gives of elongating or shortening the globe, and thus altering the focal distance, as also probably of changing the position of the lens. Though it is not a difference of construction, it equally belongs to the present subject, to point out the very high sensibility of the optic nerve in birds ; whence their extraordinary acuteness of vision, not less needed than the former property. Hence, in the language of optics, they can discern very minute angles ; thus are the vultures guided to the carcase which it is proved that they cannot smell, even when near it ; and thence it is, that the far distant hawk can see the sparrow near us, which we can hardly discover ; as, under the power of rapid adjustment, it can descend on the prey with unerring certainty.

The variation of contrivance, in the seal and the walrus, for producing an adjustment to air and water alternately, is not only interesting as a variety in invention under this head, but as a construction of remarkable ingenuity. The cornea, for this purpose, is thin and flexible, and surrounded by a strong ring ; while the middle belt of the globe is also flexible, and the back part nearly cartilaginous ; the whole being surrounded by strong muscles. Thus the axis of the eye can be elongated by lateral compression, as it is restored by the elasticity of the parts : and hence the double adjustment, which enables these animals to see as a fish and as a quadruped both.

There are also, in this organ, examples of mechanical, rather than optical variations, similarly intended for special purposes. In the rays and the sharks, the eyes are attached to a cartilaginous stem which is

articulated to the bottom of the orbit; and thus a considerable power of motion is attained. Under another construction, but for similar ends, those of a hare can be turned so as to see backwards; and, enhancing on this, the almost pedunculated eyes of the crabs can not only be retroverted, but extended in different directions, like those of the chameleon. In this animal, the entire adaptation of whose construction and powers to its food or wants I noticed in the last chapter, the body was to be immoveable and inactive, lest it should alarm its watchful and quick-sighted prey, and thence the eyes are rendered widely moveable, and independent of each other, so as to embrace the whole surrounding sphere.

The pupil, lengthened upwards in cats, and laterally in the graminivorous animals, may be either viewed as an optical or a mechanical variation; as the purpose is apparent in both. The utility of the extreme contraction and dilatation of this part of the eye, in the former animals and in owls, is not less obvious, when we consider the extreme differences of light to which they are exposed; as the necessity of the latter for nocturnal animals is equally evident. And in the owl I must also point out that remarkable variation in the skull, resembling the construction in the elephant, though for a very different purpose, through which it is extended by means of cavities, so as to give a sufficient space for the eyes, and possibly also for the organs of hearing, without inconveniently adding to its weight. But I may terminate on this subject by noticing the *Zemni* (*Mus typhlus*) of northern Europe, which is what the mole was once supposed to be. It burrows in the same manner, and the eyes are covered by the skin, so that they cannot be found till this is removed. They doubt-

less equally serve the purpose of a warning, which was all that was required: while a more complete eye would not only have been superfluous, but a source of contingent suffering. If the *Muraena caeca* and the *Gastrobranchus caecus* are blind to the same extent, and from an opaque conjunctiva, while in the *Myxine glutinosa* we cannot trace even the rudiments of eyes, we must suppose the reasons similar, though unable to decide, from our ignorance of the habits of these fishes. In other classes, the *Sorex auratus* and *Proteus anguinus* may be named as examples of a similar apparent deficiency. But there is a far greater variety in the structure of this organ than I can here afford to notice, while in many cases mere description would not be intelligible, as in few are the purposes known. And if I here add to what I have pointed out, the suspensory conical muscle in the eye of the horse and other animals which feed in the same manner, it is a variation of which the use is obvious.

Of the eyes of insects we are so ignorant that we can only conjecture; and conjectures could serve no purpose in this place. In the spiders they seem to us unnecessarily numerous: in the insects possessing similar eyes, with the addition of the complex ones which are so bulky and so visible, the difficulty is beyond all comparison greater. For organs like this there ought to be corresponding uses: but we must wait for further information. Were ignorance always acknowledged, there would be less of disputation, and less of writing and reading to no end. But all do not know when it may safely be confessed: unable to distinguish between that which is unknown and that which themselves do not know, they would fain explain every thing, for fear

that the acknowledgment of ignorance should be that of their own deficiencies.

If the varied clothing of animals has generally been noticed by writers on this subject, it includes nothing of much moment to the purpose here in view. Hair, under many differences, feathers, under scarcely any, and scales, in the sea and on the land, include the whole : since the skins of insects, the shells of the shell fishes, and so forth, can scarcely be viewed in this light.

In hair, the great variations consist in quality, length, and density ; while different qualities, being hair and wool, are sometimes united. The general purpose, I need not say, is warmth ; and it is sufficient barely to notice here its nonconducting and nonradiating properties, its annual renewals, its variations in quantity, or density, and quality, according to the variations of climate or temperature, and its occasional power of changing colour to adapt itself to that of the ground. Few quadrupeds are without this covering, nor do we see the reasons for the nakedness of the elephant and rhinoceros ; since, were heat of climate assigned as the cause, many more ought to be equally deficient. The leading variations, however, under the general design, relate to climate ; but they are all so well known that it is unnecessary to name them. The mole, formerly noticed, is an example of a more distinct variation for another purpose ; and there are similar ones in the seal and the otter, to facilitate the motion through water. In the sea bear, the white colour becomes a substitute for that density of coat in the other species, which was here inadmissible : it is the especially nonradiating colour.

In birds, facility in passing through air, and some-

times through water, is combined with clothing for warmth, so that the original design is more complex : while I need here only say, that the contrivance unites feathers and down. The chief diversity under these, is to make the down a separate substance, or to place it on the inferior part of the feather : while I must note also the property of the feather in turning off water, partly through the peculiarity of its texture, and partly through the oil with which it is pruned by means of an appointed gland. Of the lightness and perfection of the whole structure, it is superfluous to speak : nor need I do more than name that unexpected compactness and elasticity of surface, which, in most of the aquatic birds, enables it even to turn off an oblique shot.

It is in these birds that the chief variations occur ; but they are reducible to the general fact of increased down, with increase of density and of elasticity in the total covering : some of the divers however, and especially among the penguins, display an additional variation, in that compact smoothness of the surface which enables them to glide through the water like the fishes. And in each case, the utility is apparent : the density in the former both adding to the buoyancy and increasing the warmth ; while, in all the birds, this extreme protection from cold is more necessary than in the quadrupeds, from the higher scale at which their temperature has been fixed. The most remarkable variation, however, occurs in the owl ; as, united to the other peculiarities of this animal, it forms another of those completed designs which I have already noticed in the chameleon, the camel, and the mole. There is a peculiar laxity in the feathers, which, with the mode of managing its wings, confers on it that power of inaudible flight, so strangely contrasted with that of every

other bird, through which it suddenly appears before us, unheard; the ghostly owl. It is one of the instances; so often here pointed out, of an apparently insuperable difficulty overcome by a special contrivance: so simple, at the same time, that while there is no breach of the general principle for clothing, it is by no means easy to discover what is the variation through which this silence of flight is attained. It was a more difficult problem to solve than that of the cat and the martin, while the purpose was the same; nor is there any other bird in creation which could have surprised the quick-hearing and active shrew-mouse during the stillness of the night.

The fishes afford even less ground for remark, as far as the coverings are intended for clothing only; and the system is more simple, inasmuch as a cold animal required no defence against temperature. Protection from injury, added to smoothness of surface for motion, was all that was intended. Accordingly, the varieties are unimportant, and, under the present views, uninteresting. But the argument requires no additions; and the conclusion has preceded the proofs: a considerate and consistent design has been planned by One Mind, and executed by One Hand.

But one very natural reflection follows. It is, on the care, equally extensive and minute, which has been bestowed on this great variety of animals, that nothing should be wanting to their existence and prosperity, under all possible circumstances; and on that adaptation of their means and powers to their inclinations, respecting which it is indifferent whether we view the former or the latter as the principal, and the other as the subsidiary; since, under either mode of contemplation, the beneficence and the wisdom are the same.

CHAPTER X.

ON THE DISPERSION OF SEEDS.

IF I must often regret that the evidences of design in creation are scarcely intelligible by general readers, or not accessible to them, I can now point out a series of mechanical contrivances known to many, and within the power of any one to examine. And though the subject of this chapter presents no novelty, it is chiefly for this reason that I choose it, while I shall also confine myself to the most familiar and accessible cases.

In this instance, as in former ones, there was a problem to be solved: and that was, how the seeds of a plant might be sown at such a distance from the parent as to cause the dispersion of the progeny. It was to do what man does when he scatters the seed-corn across the ridge; while the plant was to be its own sower. And this problem has been solved, in more modes than one. Why it has not been done universally, why the plants thus favoured are not more useful to ourselves, and whence the selection, are questions which, if we cannot answer them, are not here before us.

This proceeding involves, not one, but many solutions of a problem in mechanics; namely, how to move heavy bodies, and, in most cases, without the aid of voluntary power, or muscular force. And the further question is, not whether man could have done the same, but whether he could have invented the means, though the execution

was beyond his power. He perhaps believes that he could : and I am willing it should be so, because he will then more readily admit that the contrivances have been those of an artist; that the proceeding was intended, and that it has been executed in so many different ways as to prove an artist abounding in resources; the Great Artist.

This problem has been executed in six different ways, at least, more or less simple. In two of those, where the contrivance is purely or partly mechanical, there is a variation in the machinery, which even an intelligent mechanic would scarcely have suggested, and which he would surely not have adopted; well satisfied in having gained his end by one contrivance, and resting in the most simple. In some cases, if the apparent contrivance is little, or if the dispersion is intrusted to those forces whose effects we generally view as accidents, we still find some subsidiary or collateral provision, bespeaking an intention to gain that specific end which is attained.

The common means, being those thus alluded to, are, the exaltation of the seeds of plants on elastic stems, so as to be exposed to the action of the winds; a power of floating through water till they meet a point of attachment; their transportation by animals to which their receptacles or investments have served as food; transportation by the coats of animals; a provision in the form of wings, through which the winds may act more effectually on them; and lastly, an elastic power in their receptacle, through which they are forcibly rejected by the parent plant.

The first contrivance is so general, and appears to be so necessary a portion of the structure of the plant, that its design for the end in question is seldom noticed. Yet

he who examines the grasses, will not doubt of the consequences produced by the exaltation and elasticity of the stem, though he should choose to doubt that the dispersion of seeds was at least one end in view. In the mosses, including *jungermannia*, this intention can scarcely be questioned; since no other purpose can be assigned to the delicate and elastic foot-stems by which the seed-vessels are elevated above the plant. In these the flower blows in the bosom of the leaves; and, almost every where else throughout the vegetable world, where the flower blows, there does the seed also ripen, and thence is it dispersed. Here it is not so: the seed-vessel becomes raised far beyond the place of the flower, through the subsequent growth of a singularly elastic stem; there to ripen its contents, and to be exposed to those forces which may disperse, widely as the winds themselves, those seeds which, light as the breeze that bears them, are of such high importance in the great economy of vegetation.

If the floating of seeds through water is a contrivance which, like the action of the winds, appears too much akin to what we carelessly term accident, to deserve notice, yet thus chiefly are the naked coral rocks of the great Pacific Ocean clothed with vegetation, and rendered fit for the habitation of man. Are we entitled to give the name of accident to that cause, or combination of causes, by which so great an end is produced—even though metaphysics, and religion equally, did not show that there can be no accident to the Creator and Governor of all things? The buoyancy of a cocoa nut, the resisting investments, and the vitality of seeds, were not necessities: but there can be no accident when the end in question is thus attained, and when, without it, all those previous and wonderful contrivances by which

these islands are created in the ocean would have been fruitless : while we can even believe that the important cocoa palm was created a maritime plant for this very purpose. As much is it accident, that the same fluid which produces fire and maintains the life of animals, is also the highway of a bird through the clouds, and the moving power of a ship across the ocean ; but this question will be set at rest, by producing a distinct provision for securing the end proposed in the transportation of seeds through water.

And this is found in the seeds of the submarine plants. These might have been carried any whither : but how were the seeds of the fuci to root themselves amid the waves ? The contrivance is equally simple and effectual. They are surrounded by a mucilage which water cannot dissolve, and which enables them to adhere to whatever solid body they touch ; even, as seamen know but too well, to the very copper with which they attempt to protect their ships from this invasion. Let chemistry name another mucilage, a substance which water cannot dissolve, though apparently already in solution in water, and then ask if this extraordinary secretion was not designed for the special end attained, and whether also it does not afford an example of that Power which has only to will, that it may produce what it desires, even by means the most improbable.

Nor is this the only subsidiary contrivance to prove, that the power of water is one of the agents which the Creator has intentionally adopted for the dispersion of seeds. The mechanism is so much less operose, that it scarcely deserved a place with those which assist the dispersion of seeds through the aid of the winds, though the general principle is the same, and though the same mechanism takes advantage of both these agents. The

down of the willow seed is both its ship and its balloon : the tree is the inhabitant of rivers ; and thus it is contrived that both the winds and the water shall convey its posterity, even to distant regions.

There is a rudeness of expedient, it may be said, and equally an appearance of accident, in ordering that the seeds of plants shall be dispersed through the coats and wanderings of animals. But neither was this undesigned, when the provisions for that end in the structure of the seeds in question are so remarkable, and often so accurately mechanical. All know the hooks on the bur, and those on the seeds of the adhesive *Galium* and the *Geum* : as all can, equally, see or infer the consequences : while the carrot, and others of the umbelliferous plants, afford further examples of an expedient, to which neither intention nor mechanical contrivance can be denied. I need not point out the syngenesious plants, such as *Bidens*, in which this also occurs ; since it suffices, in each of these cases, that I give examples under the general invention.

If there is, at first sight, a similar appearance of accident in dispersing the seeds of plants through the digestive organs of animals, the intention is here also rendered evident, by a still more complicated system of contrivance ; adding to a mechanism, not indeed of any complication, an expedient which nothing but the Power which gives life could have invented and adopted. And in this also accomplishing two great ends at once, as I have described in a future chapter on the perpetuation of plants. The fruit is the food of the animal ; but the seed is protected from the action of the digestive powers by its investments ; as it is also empowered to defy the animal chemistry by its vitality, even appearing to be thus quickened for its peculiar destination.

Thus alone, it is thought, is the mistletoe propagated : while if true, much at least of its tenacious mucilage, not less a problem to chemistry than that of the fuci, must be empowered to resist the digestive process. Nor let this mode of dispersing seeds be thought of small moment ; since it is one of the roads through which the coral islands become clothed with that vegetation which has rendered them what they now are.

But the following contrivances are so obviously mechanical, that it is impossible to doubt the design, or to avoid admiring the beauty and ingenuity of the mechanisms. If, in the case of the winged seeds, aid is derived from the adventitious power of the winds, as it is from the motion of water in some of the preceding cases, the variety of resource through which that is brought into action is well deserving of attention. That which might have been attained through any one of these inventions, is effected by means of many : while as to some at least, we can see no other reason than that which seems to meet us all through creation ; the display of variety and resource. But if dispersion is the prime object in these cases, I must not fail to point out the further contrivance, peculiar to this class of inventions, through which it is so managed that the seed shall be deposited in the best manner and direction.

The lime and the ash offer instances of wings, of the simplest nature ; and in the seeds of the fir tribe there is a similar contrivance, but of a more delicate structure. But the far greater number of these mechanisms are produced from down, various in disposition as in strength, and often presenting arrangements of singular beauty and delicacy. Not to detail all these, the *Eriophorum*, the *Epilobium*, and the several willows, offer examples

more or less simple ; while various modifications of the same machinery occur in the great class syngenesia, among which the thistles, in particular, are familiar, even to the results, so abhorred by good husbandry. But there is no one of those structures more beautiful than that which occurs in the dandelion ; while here also it would be unpardonable not to dwell on the invariable perfection of a structure, which, under apparently insuperable difficulties, is unfailing in its accuracy. Let him who can doubt that the most exquisite art designed and executed this most common, but not less wonderful piece of mechanism, examine a single star with its attached seed, the lengths of the stems, the mode of their divergences from the receptacle, and that accuracy in those divergences which causes the edge of each star so to unite, that a continuous surface is the consequence, and neither interval nor irregularity exists. But that surface also forms a globe : while this must result, not merely from the distribution of the seeds, but from a mode of expansion in the receptacle, on drying, which, if aught ever appears to be casual and uncertain, would seem to be under the guidance of chance alone. Nothing appears intended here, yet the end is ever gained : and far more remarkably still is it gained, when not one of these receptacles is globular, nor even of a spherical surface ; and when, beyond all this, few are in any manner regular in their forms, while scarcely any two are rigidly alike. Yet the result is ever the same. Be the receptacle what it may, the downy surface is a globe : while we can at least see that this was necessary, since thus it is enabled to evade, till the seeds are ripe for dispersion, the winds which would otherwise have carried them prematurely off, and defeated the Creator's intention. He who can look even at this common and des-

vised object, and not see in it a power which baffles all calculation, added to the most consummate art, may cease to study the Creator's works, for Creation can teach him nothing. Even he who rejects or disdains these higher thoughts, should cease to pride himself on his talents for observation and reflection, if he is not struck by the efficacy of this most artificial and beautiful structure, for the intended ends; seeing that the storm passes over it unfelt, till the hour of its ultimate destiny is arrived.

The last division of contrivances for dispersing the seeds of plants, is founded on that most inexplicable property of matter, elasticity, so largely used throughout all Creation: and it is the most purely mechanical, since it depends on no extraneous aid. Under this principle, the seed-vessel, or some part connected with it, is provided with a latent spring, to be brought into action as soon as the seeds are fit for dispersion, and not before. It is either incomplete, or dormant under a detent or check; like the spring of a gun-lock. This alone is an ample proof of design; because it is a train long laid, and implying foresight. And the action of the spring is prepared as gradually as the ripening of the seed, under an accuracy of adaptation equally bespeaking the nicest care; while the detent, where present, is also formed in a special part of the seed-vessel, destined to give way when its services are no longer wanted, or would be prejudicial. I must confine myself to a few instances where the mode of action is varied; and the most familiar examples are the best.

In the *Cardamine*, *impatiens* and *hirsuta*, the valves of the pod are detained at the point, and they discharge the seeds with great force, by curling back when disengaged. In the *Geraniums*, the long beak of the seed forms the spring, and the detent is at the seed-vessel, which is also

contrived to be but half a capsule, that its contents may escape. In the broom, the crackling of which in a hot day is familiar, each valve recoils in a spiral direction when the detent-yields, as is the case, more or less remarkably, with many of this tribe: and in some of the familiar ferns, it is also the recoiling elasticity of a spring, under different modes, which produces the desired effect. The common balsam, the *Noli tangere*, and the *Oxali*, present other examples; but I need not carry this enumeration further than to note the singularity of invention in the spiral capsule of the *Streptocarpus*, directed to the same end.

But the peculiarity of circumstances under which a similar invention in the *Mesembryanthemums* acts, adds much to our impression of the wisdom and foresight that have been exerted on this subject. In all the preceding instances, it is through the drying of the parts that the springs are brought into action: but had this been the case with that plant of the desert, the seeds would have fallen on an arid sand, and have failed. It is therefore commanded that the springs which have been constructed in the calyx, should close in dry weather, and open on the occurrence of moisture. Thus also is it with the rose of Jericho (*anastatica*), where the seed-vessel is rolled along the sands by the winds, until, meeting with a moist spot, it opens and parts with its seeds in that only place amid the parched plain where provision has been made for their vegetation. Can any thing have been neglected, where calculations so minute as this exist? And can this be aught but the result of thought and design, as of universal knowledge and perfect foresight?

This must suffice. These are contrivances for a great and valuable end, which we can especially appreciate, because we can compare them with our own designs:

and as well might the inventor of the catapult and the crossbow doubt his own ingenuity and intentions, as those of the Creator. It would exceed my bounds to describe the other numerous, and often singular provisions for the same general object, which occur in nature. The conduct of the *Trifolium subterraneum*, in burying its own seeds, may suffice as a specimen. If it has been suggested that the locomotion of the seeds of *Equisetum*, under the application of moisture, may serve a similar purpose, the power seems inadequate to such an end.

CHAPTER XI.

ON THE SYSTEMS DESIGNED FOR CLOTHING
THE EARTH WITH PLANTS.

IF we should observe, in one place, the burning of lime, in another the quarrying of stone, and in a third the preparation of scaffolding, we might, in ignorance of such a work of art as a house, form any supposition but the correct one, as to the purpose of those labours, nor should we be obliged to believe that there was any connexion between them. But if, in the same spot, we should see them all, succeeding or simultaneous, and followed by the mason's art, we should not doubt that a plan had been laid, from the very excavation of the quarry, and continued towards its result, by a designing architect.

Of such prolonged plans, executed by successions of agents, sometimes apparently independent, at others more obviously connected, Creation offers various examples: and we need only examine them to be convinced that they were as truly such as in the former case, and therefore directed by a Designing Intelligence, for the very end which we observe to follow. It is true that we commonly look at the result without attending to the means, to the causes and the steps; or we do not analyze, sometimes from ignorance, more generally because the objects are familiar, or, far worse, from the pernicious habit of concluding that certain things must be what they are. The ignorant must be taught, and

the careless be roused: while to him who doubts or disbelieves, from perversion or want of will, it can only be recommended to free his mind from false systems, and to examine the chain of causes and effects, as he would investigate any question of pure philosophy.

And these are, in reality, questions of philosophy. It is true that the works of the Deity cannot be traced with the same facility as those of man; because they are not equally accumulated in one place, because the agents are often various, and remote from ordinary examination, because they often perform many different offices, and further, because, under the system of the Creator, they occupy much time; often more than the life of man, or the lives of many successive men. Yet all this but makes a difficulty, often easily overcome; while to overcome it is a source of pleasure as well as of useful knowledge. It is also the business of man: it is in his power, and it is his duty; and if he neglects it, he has no right to disbelieve: least of all, to disbelieve, when others have undergone the labour of examination and induction for him, and placed the evidence before his eyes.

Independently of the comparatively simple design for covering the surface of the earth with plants, which consists in the growth of one set on the ruins of a preceding one, I must here examine one of these involved plans, while I have selected the present subject partly for that very purpose; as an example of those designs which, though not immediately obvious, are not the less demonstrable. It is a complex design also, because the simpler act of clothing the earth with vegetation is made conducive to the extension of its surface. Or, while chemical powers are succeeded by mechanical agencies, continuously connected and tending to this

great end, the work would often be incomplete but for the further aid of vegetables, which thus assist in producing the habitations intended for themselves. And in commencing with this subject, I must refer to the 20th chapter, where the enlargement of the terrestrial surface through the agencies first named, is treated of under another Attribute. That there is an inevitable collision among the facts of science, as adduced for the purposes of moral evidence, the reader must be already aware.

No one can have seen a lake, without observing that wherever a river flows into it, the borders consist of meadows, or of marshy land, or both: while the marsh is a preliminary to the meadow, and is finally converted into one. If the whole process be watched, it will be found to commence in the shoaling of the bottom at the entrance of the river, sometimes producing islands, or banks, which, gradually attaining the level of the water, become first marshy tracts, and are finally elevated so as to form solid plains of meadow land. The progressive deposition of earth and stones by the river is here the fundamental cause: and as far as this acts on that land which has already surmounted the general level of the water, the increase is the result of inundations extending themselves over it. The consequent effects, in the narrowing, the shortening, or the dividing of lakes, and ultimately in their obliteration, so that nothing at length remains but a river traversing a plain, I have noticed in the chapter here referred to: while the practical and obviously designed result is, in all cases, an acquisition of new and valuable lands. My object here, is to point out that portion of the total plan which is effected by the intervention of the living and vegetable creation, through the inclinations, or

instincts, of plants appointed for the completion of this great design.

It is a striking proof of Design, that two processes, entirely distinct in their natures, are brought to bear on the production of one effect; the second being also prepared to follow and complete what had been commenced by the first. It is a further proof of such a regular and fore-ordained plan, that while the general inclinations and structures of the plants destined to this end are peculiar, so is there among them a still further gradation of inclination and structure: a succession of distinct desires and powers, which enable some to commence that portion of the general duty which others are to take up, and others again to terminate; while none of these can perform the office of their associates in the work. In every case, even under the absence of all analogy, we must grant that such a mode of proceeding bespeaks a design: it is impossible to doubt it for a moment, when we find man himself pursuing the same system, and, whether he knows, or not, that he is imitating nature, sowing vegetation to secure and consolidate the mud which his piers and dams have detained, that he may gain a new territory from the waters.

In the proceedings of nature, however, the plan is more perfect; and while the results are more numerous, the provisions for each are as minute and accurate, as the effects themselves are unfailing. Not only is the new land consolidated, but the plants are constructed with powers to detain what would otherwise have floated on with the stream, to be lost in the ocean; that most valuable portion of the whole deposit, on which the unceasing fertility of these new lands is to depend. And while the living plants serve to detain and to bind, the dead ones are ordained, in their generations, to fer-

tilize, and, still further, to aid in elevating the new plains beyond the eventual inroads of the waters. A short list, selected from a numerous catalogue of plants, will furnish that detailed evidence which the reader can easily verify and extend.

In the sea, it is the *Zostera* chiefly, which, with its long, numerous, and firm roots, lays the first foundation of that which will afterwards become a salt-marsh; acting beneath the water, like those far different plants which consolidate the dry sands of the adjoining shores. In fresh-water lakes the *Scirpus acicularis*, *Subularia aquatica*, and others, perform the same initial duty: and when we find that all these plants have been created to live and to propagate entirely under water, we cannot doubt that they were appointed to the very office which they execute so well. But in fresh waters, if not, with us at least, correspondently, in the sea, the detention and consolidation of earthy matters are effected by many more plants, not purely subaqueous, but of an amphibious nature. These root beneath the water, but grow above it: acting by means of their stems and their crowded growth, in detaining what their roots consolidate, or checking that action of the waves which would diffuse the earths along the bottom, and retard the desired effect. Such are the bulrush and the common reed: and if the most incurious spectator can satisfy himself respecting their effects, so must he be very unwilling to believe, who can doubt that the singularly long, powerful, and prolific root of the latter, was constructed for the very purpose of consolidating the earth in which it loves to grow, and not less for ensuring the extension and perpetuation of so valuable an agent.

If my limits do not allow me to enumerate all the plants, even in our own climate, far less in others, by

which these offices are executed, still more impossible is it here to describe the various powers and actions of each tribe or species, from the nearly terrestrial reed just mentioned, to the *Potamogetons* but slenderly connected with the land, and to the *Lemma* and *Conferva* which are entirely independent of it. And it is best that the student of nature should examine for himself the various plants, *Nymphaeas*, *Charas*, *Hippuris*, *Lobelia*, *Stratiotes*, *Hottonia*, *Butomus*, *Hydrocharis*, and more, which take their shares in this useful work. But it is most important to remark on that further provision, in a design where nothing has been overlooked, through which, whatever other separate purposes these several plants may serve, there is some one, or more, adapted to every possible situation and circumstance under which this work may be carried on. Thus have structures and inclinations been provided, not merely for the sea and for fresh water, but for every variety of each: for the pure ocean and the brackish æstuary of a river, for the clear lake, the rapid river, the alpine pool, the heated pond, and the foul and stagnant ditch. The *Scirpus maritimus* and the *Ruppia* thrive where the bulrush and the *Potamogetons* could not exist: the *Lemma* does its best to reclaim that pond which would bear no other plant: the *Lobelia* shuns the poisonous ditch which the *Hydrocharis* prefers, and the *Ranunculus aquatilis*, appointed to this duty in that shallow pool which the first heats of summer evaporate, is equally content to live beneath the water and on the dry land; amply provided with means, as with inclinations, for each mode of life. But he who would scan the whole of this great design, must investigate all this and far more: while, if he would see, under one striking view, what the Author of nature effects in this manner, he

must not confine himself to the rivers or the lakes, the marshes or the coasts of our own country, but turn the eye of botany and geography on the singularly rooted Mangroves, the gigantic reeds, and other uncounted plants, which cover the swamps of the torrid climates, and are daily converting unnumbered miles of sea and river and lake into habitable land. He will not doubt the ultimate value of the result, when he finds the marshy woods of Borneo occupying hundreds of square miles, all gained from the ocean by the labours of the vegetable world.

There is yet, however, another stage in the process which I have been describing, though I need not trace it minutely. The plants which had performed the work thus far, can do no more when once the new land has surmounted the surface of the water. A new set has therefore been appointed to carry it on to its completion. The *Salicornia*, *Arenaria*, *Crithmum*, and many more, perform, on the sea shores, that for which there are provided, near fresh waters, marsh plants beyond numbering, and too well known to require it; including even trees, like the willows with us and the palms in hot climates, which aid, in obvious ways, in the great work. Thus does the marsh at length become a plain, fitted for pasturage or agriculture; or demanding only the further labours of him for whose use it was rescued from the waters. The last race has deserted it, as preceding ones had abandoned what they had produced: yet each is still performing its appointed duties: and, if excluding itself by its own actions when it could no longer be useful, continuing to prepare a new place for its successors, to surrender it again when it has executed the will of Him, of whom it is the blind but obedient agent.

If this be not a regulated plan, intended and executed, I know not where to seek one, even in the works of man: but I must yet note an analogous but different proceeding, independently of water; and the more so, that I have not examined this subject in the chapter on the enlargement of the earth. This consists, fundamentally, in the deposition of sand on sea shores; the winds performing, in this case, what the water does in the others. And however injurious the consequences may occasionally be, in the overwhelming of fertile lands, I as little doubt that the general results are beneficial, as that the whole was designed. And we are assuredly entitled to conclude thus, when we find that a provision has been made for perpetuating these acquisitions of land and rendering them fertile. Mankind is ever more ready to complain of injuries than to be thankful for advantages.

If this sand is not universally calcareous, it is such far most commonly: while, as the produce of sea shells, the levity of the fragments allows this kind, at least, to be most widely dispersed, so as to become calcareous manure to places within its reach, and thus producing valuable collateral effects, in addition to the accession of territory thus gained from the bottom of the sea, through actions so obvious that I need not describe them. The coasts of Holland and the Baltic, of Italy, France, Africa, afford examples of this last most conspicuous effect, as the Western Islands of Scotland do of the other: while nearly the whole of Tirey has been created from the sea in this manner. Did the Author of nature intend this fundamental effect, or did He merely foresee that it must happen, and thence provide means for rendering those additions useful? The latter conclusion will answer the present purpose: and to

this, at least, assent will scarcely be refused, when the provision for converting such lands into agricultural soils is examined.

Here, as in the case of deposits from water, the prime object was consolidation, that the winds might not destroy what they had produced ; and the second was to induce a more fertile surface, by the addition of vegetable matter. And both are accomplished by the same means ; through a special creation of plants, provided with inclinations to occupy those places, and powers to effect these purposes. All of them are willing to grow in sand ; and some will grow nowhere else : while the others, equally prospering on the incipient pasture, form the connecting link through which it is to be completed. Here alone we see the proofs of design : but no doubt can remain when we examine the long roots of these plants, tenacious as they are numerous, and intersecting the sand in every direction, as if the root, rather than the plant, was the contrivance and the object, and thus rendering it a firm mass. Man even takes advantage of them for the same end ; and, when he would have invented them had it been in his power, he cannot doubt that for this purpose they were invented and ordained.

Among these, on our own shores, the *Elymus*, *Triticum*, *Arundo*, and *Carex* of the sand, are the most familiar, as they are the pioneers in this great work : but few can be unacquainted with the *Convolvulus*, *Bunias*, and *Euphorbias*, of the sea shores, with the *Eryngo*, the *Matthiola*, the *Kali*, the *Arenaria rubra* and the *Galium verum* : while, knowing the general desires of plants for soil and water, we might wonder at a choice so apparently unreasonable, did we not know by whom that choice was directed.

Having thus sufficiently traced the joint solution of two great problems, the enlargement of the vegetating surface of the earth, and the foundation, with the progress, of that vegetation destined to occupy it, I may proceed to the simpler plan already indicated; more widely acting, if not productive of the same conspicuous results. That it is familiar to botany, is an additional reason for this examination: the concurrence of belief is an aid to the force of evidence; while there are many who have yet to learn in what manner Creation ought to be contemplated.

I have shown in the 6th chapter, how the naked rock is converted into soil, through ch emical and mechanical actions, and thus rendered the home and habitation of vegetables. The design is apparent, and the success corresponding: yet the Governor of the world has not trusted to this alone, desirous, we may safely suppose, that no spot of His creation should remain unoccupied by life, and thence ordaining other agents to fill the blanks or supply the defects which a prior set might have left. And seeing that the chemical and mechanical powers alone could not have effected all the requisite purposes, we must still more admire the wisdom and power which are never wanting, and not less the consistency of a plan which developes itself to our inspection as if He had designed to instruct us in His ways.

Here the vegetable world is the sole agent; while, as in the preceding cases, one family of plants is the pioneer and precursor to another of a superior nature: each retiring in succession, as it has contributed to place a better race on the same soil. And thus life, under some form, the means for other and superior life, is never wanting; and every part of the inanimate

creation, however apparently hopeless its nature, is rendered the habitation of some plant, enjoying life itself, and possibly also subservient directly to animal existence.

Though the chemical powers of nature convert the rock into soil, that operation is often slow; scarcely occurring at all in the case of quartz. There are situations also where soil cannot rest; or else it becomes removed, from the flow of water. Here it is, that the vegetable agents in question are ordained to act, as here they are made to inhabit: and from this point their actions are most easily traced. And when we find that a specific family of plants, utterly unlike all others, in their instincts or affections, as in their nature, their structure, and their powers, execute this prime office, surrendering their places afterwards to a second, scarcely less remarkable in these respects, yet approaching nearer to the general vegetable world; as they are also the immediate precursors of those more perfect and more widely useful plants, we cannot for an instant doubt the design. It is in the multitudinous and incomprehensible tribe of lichens and analogous plants, that we find these pioneers of vegetation, seeking their places where no others could exist; demanding no water, requiring no soil, careless alike of cold and heat, of the sun and the storm; rootless, leafless, flowerless; if not seedless, perpetuated we know not how, unsusceptible of injury short of destruction, and, if not immortal, tenacious of life as are the seeds of plants themselves, and capable of almost equal dormancy. What their anatomy is, no one has ascertained: and if they do produce seeds to be spread by the winds, we have still to explain how that which must be lighter than the winds themselves, and which the microscope cannot discover, should adhere to

the solid rock. Yet thus is the naked rock clothed, even where, as in the case of quartz, no possible soil can exist, nor any decomposition occur; while the same mysterious organizations refuse to occupy that which we should pronounce far more fitted for their habitations.

But the Creator has only to will, and it is done: nor can we contemplate this extraordinary form of vegetable life, without reflecting on the power which has given that life to such an organization, so unlike to almost all else, yet so perfectly adapted to the purposes which it was created and commanded to serve. And if the species are so numerous that they are yet uncounted, so are there kinds allotted for different qualities of rock, and for different surfaces; for the calcareous and the flinty, for the smooth and the rough, for the precipice, or the wall, or the bark of a tree, and even for almost each bark of each tree. Thus also are there individuals appointed for the damp and dark forest, the sunny and arid cliff, the frozen alpine summit, and the salt sea shore, the climate of Bengal and the snows of Greenland. But this is not all. There was a problem to be still solved, and had it not been done, it would have left all this apparatus of little use: the very purpose in view would have been defeated before it was well commenced. Man could not have devised the means: he scarcely even knows how to believe the fact when it is before him; so contrary is it to what he calls the laws of nature.

It is a general law for plants, that water is essential to their existence, and that deprived of this, once dried, they are irrecoverably dead, though many have been enabled to retain it with almost miraculous obstinacy under the most unfavourable circumstances. But had this law involved the lichens, it would have been fatal

to their appointed duties ; while their bulk and structure are commonly such as to have rendered the retention of moisture impossible. Exposed to a burning sun, on naked rocks, and without the means of resisting its influence, they are often so dried as to crumble at a touch : while this condition is sometimes of daily occurrence. Their very races might have been exterminated : but the Creator never leaves His work imperfect. He has made an exception to the general law : the principle of life is not withdrawn, and they are ready to revive and resume their functions at the slightest return of moisture. Nothing but unbounded power could have effected this, as unbounded wisdom planned it. It is a fact that wars against our very definitions of life : for it is life in a dormant state ; inactive, and incapable of acting, yet continuing attached, and waiting to recommence its actions when the instruments through which it acts shall again be serviceable. It is the mystery of the seed ; it is perhaps even a greater mystery. And if that dried lichen can preserve its principle of life for months or years, as it is known to do in our cabinets, who shall say when that can depart, where no organic change is taking place, and no chemistry acting ? It is an immortality : but it is an immortality to teach us how little we know of life, how rashly we decide, when we pronounce on what shall be, or what cannot be effected.

I might prolong the investigation of this contrivance through the remainder of this singular family of plants, since the preceding remarks relate chiefly to the crustaceous lichens. But if my space does not admit of botanical minuteness, it is nowhere the object of this work to teach Creation : its end is to teach how Creation ought to be contemplated, for far higher objects than

those of mere science. Suffice it, that in whatever way the foliaceous and the shrubby lichens may assist, the result is to lay the foundation of a soil on the naked rock, partly through their own living structures, partly through their decomposition, and partly through the flying particles of earth which they detain; if they also aid in the decomposition of their rocky abode itself, by detaining moisture on its surface.

But the soil thus produced is unfitted to give a hold or a place to the larger and more perfect vegetables. Still, the design is carried on: and a new tribe of plants, of a higher organization than their precursors, yet inferior to those which are to follow, has been created for this end. These are the mosses, using that term in its popular sense: and their variety resembles that of the lichens; while if we cannot find a distinct use for each, it is a fact which does not interfere with the present inquiry. These have scarcely the power of rooting themselves on a naked surface, if we except the barks of trees: but they attach themselves readily to the least quantity of soil, as formed and collected by the lichens, and with equal facility to the plants themselves. And that they execute the office of forming additional soil, the least observation will show: partly through their prolific nature, and partly through a structure especially adapted for detaining earth. Partaking also largely of the same tenacity of life as the lichens, they similarly defy the more usual powers of destruction.

Their office being at length performed, there is room and lodgment afforded for plants of greater bulk and more perfect structures: but I need now do no more than desire the observer to examine the summit of a wall, where, in the Grasses, the Arabis, Turritis, Sedum,

Antirrhinum, *Saxifraga*, and many more, rooted in their mossy cushions, he will see those plants which are destined to replace and exclude their immediate predecessors ; still adding to that soil which may one day bear the trees of the forest.

I might have pursued this subject further, and shown how one tribe of plants has been appointed to pioneer the way to another, through the whole range of the vegetable creation. It is a part of the total design, ever acting, if often overlooked, though, practically at least, known even to the husbandman. He who finds it necessary to replace one plant by another, under what he terms the rotation of crops, is but following that great plan from which he cannot depart with impunity. He who labours in reclaiming waste lands, is following the system of the Creator, though he may not perceive it. And if one race of vegetables quits the soil which it is said to have exhausted, if there is one which prepares a place, or furnishes a stimulus, for a future tribe, if the tangled shrubs of the forest perform their own special office, in detaining the seeds of other plants and in giving a shelter to future trees, or if the fallen leaves of the forest prepare, in rotation, a soil for the more useful plants of a lower stature, all is but part of one great plan, and that plan is the design of the Creator. It has been said that plants poison the soil which they inhabit, by their own secretions, so as to exclude themselves, as they also injure others. This cannot be true, even in vegetable physiology, when the roots do not discharge the peculiar secretions of plants, when there are so very few which produce any specific secretion, and when there are thousands, such as the oak, which will thrive in the same soil for centuries. And, to omit other objections, there is neither purpose nor reason in such an

arrangement, while the former view is consistent with the whole of the Creator's system, as it is in itself intelligible and simple.

But while I need not pursue a fanciful hypothesis, so cannot I here undertake to discuss what I have indicated. This must be the business of Natural History and agriculture: but let him who reads or observes, never forget, that in all this, as in every thing else, there is nothing casual, nothing purposeless, nothing undesigned; that good ends have been intended, as good purposes have been effected; and that all creation, every where, presents to him who will examine it, even as a mere philosopher, and apart from all piety, the most incontrovertible proofs of a Great Artist, intending, designing; perfect in wisdom, and absolute in power.

CHAPTER XII.

SYSTEMS OF VARIATIONS IN ANIMALS AND PLANTS, SUBORDINATE TO GENERAL PLANS.—EXAMPLES OF LIMITED GENERAL PLANS, FOR SPECIFIC ENDS.

PURSUING the subject indicated in the beginning of the 7th chapter, the animal creation may be viewed as forming a single design or plan, among the other designs in the universe. Under the general form by which an animal is distinguished from all else, there are subsidiary collections of forms, or involved and inferior plans: while these again include plan within plan, till we arrive at the single individual. The popular division into quadrupeds, birds, fishes, insects, and reptiles, will serve to illustrate the first set of subsidiary plans; though abounding in imperfections, when we endeavour to separate these, and to view them as the actual leading plans beneath the first. Science has attempted something better, in its present leading divisions, of vertebrate, molluscous, articulate, and radiated: but while I need not here criticise this scheme, it is, at least, too inclusive in some parts to serve the present purpose; as it is far too obscure and doubtful on other points: while the mere forms in the last division could not be made intelligible by words, and are unknown to all but naturalists.

Zoology indeed is yet unable to perform what it has so long laboured to effect: nor can botany boast of better success. If the greater division above named is im-

perfect, and scarcely even convenient, the difficulties and imperfections increase as we proceed downwards. It is true, that the last proposed division, be it what it may, always assumes to be perfect : but the inventor's warmth does not produce conviction against facts ; and all, in succession, share the same fate. These schemes I need not, however, discuss : they are of no value, for the present purpose at least. That which would be here required, is the actual plan on which the Creator wrought : and that is the "natural arrangement" which natural history has long sought, in both the departments of organization, but has not yet found. We are for ever checked by gradations and intermixtures of plans ; and the result is, that although we trace certain plans, and portions of plans, within the chief one, or within many successive and subsidiary ones, we cannot make out the whole design. We have perhaps proceeded on a wrong assumption, in supposing the whole plan so divisible and definite : but it is also possible that it is merely a more delicate division than we can yet make out ; as it is possible too, that when the whole of creation shall be better known and studied, even that which now seems disorder and irregularity will stand forth in all its clearness.

But this does not prevent me from taking a sufficient view of this subject for the present purpose. That there is such a system of plans, is evident ; and if we trace the fragments of many, there are others which we seem to know with considerable accuracy. This is not indeed to be acquainted with The Design of the Creator ; but wherever there is a consistency of design in any portion of the whole, we are sure that we have discovered that portion of the total plan, and the present object is sufficiently attained. On a subject of this enormous extent,

I can, however, but give a few very brief hints, rather than sketches, and then select some examples as subjects for analysis. That alone will be all the proof that I require: the reader acquainted with natural history can proceed without end in the same manner; since the line of investigation is thus pointed out.

If I take the present mode of arrangement in zoology, the first division, or the vertebrate, assumes a brain within a head, with a branch passing through a spine, as one of the Creator's fundamental inferior plans in the general design for animals. As divisions beneath this, or plans of a third order, we make one of quadrupeds, one of birds, one of fishes with lungs, one of fishes with gills, one to include the lizards, another the tortoises, another the frogs, and a last the serpents. Under each of these again we find other plans, as in the webfooted fowl under the birds, and the flat fishes in that division; until at length the general plan for a lion, an eagle, or a whale, becomes the broad rule from which the separate species in a genus are modelled, and varied into individuality; the last step of all.

And however imperfect our divisions may be, we cannot doubt of a design, because we trace a purpose; ceasing to trace it, probably, only where we are still in ignorance. Thus far we see that the primary end was, to inhabit, and to move on, or in, the earth, the water, and the air: to occupy particular stations in each, or to perform particular functions, or possess peculiar pursuits; the chief, or almost sole one, being food of different kinds: as the ultimate purpose is, to fill the earth as much as possible, by consuming every imaginable variety of this. When the plan has descended down to individuality, we can sometimes similarly trace the reasons for the variations, or the species; but when we

cannot always discover a distinct purpose of utility, as in the endless varieties of parrots for example, the cause may lie in our own ignorance ; though it is also possible that such variety may have been the very purpose of the Creator.

The general reader can also contemplate the same subject in a different manner, with little knowledge of natural history, or little attention to it. In the quadrupeds, there is a division for climbing, like the monkeys ; for flying, like the bats ; for ruminating, like the ox ; one to prey by chasing, like the wolf ; or by surprise, like the cat : while others again burrow in the ground, prey by swimming, or carry about their young. And in many of those divisions, as in others which I might have suggested, there is still plan within plan, extending even to the moral appointments : the ruminating sheep possessing a different activity and different inclinations from the equally ruminating ox ; as, even in this single genus, and others, we find different characters with different forms. These are the philosophical views of creation which a reader must learn to take ; for the present purpose, as for many others. Natural history will aid him ; but not much. I have no space for more than these hints, and shall proceed to those selected examples which I promised.

In the first case here chosen we find that a peculiar plan, and as partial as it is unconnected with that order of plans which I have just pointed out, has been adopted and followed ; and followed also through considerable difficulties and obstructions, as those appear to us ; while, further, persisted in where we should decide that it ought to have been abandoned ; and moreover, preserved where no purpose is attained by it. It is the determination to adhere to a plan once adopted : and it is

from these very circumstances that we become satisfied respecting an original thought, or design, pursued to its utmost exhaustion, and till it must be abandoned for another. It is for this reason that I have selected it, in preference to any of the more visible plans already alluded to: as naturalists will now also allow that it is in anatomy we must seek for whatever is essential in the contrivances for distinctions in animals. And while this case, to which comparative anatomy will add many more that I have no room to notice, proves, not merely design, but One intelligent and designing Creator, so does it exclude all systems of chance; the very variations marking that steady pursuit of a single primary object, which no multiplicity of designs could have equally proved to those who have adopted this scheme of Creation.

Nothing can be much more dissimilar in shape and use, than the arm of a man, the fore-leg of a quadruped, the wing of a bird, the fin of a turtle, and the pectoral fin, or flipper, of a whale, though I should confine myself to those: as these parts appertain to a very partial plan within that of the vertebrate division; yet, as a general one still, involved, on this single point, with all the inferior plans under it. So complicated with each other are these plans, and so involved is the total design. It is not wonderful that natural history is at a loss in choosing principles of arrangement. But, whatever the differences, one leading design pervades all those modes of limb. The number of bones, in longitudinal order, is the same in very many, if not in all, though we do not always see why: the great omissions are made laterally, and in the extremities; though, even there, bones are often retained without any apparent purpose. But as it is impossible to examine the whole

range of comparative anatomy, even on this single point, I must content myself with a few examples among the most familiar and most striking.

If the shoulder and the "arm" bones in the fore-leg of a horse correspond to the same parts in ourselves, though the uses are so different, the cannon bone represents the metacarpus, or the undivided portion of the human hand. Five bones were not wanted here; but two more than the principal one have been retained, while applied to a far other purpose; being the splint bones, and serving to give an additional elastic base to the arm bone. And in the same animal, the coffin bone, representing the last phalanges of the fingers, bears even the lateral marks of those, though, for all its offices, this bone is a single one: marking that determination to adhere to a plan, which will appear throughout the whole of this slender examination. The superfluous side-claws in a hog are examples of the same nature: and thus of much more in quadrupeds, which I cannot here take room to point out. In birds, the persistency in following this plan is even more remarkable: and, as in the last case, it more especially strikes us when we can see that there was no necessity, or, at least, cannot conjecture one. The extreme joint of the wing is a finger, though it is but a base for the quill feathers: while, under a similar persistence in the plan, there are the lateral traces of two more, as if in equal exhaustion of the contrivance with the coffin bone of the horse. And the hook of the bat, for which we should have expected a specific bone, is formed of its thumb, as its wings are by the fingers and arm.

As we proceed down the scale in the vertebrate animals, the determination to persevere in this plan for the fore extremity becomes still more remarkable; since it

continues to go on under continued exhaustion, till it becomes difficult to trace; as, at length, it vanishes. In the whale, an entire hand is lodged in the fore fin: and though we know the use of this instrument in supporting the young, it is difficult to conceive any necessity for this number of bones and joints, for such a purpose, and covered by so solid a mass as to defeat their nicer uses. But the same might perhaps be said of the human foot; the exact resemblance of which to the hand, in the fundamental plan, different as are their uses, I shall immediately point out. In the ordinary fishes, a representative of the shoulder blade remains; yet it bears but a limited resemblance, in use, to that which it served in the quadruped. It does indeed support the pectoral fin, the action of which required such a base; but it is rather the main rib: yet not for the use of lungs, but for the sake of the intestines: while I may here also note, though not strictly in place, that although the ribs are retained in this tribe, they are considerably reduced in importance, and only aid in performing this very different office: while in the serpents they may almost be said to become feet; and in the flying lizards some of them are extended straight, so as to be the base of wings. In the fishes we also find that the principal, or most active fins, are modelled after the legs, or arms, and wings, of the quadrupeds and the birds; while in that extremity here under review, the pectoral fin becomes a wing, as in the *Trigla volitans*; and while further in the *Holocentrus ruber*, the rows of phalanges become as independent as fingers. Such variations as this render the whole progress of the design more uniform: and similarly, in the other extremity, we trace the feet and claws of quadrupeds and birds, in the podal fins of the gurnard: while,

in the genus *Lophius*, still more remarkably, and in the *marmoratus*, *rostratus*, and *pictus* especially, the animals appear as if they were about to pass into frogs.

To return to the fingers in ourselves, we have no advantage, in numbers, or in multiplicity of bones, over the quadrumane animals, or over those in which the fore-feet alone serve the purpose of hands, or even over a dog, whose hand, such as it is, serves for little more use than a foot. Yet, for us, that great end which renders man the mechanic which he is, has been accomplished by a variation so slight, that while it bespeaks the ingenuity of the Great Artist, it equally evinces the determination to persist in a plan once formed. And it is the more remarkable, because, under a plan which extends partially to the fore and the hind extremities in the vertebrate animals, the general design of the hand and the foot is the same, in man and in all the quadrupeds; whether, in the latter, they are used for hands and feet both, or only as feet. If our fingers are especially prolonged, compared with all but the quadrumane animals, this is the least part of the contrivance: the thumb opposes them, while it acts in the same direction, in even the most handy of the quadrupeds; and by this simple and ingenious variation of the general plan, adding to it a power of muscle not found in those, the immense results in question are attained. The reader who desires to see an idle hypothesis founded on this fact, may consult Helvetius: as he will easily answer what I need not.

If I selected the fore extremity in particular, for an example under this instance, I cannot venture to pursue it any further. Even thus far, it suffices for my purpose: but I may yet note some facts of a similar na-

ture in other portions of the anatomy of the same division of animals; yet under less extent and minuteness. They are rather inducements to the reader to pursue the same subject, than aught else; though even thus slender, they will serve to confirm the present views.

The difference, both of form, and of application as motion is concerned, between the leg of a man and the hinder extremity of a quadruped is very great: yet the general plan is the same. If man be conceived the standard, the heel has become the hock joint in the latter, and the toes are the substitute for the foot. The application of the metatarsal bones is entirely different: yet each object is attained as effectually as if the original plan had differed. And even among quadrupeds, where a special purpose is to be served, other variations are made, yet the original plan is never altered. The hare and the kangaroo use the metatarsal bone as a foot and a leg both: the dog and the cat use it thus, much more partially. In the elephant, where extraordinary weight was to be supported, the proportions of the upper bones are changed: and thence the singular effect produced by the hinder knee of this animal.

The great similarity of structure between the human foot and hand is another example where the same plan is adopted as in the quadrupeds; though, in these, with some exceptions in the handy animals, the uses of both sets of extremities are the same. Those cannot well differ more than they do in us; yet by simple variations of position and proportion, still retaining almost the same number of bones and joints, each purpose is effectually answered. Thus also, under the preservation of the same plan for the further portions of both the sets of extremities, the hinder foot becomes a hand, as well

as the fore one, in the quadrumane animals. And the same occurs in birds; as among the predatory ones very remarkably, but most perfectly in the parrots; where the utility of having adopted the same plan for both sets of extremities becomes apparent. And in this extremity, in birds, the parts are varied according to the wants, under the same adherence to the original design; just as we may imagine the human hand to have been varied from the foot: parallelism being changed into opposition, as in the human thumb, or a phalanx being omitted, and so forth. But it is sufficient to have thus noticed this extremity under the present view: as I may refer to what was formerly said respecting the feet of animals.

Still, I must point out the exhaustion of this particular plan in the fishes. In the ordinary ones, there is a bone representing the pelvis in the terrestrial animals, though it performs but the very insignificant office of supporting the ventral fin: a duty as unlike its prevailing one as is easily imagined. But at length it vanishes; while this gradation seems to show that the plan was never to be abandoned as long as it could possibly be maintained. Even in some serpents, the rudiments of the pelvis have been traced, though apparently quite useless to them; for their's is the most simple of all the vertebrate skeletons, having only a spine and ribs. Thus also the rudiments of feet have been found under their skin; being as perfect an exhaustion of a plan as any we observe among these analogical structures. In the cetaceous fishes, there is neither posterior extremity nor substitute for it, in any mode of fin: yet in some of this tribe, there are bones occupying the same place as if those had existed: utterly useless, to our conceptions, and therefore, as in the ob-

scure fingers of the pinion bone of a bird, or the coffin bone of a horse, appearing to be a mere superfluity derived from the principle of persevering in the original plan till it can be followed no longer.

Similar reasonings are derived much more extensively from anatomy, but I can barely afford to point out where a few of them may be sought; as they are easily pursued by any one acquainted with this subject. The spine is an obvious example; the vertebræ varying in shape and distribution, as they regard the different offices served; and while the whole is sometimes flexible in different degrees, so, in other cases, these divisions are so fixed, that we do not see why the plan should not have been altogether abandoned. To our conceptions, that which was never to move, needed not the external marks of a joint: the united vertebræ of a bird might have been one bone. Or the bony shell of the turtle might have served to dispense with immoveable vertebræ and ribs. There is no purpose in the external muscles of the human ear, though they were practised and exerted to the utmost: but they conform to that general plan under which they are useful in quadrupeds. The mammæ of the male animal have been a perpetual stumbling block to naturalists; and a recent answer, well known to anatomists, cannot be the true one: the present is the apparent solution; as it is for the useless presence of the marsupial bones in the male opossum.

The peculiarity of structure in the flat fishes is even a more striking instance, perhaps, than any of the preceding, in illustration of this perseverance: and I cannot omit it, under the present view. This tribe, of which the Sole and Plaice may serve as examples, might have been constructed on the same principles as the Ray;

since their general shapes and modes of life are similar: but they have been modelled from the plan for the perpendicular fishes. The flat fish is a perpendicular one, laid on its side: the dorsal and anal fins continue; but they become lateral, as such fins are, professedly and originally, in the Ray: thus serving a purpose entirely different from that for which this invention was originally intended. And while it was necessary that the eyes should look upwards, the head has been flattened for this purpose, and twisted to the right or the left: when, in the cartilaginous tribe, the head was originally planned as a horizontal one. Thus is there a general aspect of obliquity about these fishes, resulting from this wrenching of a plan originally regular. And the anatomist who chooses to examine the bones of the head more minutely, will find that every bone of a perpendicular fish is there, though distorted, and rendered unequal where they used to correspond, to suit this general distortion of forms: even the two sides of the mouth are dissimilar; while the pectoral fins, and even the abdominal cavity, are sometimes altered for the same reason.

The unexpected nature of the Cetaceous fishes seems also best explained on the same principles: it is the terminal point of a plan commencing in the quadrupeds as land animals, and gradually traced to a perpetual residence in the water, through intermediate stages of construction or variation. The seal forms the first great remove from the pure terrestrial quadrupeds, though I need not now pursue the anatomical differences: while the Manati and the Dugong carry down this exhaustive plan, till it terminates in the Whale; a fish in the more obvious sense, yet breathing air, warm-blooded, giving suck, and retaining hands, such as they are, for uses

similar to those in many of the quadrupeds. For aught that we can see, there might have been whales and porpoises still; yet as fishes in the whole of their anatomical structure. It is true, that there may be reasons which we do not perceive; as there must be designs which we have not yet discovered. But, in the mean time, under so many examples of this principle of exhaustion, we may not prove very wrong in concluding it to be the solution of this, and of many other difficulties in natural history; as I shall more fully note directly.

In the tribe of fishes, it may yet be interesting to notice, if but slightly, the great variety of forms into which the general design for their construction has been modified, while there is seldom any part of the anatomy omitted. This is less perceptible among the quadrupeds, and still less among the birds; while, in the other divisions, it is almost nothing. In many cases we see the purpose of those deviations: as in the downward mouth of the ray, the ploughing snout of the mullet, the exquisite form of the mackerel, and the vermicular shape of the eel. And thus we see why breathing holes or closed gills should be preferred to open ones, when the animal is to inhabit mud or sand, or when it is to pass any time in the air; knowing that the free access of air to gills is deadly. But we discover no great reason for the wings of the flying fishes: not indeed thus proving that there is none, since we do not know the use of the claws in the gurnard; though not doubting that so remarkable a variation as this must have its uses.

But I must quit details which I have not space to pursue any further, to point out some familiar examples of what are termed gradations in the animal kingdom;

or cases of intermixed structure, or of transition, such as that just noticed from the quadruped to the whale. The history of such gradation forms one of the most interesting portions of the organic department of natural science, as it is also one of the most extensive: but it must here suffice to point out what is best known to readers at large. The cultivator of natural history must pursue this subject among the associated orders, genera, and species of his science, and through the difficulties which he finds in drawing an effectual line of separation between proximate ones in either division.

In the Penguin, the gradation is not that of anatomy, but of application; there is no passage towards a fish, though the wings serve no purpose but that of swimming: it is a false instance, though a popular one. In quadrupeds the transition between the sheep, goat, antelope, and deer tribes, is genuine, though among the slightest; as a slender acquaintance with natural history will enable us easily to recollect similar ones. The passage from the walking to the flying quadrupeds is far more remarkable: commencing with the winged squirrel, and ending in the bats, which contest a common place and food with the parrots and the swallows. The *Ornithorynchus* is also an extreme case of this nature. Two very distinct divisions in the vertebrate animals are associated by means of the Serpent and the Eel. Both are without sternum; and though each has ribs, they serve very different purposes in the two. Both are scaly, have extensible jaws, and not very different heads; and though severally allotted to water and land, each can move on, or in both, as they also move in a similar manner. Yet the one has gills and the other lungs: that essential difference, but for which they might

almost have interchanged elements and pursuits. And here, the Proteus serves to form a very unexpected connexion between these tribes and the lizards. The frog, in another division, unites with the fishes, in a very distinct manner; being a fish during one part of its life, and a quadruped reptile during the other; while combining the two distinct plans, in the essential fact of having gills in the first portion of its existence, and lungs in the other; or rather, the former disappearing as soon as the latter are brought into action. But I cannot enter further into this subject: of that which belongs to science, a little will serve my purpose.

It is on facts like these, however, but much more on superficial gradations and resemblances than real ones, that there has been founded an hypothesis, once fashionable in natural history, and still popular, that there was an absolute gradation throughout all animal forms, that this division graduated into the vegetable one, first, and from that, finally, into the mineral kingdom. Not to enter into this useless subject, it is sufficient to say, that the rooted animals were asserted to form the first great transition, and the corals the second: while I have also noted this speculation elsewhere. The difference, at least, between life and death, organization and its absence, is entire. But had such an hypothesis been true, natural history might for ever have sought in vain that system of plans which it is seeking in its natural arrangements: while, though its success is imperfect, it has not been purposeless. Still, I must remark, that although it has now adopted the truer course, it seems to have overrated its hopes from anatomy: since it must perceive, that the same exhaustive or graduating system of plans exists there as in all else.

I might equally have taken up this department of

Creation in many other modes, and thus have traced many natural divisions, or divisions forming plans, of some kind, more or less involved, or consecutive, under different sets of characters; thus pursuing it down to genera and species; as thus also I might have pointed out similar exhaustions and intermixtures or gradations. This mode I have partially chosen in the case of plants; and any one can apply it to the present division. But it is thus, under any mode of investigation and arrangement, that the naturalist is perpetually compelled to abandon divisions and classifications which he knows to be founded on nature, and content himself with imperfect, or partially conventional ones; because the assumed plan is not that which he at first hoped; from the causes which I have here been assigning.

But it is necessary now to take a brief review of what has preceded; partly for the sake of natural history, but more as it concerns the object for which all these statements have been made. I have demonstrated a multiplicity of plans, or of plans entangled within plans; first in a successive order, and next in a collateral, or intermixed one; two or more sets existing in one object, or division of objects: while there is perhaps not one of these, in either of those two directions, that is not carried towards exhaustion, as they are also intermixed, under those exhaustions, or otherwise, in every possible mode. And hence, though each of those plans, in the mind and conduct of the Creator, is perfect, as the entire result is perfect, the confusion becomes so great, that we cannot extricate the parts ourselves, or at least not under our present knowledge of natural history; if we ever shall.

But so wide a view of His proceedings in this case perplexes us: it is better to take a single plan out of

the whole ; as I have already done in sufficient detail for this illustration. That plan is pursued, with a resolution to gain the end through deviations: it is not abandoned till it is exhausted; and then only, a new one is substituted. It is an apparent determination to follow up a first thought, as long as that can be made to serve the intended purposes. And it is the same as to all other plans, in whatever manner successive or entangled: while that conclusion concerns natural history particularly, as the more general ones concern the conduct and character of the Creator.

If already indicated, I may restate these more decidedly here. A designing Artist is proved, and it is proved that there is One Artist, laying down rules for Himself, and carrying those into execution, so as to effect what He intended. All chance is excluded under such circumstances: and wisdom, through resource, is marked by the facility with which the difficulties consequent on such a rule are evaded, or overcome, in so many ways, and with such perfect results.

The suggestions which a philosophical contemplation of nature, under the Great Source of nature, offers to natural history in this case, as to science universally, are little pleasing to those who laboriously inquire into facts, and far less so to the constructors of hypotheses: throwing more than doubt on the toils of the one, and the vain efforts of the others. And I have not therefore intermeddled with those, except when the present higher duty compelled me to it. If such is the conduct of the Creator, whence is natural history to hope for the "natural arrangement" which it seeks, pursuing that in the manner it has done? Unquestion-

ably, He has wrought on a plan : but it has not been on the plan which we have assumed. The cultivators of this science have commenced with their own artificial arrangements ; aware enough indeed, generally, that they were so, yet not always ; and only discovering this when they found themselves defeated. Still they have fancied that His plan must resemble their own, that it could all be defined, and that every portion of it could be equally defined and separated : while still they persevere. This conclusion was not unnatural ; but if their basis is as faulty and unfounded as they will now perhaps perceive it to be, it must be abandoned. Let arrangements for use be still pursued ; and the more they are approximated to those of nature, the more we shall learn : but if what I have thus suggested is the true Theory of the organized creation, it will be long yet before we shall have laid down the Creator's plan, if ever we do ; as, even then, it will scarcely serve the purposes so long and vainly expected from it.

As those general remarks have superseded much of what might have been observed respecting the vegetable kingdom, so is the subject itself much less complicated. But the essential circumstances remain the same. We can trace no entire plan throughout : we find similar successions and complications of plans ; and that which we have at first imagined ourselves to have defined, has passed into some other, or become intermixed with it, or with many others. Botany adopts some system which it imagines to be that of nature, the Creator's own plan ; it adopts inferior plans, and it pursues them all, till they slip from beneath its hands : it begins again, and is again disappointed, yet ever as confident as before, till it is obliged to surrender to invincible

facts. It now believes that it has really made a natural arrangement at last; or rather, that it is not far from having completed such a one: but while it has produced that, which, equally unwieldy and laborious, does not facilitate investigation and nomenclature, it has not made the discovery which the present views should enforce on it. New analogies and resemblances have been discovered, the knowledge of nature in this department is enlarged: but the intricacies and difficulties develop themselves the more as we proceed; and the end will be to perceive, as in the animal kingdom, that the total plan was not that which had been imagined, and that the development of it is still at a hopeless distance.

Notwithstanding this, we can still trace, as in animals, partial plans, or fragments of plans, and in successions of gradual descent, down to individuals: while we can thus follow some principle of order, sufficient to assure us that rules have been established and observed, and thus equally proving the design of One Artist, as excluding all systems of chance. And it is such a partial plan, which, as in the case of animals, will best answer the present purpose; as it suffices for that. In the system last alluded to, too many different and leading principles are united, to allow us to believe that this was the plan on which the Creator proceeded. This is not to work by any rule: and if the principle were not too complicated to be the true one, the endless and ever increasing anomalies would prove the falsity of the assumption, as they also render that system totally unfitted for the present purpose.

I shall therefore take the illustrations here required from the Linnæan system, which to its other advantages adds those of facility and familiarity. It is

not indeed a perfectly natural system, far from it; or, in the language here adopted, it is not the plan from which the Creator wrought even in producing the external forms of plants. But it is very far also from being an artificial one. It contains evident portions of plans, used in regulating the forms of plants, and often also to a very considerable extent: and I can thus perform by means of it all that I have done in the case of animals, and somewhat more.

The stamina form a most important part of a plant; and their number being adopted as one leading plan, has been followed with considerable success, from one to ten, at least; as, in this system, such plan has been rendered the foundation of a class: on which point, however, this project must be considered an artificial one. An equally essential part, the pistil, has similarly been adopted as a subsidiary plan; forming the artificial order. And if, in both cases, the artificial system has been regulated by numbers, as far as was possible, so is there no reason to doubt that this has been a part of the original plan. Beneath the order, the system has adopted divisions: but, whether tied down by an artificial logic, or unable to define these fragments of plans sufficiently, they are now but a sort of aid towards facilitating the nomenclature. And the genus is an attempt to ascertain the real plan of nature in the final proceeding towards individuality: while, if the success is not here universal, it is very considerable, and in many instances perfect. I limit myself here, of course, to one portion of this system: that which is not understood under nature, nor classed to any great purpose by art, is useless towards these views. But whoever will examine the system thus far, cannot doubt that it includes a design; art itself daily acts thus: it is at least a portion of the

entire plan of proceeding; and while considerably inclusive, it has also the merit of great simplicity.

Now, even the two chief plans, as thus conceived to be the original intentions, and under the combination formed by this system, often include a certain portion of other associated plans; if not doing this as widely as a certain botanical ardour might have wished; marking, still more, the pursuit of a plan even further; but which, as usual, we lose sight of very soon, amid the intricacies of that which we cannot yet trace far. This is the case in the grasses, strikingly: where, with three stamina and two pistils, we have a very extensive collection of plants, possessed of many other common and peculiar characters, and thus forming what the more operose system above mentioned terms a natural order: though here the pursuit is again checked by anomalies and exceptions which are too well known to require detail. How this also holds, if partially, in the *Asperifoliæ* under *Pentandria*, and in other cases, I need not here say.

In the genus, the plan becomes more easily traced, because it is more simplified; and in some instances we cannot doubt that we have attained to a knowledge of the Creator's design and mode of proceeding. *Veronica* is a simple and familiar instance; having one of the four segments of the flower smaller than the others: while, being an exception from the universal rule of equality in this part, we can as little avoid admiring the simplicity and precision of the contrivance, as we can doubt the design. If this peculiar case evinces an intention to form families or groups, there are other genera in which that is still more striking; since we are quite sure, that as there was no chance, so could there have been no other or collateral purpose in view. Under any essential alteration in a flower, we might find or imagine

one; but when the peculiarity is so minute, that while it can serve no purpose, it is not even an ornament, and makes no difference in the appearance of the flower, though still as constant as the most important parts, we can only conclude that it was the link of a group, the mark by which a certain family of individuals was to be denoted. If botany can afford abundant instances of this nature, such, very remarkably, is the tooth at the throat of the corolla, in *Lanium*, that on the filament in *Prunella*, the scale on the petal in *Ranunculus*, the cross formed by the anthers in *Glechoma*, the hairy throat of the calyx in *Thymus*; with far more, familiar to the most slender botanist.

This is indeed virtually acknowledged by botany, when it selects such marks to group its families: while also knowing, that when it has made a successful choice, it has often united, even under so apparently trivial a bond of association, plants allied by many other general features and important particulars; and sometimes even in their chemical properties: as is considerably true in *Ranunculus*, *Thymus*, *Mentha*, and others. And where this happens, we can as little doubt a plan, as that this was to be the special designation of what may be called a natural group: that very mark by which the Creator has chosen to denote such families. And we must not complain of the irregularity of Creation, when we have selected injudicious ones: following our own artificial systems in preference to nature. Doubtless, to possess one cotyledon, or two, is a most important fact in the anatomy of a seed: yet nothing but perseverance in a fanciful system can believe it to have formed a leading plan with the Creator, when we find that the former structure exists in plants so utterly separated in every thing else, as the palms and the grasses. This may be

botany ; but it is not nature : yet it is botany only while it is new, and as long as a sonorous term seems to imply knowledge which others have not attained.

Recurring to number, I have already shown that it has been adopted as the foundation of some plan or plans in this department of nature, while it is one of those which should attract us, from its simplicity, and from its conformity to our own proceedings in similar cases. And it is interesting to remark, that plans dependent on mathematics have been equally, but far more extensively adopted in the mineral kingdom ; since the entire plan of crystallization is regulated in this manner : while if the atomic theory of chemistry, as it is termed, is really explicable in this manner also, it would form another example of the same system of proceeding. But this attention to number, as the basis of a plan, is much more widely visible in plants ; though ever, as usual, under exceptions. With five stamina, there are five petals, and five parts, or segments, in the calyx : and if there is a deviation, it is generally that of doubling the number, while a mixture of incongruous numbers is rare. And we see neither utility nor necessity in this : except that we may imagine such when the stamina are fixed on the petals : if on the receptacle, any number was equally admissible. The *Veronica*, for example, might have had three stamina ; not two, as the submultiple of four petals or divisions. But any botanist can pursue this investigation further than I need, or dare : and if he will study his subject under this high reference, he may be assured that it will add deeply to his interest in his science, though it should produce no better effect.

But I willingly point out further examples of designs, or rules of proceeding in this department : it is much

more accessible than the animal world ; and facts that can be seen are more impressive than those which are related. Thus to show how this science may be contemplated, ought also to lead to thinking, in that which is too generally pursued as a mere system of nomenclature. In the Tetradymania, a very simple modification under the number six, separates an entirely distinct group of plants ; while the families are distinguished by some of those delicate modifications which almost evade us, so as even yet to be sources of much doubt. And here the greater plan is not without a collateral purpose, or meaning ; since it unites many plants, of qualities so analogous, as to extend to that peculiar chemical distinction, the large comparative proportion of azote, on which their well-known properties, including pungency, seem to depend.

The Didynamia, already partially noticed, present another pursuit of a similar nature. The original plan is singular and unexpected : it is one of those inventions which strike us by their departure from more obvious rules and forms ; while to vary it, as it has been, would require, for us, no small efforts of contrivance. If I have already pointed out some of these, while I might easily add many more, such as *Ecremocarpus*, *Acanthus*, *Antirrhinum*, distinguished for peculiarity of contrivance, it seems also rather a casualty than a design, that a trifling segment should be turned back, instead of remaining straight, as is more usual : in a rose it is an accident, or at least it means nothing. But in the flowers in question, wherever it occurs, it is a law not to be departed from : it is the family stamp and character. Supposing, again, that we, undertaking to distinguish their families, had exhausted every other contrivance under such modifications as I have described,

should we have found out a fresh expedient for distinguishing a family? I know not: but He who planned this system attains it by reversing the flower, as in *Scrophularia*: thus also departing from the original principle and purpose, if that was, as it seems to us, the protection of the stamina.

In the *Diadelphia*, or rather in the truly papilionaceous flowers, there is a distinct and peculiar plan; while the final cause at least, as in the former, seems to have been the protection of the stamina from injury, and, as is usual, from wind and rain. The scheme is even more peculiar and complicated than in the *Didynamia*, while the modes of deviation are much more limited. Yet by means of extreme niceties in some minuter parts, effectual distinctions for families are produced; as in *Vicia*, *Lathyrus*, *Orobus*, and in another manner, in *Ornithopus*, *Astragalus*, *Medicago*, and others.

The compound flowers, belonging to the partially natural *Syngenesia*, introduce us to another distinct plan, in which the first subsidiary ones are peculiarly remarkable; while the schemes for distinguishing families are so delicate, that botanists are for ever wavering, and are not yet agreed. If number is here constant as to certain important parts, it is no longer the universal guiding rule. If all the secondary divisions, or orders, were the same in essence as one of them is, we should say that the plan of composition, or the crowding of many small flowers into one, or into a common calyx, was a necessity: but the order called *Polygamia æqualis* removes that necessity, as the *superflua* seems to be a pursuit of the same plan, to even less purpose. But abandoning all views of purpose, or of utility at least, we see that it is one among these ever puzzling plans, and that it has been systematically followed.

Unless the reason be that moral one which more persons will dispute than admit, we cannot discover the intention of a contrivance, which in a physical sense comprises two plans, though, in the other view, they would be two modes of one. I allude to the Monœcia and the Diœcia. If the residence of two sorts of flowers on one plant was necessary, as in the first case, that necessity is the consequence of a previous contrivance opposing the predominant one. In the latter case, the plan, whatever the purpose be, is extended, or completed : while expedients, of a necessarily casual nature, are adopted, or rather trusted to, that the indispensable end may be attained. I shall leave it to those who are not afraid of being accused of fanatical conclusions, whether the object, here, was not to teach us what we might never otherwise have discovered, or even conjectured, respecting a most important circumstance in this department of natural science.

But I must dismiss this department also ; though I have but touched the surface of a wide field of investigation, and not a difficult one. My present purpose is answered by even this ; but the cultivator of botany, if he is wise, will pursue it much further, and the road is now open before him. Whatever I had attempted to prove before, in the remarks on the animal kingdom, is now sufficiently proved again, in a somewhat different manner : and what that is, I need not repeat.

The proceeding which I have thus far adopted in tracing the design of the Creator, under specific plans subsidiary to more general ones, has professedly related to forms, or to construction ; to that which is usually termed Natural History, but which constitutes the technical department of that branch of science, or, as it

might justly be called, the mechanical part. But, where there is nothing without a purpose, I have unavoidably touched on those where it was occasionally necessary to vindicate the reality of a plan, by showing that there were uses designed by it. This is the argument from final causes: rendered unfashionable by certain metaphysicians, as I shall hereafter have occasion to point out more fully; and, if not from that prejudice, too much neglected by naturalists, to their own great inconvenience, even in their physical pursuits, and with much more serious ones in another view: while perhaps chiefly neglected, because the investigation involves inquiries very remote from their usual mechanical pursuits, with those habits of moral reasoning which they have, unfortunately for knowledge and themselves, too much neglected. But to pursue the subject already indicated, under such views as this, would be to enter on a field so immense, while it would also involve much repetition, of what I have adduced for other purposes, that I can only select a few examples, rather as a guide to others, pointing out the mode of inquiry, than as even sketches on this subject: while in those also I shall confine myself to the simple department of botany. Under these hints, any one can follow the same mode of investigation respecting designs, into the animal kingdom; and thus deduce for himself plans which I have here no room to pursue. Botanists have often noticed certain contrivances for protecting the stamina of flowers; and adding to these some others, intended to insure the desired consequences in the fertility of the seed, the whole may be viewed as constituting one of the plans in question. The anthera was, in the first place, to be protected from rain and wind, lest its pollen should be lost; and the means adopted are varied in

such a manner, that the peculiar forms of the flowers seem directed to this sole end. There is no mechanical general plan therefore : it is a collection of different contrivances, bearing on one object : while they seem thus varied, as if to show in how many ways that could be attained.

In the *Didynamia*, this is done by the upper lip of the flower, under different shapes, or by concealing the anthers within the tube ; while the *Orchideæ* protect theirs in a similar manner, but often with increased security. The simple method, by means of a tube, is however the most common, as in the primrose for example ; while this plan may be considered to pervade the compound flowers, yet with the additional security of uniting the anthers round the pistil, in one division at least of those. In the papilionaceous flowers, the securities are multiplied beyond all apparent need or use ; since there are three distinct contrivances bearing on the same object. The stamina surround the pistil in contact, with an equivalent effect to that which they have in the *Syngenesia* ; and again, the whole are generally so inclosed by the keel and wings, that no injury can reach them. But, beyond all this, the erect breadth and partial bending in the middle of the vexillum render it a perfect wind vane, so that not even the wind can reach what seemed already sufficiently protected.

Under so little of apparent design and peculiar mechanism that the intention is commonly overlooked, methods of so evading the wind as to shelter the anthers from it occur in an immense number of flowers, and under different contrivances. The conoidal shapes of corollas are among those ; and the protection is often very perfect, when the flexibility of the footstalk is added. And that flexibility alone answers the purpose,

in flowers where the corolla gives no peculiar protection; as in a veronica or a rose. And if the anthers seem unusually exposed in the grasses, the great length and flexibility of the filaments not only enable them to evade the wind, but to reach many pistils in one spike, and often in one panicle. In cases where protection from more than wind was required, and where no contrivance of this nature would have succeeded, the essential parts of the flower are completely encased; as in those plants which blossom under water. But to pass from constructions to which more might easily be added, I may lastly note the very wide protection which is afforded by the sensibilities of plants as to rain, and the power of closing the corolla: while it is probable that the same purpose is served by their nocturnal sleep; whatever else may here be intended.

If the meeting of the pollen and the stigma is the ultimate end of all this contrivance, many direct means are resorted to for this purpose, in addition to this previous protection. The accuracy of adaptation in most of the didynamia, diadelphica, monodelphica, and syngenesia, is among the most simple. In many, as in the tetradynamia, and the didynamia universally, and in the primrose and many more very widely, some of the stamina are long, and others short; that whether the flower should droop or remain erect, there should be some anthers uppermost. In the permanently hanging or permanently erect, the lengths of the stamina are often regulated in the same manner: as, in other flowers, we sometimes find incurvated stamina, apparently bent for the same purpose.

The execution of this general plan is far more remarkable, when we find a contrivance so special that we cannot misapprehend its meaning. I already sug-

gested a peculiar moral inference which might be drawn from the monœcious and dicecious plants ; but the facts of analogous bearing are not thus limited. And, not to repeat that inference, I cannot see anything unreasonable, or inconsistent with the Creator's general conduct, in supposing that while He has given us the powers necessary for investigating His works, He has also afforded us clues for discovering such parts of them as those powers could not have reached ; just as He has communicated specific portions of knowledge to certain animals. If any one shall object to such a system of revelation as this, it must be recollected that the geometrical knowledge of the bee is an absolute revelation of the same nature : and if His purpose was, that we should know Him, as we cannot doubt, and if a knowledge of His physical creation is one of the means which He has appointed for this end, we have no reason to question one mode of communication more than another, when it was His intention that the object should be attained. He at least who believes that God has openly revealed His character and His will where He had not communicated the powers necessary for discovering those, can scarcely find good reasons for objecting to such a view as this ; while I have noted further facts leading to the same conclusion, in other parts of this work. And if therefore I may be allowed to consider this as a peculiar plan, the means being also much varied, it becomes a very remarkable one, from its moral bearing.

The special contrivances in question are familiar in the *Kalmia* and the *Barberry*, under two modifications ; the former consisting of a spring and a detent, the latter being muscular power under irritation. I need not quote analogous instances : and if the floating flower

of *Valisneria* has often been produced as an example of these peculiar contrivances, so may I point out the arrangement of the essential parts in *Acanthus*. In the grasses, the contrivance for the same purpose is so simple that it is easily overlooked; though in the case of wheat it is well known to cultivators. Where more flowers than one, as in the latter most striking case, arise from a point of the spike, the time of flowering for each is different; so that there is a provision in reserve, in case of accidents from stormy weather.

The contrivance for the same purpose in the monœcious and dioœcious plants, but as to the latter most essentially, is even more remarkable, from its utterly independent or foreign nature. Insects are here the great agents: but it is now superfluous to enlarge on what has at last become as admitted as it is familiar. And if that be also true, which has been asserted, and not, I believe, disproved, that the bee tribe, which are the great commissioners in this duty, always adhere to one plant at a time, in collecting pollen, whether from those flowers or others, we cannot but admire the commanded instinct through which it is arranged that irregular mixtures shall not take place.

I have elsewhere described, for another purpose, many of the contrivances resorted to for the dispersion of seeds; so that I need only desire the reader to contemplate those under the same light, as forming a complicated plan for obtaining a peculiar end; as that end is also the accomplishment of an ultimate purpose, to which the plan already detailed is subservient. And thus also, since I need not further pursue this subject, it will appear that the total plan for this great object is a complex one, or includes many subordinate plans: since I might have added to these, the schemes for the

hybernation of buds, and the protection of seeds ; subjects which, well known as they are, I gladly leave to the reader's own contemplation.

If the following subject, like almost every other one in Creation, might have been contemplated under many different lights, I know not where it could better have taken its place. There was one general purpose to be served, and it is effected by a multiplicity of contrivances. It is indeed, in no sense, a classification under natural history ; but it is still a plan, inasmuch as there was a single definite intention on the part of the Creator, which is accomplished by various means. Such plans as this may be termed moral ones : while an example of this nature will be useful, in leading the student to links of association that he may not yet have observed, and thus to examine and reflect on what he may have overlooked. Under the more views, the more generalities and the more purposes, the objects around him are presented to his mind, the more will his interest be increased, and his reflecting powers exercised : while the moral results can scarcely fail to be valuable.

For whatever reasons, many of which, if not all, we can trace, there are plants which cannot support or erect themselves by their simple strength, as others do : and the contrivances for supporting these constitute the plan in question. The simplest support is attained through mere entanglement : it is scarcely a contrivance. But I may point out the claws or radicles in the Ivies, and the union of those with volubility in the parasitic *Cuscuta* ; as the same end is also widely effected through the mere volubility of stems. That of tendrils is a more special contrivance : but, without any distinct organ for this purpose, the effect of a tendril is attained through a peculiar sensitive power, with

consequent action, in such leaf stems as those of *Fumaria* and *Lophospermum*. The long strings of the tropical climbers, being a species of radicle, are distinct contrivances for attaining the same end. The adhesive hooks of *Galium aparine* form another : and whatever other purposes the hooked prickles of the feeble roses and the brambles may effect, they perform the same service to those plants. But of all these peculiar inventions, the most remarkable is that which occurs in a tree of the Indian archipelago ; of which Mr. Crawford has not given the name or characters. Growing on a shallow soil above impenetrable rocks, the base of the trunk produces buttresses, which, by resting on the surface, support it against the violence of the winds : as a similar expedient is occasionally resorted to by some of the Palms.

In other cases, without any superfluous organ for that purpose, the object is attained by peculiarities or variations in the general structure. The hollowness of the stem is here the leading principle, as in the quills of birds ; increasing the strength under equal quantities of matter, through familiar mechanical principles. In the umbelliferous plants, it is as well known as in the grasses ; but it extends far more widely. And in both of these tribes, to guard against the effects of great length, joints are interposed for increasing the strength ; the middle of the intermediate cylinder is also often enlarged for the same purpose. In some other cases, the hollow stems are strengthened by projecting ridges on two or more angles, as in *Scrophularia* for example ; or by pith, or by diaphragms, as in certain rushes. In the flower stem of the onion the mode of enlargement is particularly striking : not only from the mathematical principle adopted, but from that peculiar

part of it where the bases of the two cones meet, so as to afford the greatest strength : while mechanics have adopted the same principle, unaware that they were copying nature, in the doubly conical and hollow beams of scales. And lastly, in the grasses, as the stems diminish into peduncles, an extraordinary gift of elasticity becomes the source of support and strength both.

In terminating on this subject, I will point out that which bears the marks of a plan, because it includes a considerable number of similar, often identical, contrivances, yet under more than one apparent purpose, or under purposes which we do not discover. And I choose to end with it, as an inducement to the student of nature to pursue these inquiries into plans and uses, since it is one example of many, equally obscure, by which we are surrounded.

The subject in question relates to the defences of plants ; comprising, chiefly, prickles of various kinds, with other superfluities of a more minute nature. That defence, for some object, is the end in view, is proved by the sago palm, which, when young, is covered with such prickles, to protect it from the wild hog and other animals, while they drop off when the enlarging plant ceases to be a tempting food. In the hawthorn, the thistles, and many more, the object of this defence seems to be to preserve the fruit and seeds for birds, and, in the former, as a winter store ; while this inference seems especially justified by the holly, where the prickles on the leaves disappear as it grows out of the reach of the larger animals ; as the fruit also is most abundant on the inoffensive branches. The pine-apple seems to be defended for man in a similar manner : and if the tribe of cactus is singularly protected in this way, it is, possibly, because its succulent nature might have

otherwise led to its extermination: while, whatever uses these plants may serve, such an event as this, we are sure, could not have been permitted. But if there are cases, such as the rose, where we can discover no purpose, unless it be, again, that of protecting these flowers for us, though I have elsewhere suggested a less acceptable one, I must leave this, and more, to the ingenuity of others. Such is the case of the nettle, where defence seems purposeless, and the power of offence is very great. That down serves as a protection from cold, we are sure; because the plants thus furnished, increase, or throw it off, as the temperatures change; as others acquire what, if not non-existent, was scarcely to be traced. It is a parallel case to that of animals in the same circumstances. The uses of ordinary hairs have appeared a source of difficulty; but they seem, like the polish of leaves, to be aids in preventing that adhesion of water which might be injurious; whatever other unknown purposes they may serve.

DIVISION II.

OF THE

KNOWLEDGE OF THE DEITY,

&c. &c.

CHAPTER XIII.

ON THE KNOWLEDGE OF THE DEITY. OMNISCIENCE.
OMNIPRESENCE.

CONFORMABLY to the plan formerly stated, the Knowledge which belongs to the Deity is among the attributes to be considered in this work. But while the necessary existence of this in Him can be deduced from every page of this book, it is not a quality, from its very nature, admitting of that kind of physical proof which has here been applied in other cases. All that can be done, on that ground, is to illustrate its nature and to infer its probable extent, from those general views of physical knowledge which I shall place under this division. Whatever else the subject requires and admits, must be sought in the *à priori* and metaphysical arguments.

Perfect knowledge, or Omniscience, must be a necessary part of a perfect Being. The proposition is so nearly identical, as to be little better than nugatory: nor is it easy indeed to see what more is performed by metaphysics, in every other case, under the same mode of argument. This is too often, I fear, the best which the *à priori* reasoning can effect on the subject of the Divine attributes: though it is not always perceived, because the customary encumbrance of words prevents the identity of the proposition from being detected. I think it but just to the reader to state this fairly, and at the very outset of these metaphysical chapters: since

the usual expansions of this form of argument will not then confound or mislead him, as is too common. It is a mode of argument which may sometimes be of use; but it should not be allowed to deceive any one: while it will be a profitable exercise for the reader, to extract from the wordiness of writers on these subjects the very simple results of which I have thus given him an example. He will scarcely believe, at first, that even writers as condensed as Clarke are amenable to this further analysis and condensation.

Admitting, now, some other attributes which will hereafter be stated and proved, it follows that Omniscience is a "necessity" in the Deity, because Omnipresence without it would be a contradiction. A Being with senses, or, in His case, with perception, who is everywhere, must perceive, and therefore know, every thing. Nor could wisdom exist without knowledge; perfect wisdom without perfect knowledge. This attribute is equally necessary to a government: and for a perfect government, or a providence, such as is that of the Deity, knowledge must be perfect, or absolute. Further, all the knowledge which created beings possess, or can acquire, must be given by the Deity, or else the means of acquiring it must be given. He therefore either gives what He knows, or in giving the means of acquisition, He knows all that can be acquired: which is to possess absolute knowledge.

Again, under another mode of argument, we admit that we know, to the extent of the capacity of our senses, or to that of our power of observing, and of remembering, comparing, and concluding. And, by those powers, we attain to know something, or much. But in all this, the Deity is perfect; and thence He knows every thing which can be a subject of knowledge. As an ex-

ample under the fact of observation, our sense of sight is dependent on the impulse of light, as, without it, we have no perception of distant objects ; even then, seeing but surfaces. But a Being who is all perception, requires no external senses ; and therefore the interior of a solid is seen by the Deity, or known to Him, as the surface is to us : as is equally true of concealed structures and actions. And universal perception is universal knowledge, within certain limits ; while it is perfected by the absolute possession of those powers of memory and comparison which we are compelled to admit. The knowledge of the Deity, distinguishing, here, knowledge from wisdom, must therefore be universal, in every sense : extending to the entire universe, and to every thing which it includes.

The illustration thus used might seem to limit this knowledge to physical nature : but it must be the same for the moral world. Confessedly, the Creator appointed the moral powers, or the moral existences, as He did the physical world. The latter is also a subsidiary to the other : and He cannot therefore know of the basis, without knowing also His own designed superstructure. Or, should these be judged independent, He cannot be ignorant of any thing which is of His own appointment ; while there can be nothing which is not such, unless there were effects without causes. Or, in this case, to recur to an illustration from man, we trace, within the compass of our discernment, the moral movements of men ; their motives and actions. Universal discernment must trace all. But motives consist in feelings, thoughts, reflections, conclusions : while these again depend on certain moral constitutions, partly formed by education, and partly original, or created. These are the mind of man : and a knowledge of them

is the knowledge of his mind. If that mind, or any portion of it, was created, or given by the Deity, it must necessarily be known to Him: if, on the contrary, it was formed by education, or the influence of external actions, it is already admitted that He knows those actions, whence He must equally know the result, through that perfect reason, or wisdom, which will hereafter be shown to be an indispensable part of Himself.

Hence arises a moral conclusion far too important to be omitted, on account of its practical value: while this inference, deducible, surely, by metaphysics, whether independently so deduced by us or not, coincides with that which Revelation teaches us respecting Him: a matter of no small importance as it concerns certain Theists. God is informed of all that man wishes or desires, as well as of what he does; or, He knows the heart of man.

There is another argument for the perfect knowledge, or Omniscience of the Deity, which I may also state: little as any arguments for proof can be required. But different views of proof are often useful, in some other manner than from their mere value as such. He governs the moral world as He does the physical: and we believe that He is just, under the usual *à priori* inference. But if He could not even govern, as I have already said, far less could He govern justly, without an absolute knowledge of every thing: even of every thought and motive, as well as action. The inference which follows would be much stronger, if we could prove, from Natural Religion, as has been, and may be, disputed, that He rewards and punishes in a future life. If He were not morally omniscient, He could not judge the world in equity, in "righteousness." The argument is perfect, for those at least who believe in the Christian revelation.

This is a sufficient expansion of the argument for the Omniscience of the Deity, as far as the present is concerned. As to the past, there is still the same *à priori* argument, reducible to a similar identical proposition. The memory of a perfect Being must be perfect; or He who sees all existences and actions at one glance, must equally see the stores of His own mind. And, repeating a former argument for a new purpose, He who made that which is, or produces, memory, in man, could not be without the same power: or, enabling man to review his limited stores, He must also be able to review His own, which comprise, of necessity, all knowledge of the past, because He knew all when it was present. It seems superfluous to add, after the metaphysicians, that He who could forget one thing, would be imperfect, and might forget all, or lose his memory: which would be an “absurd” conclusion as to the Deity. The inference follows, that He is omniscient in the past as He is in the present.

All these reasonings and inferences appear so simple and conclusive, when thus presented, that they may seem trifling, or superfluous. Yet that judgment would be wrong: it is the simple mode of stating them which gives them this aspect, as happens in innumerable other cases of human knowledge and reasoning: and it is very certain that they are not often thus stated. It is much more easy, and far more common, to involve them in an obscurity and extent of phraseology which gives them the fictitious aspect of profound knowledge.

An Omniscience as to the future is much more difficult for us to conceive, because of our own limited powers respecting this. We rather conjecture than know. We see what the past has been; and thence supposing a similarity or continuity of circumstances, infer a similar set of events, or a future. Thus, in physics, we foretell

correctly whenever our knowledge is perfect. In morals, less correctly; because our essential knowledge is deficient, and we cannot compute the disturbing forces. But if, in physics, we do this truly, when we know, He who knows all must do it truly for every thing. He must know what the circumstances will be, because they are in His own intention or knowledge; while it is in this that we are deficient. And He infers the events, as we do; but perfectly, in proportion to the perfection of His reason; and therefore absolutely, as well as universally. Whence, in this department of Creation, He is Omniscient in the future.

In morals, though the general train of reasoning is the same, there starts up a great difficulty, arising from the free-will of man. But, postponing that question at present, we may reason in this manner. We know, in certain cases, what man thinks and feels, and what he will do: and thus far we are scient in the moral future; or can foretell human actions, exactly according to the extent and accuracy with which we have appreciated the moral facts. It is true that such knowledge may be limited to one event and to a short future: but this is only because our knowledge of the moral facts is similarly limited. We admit that He knows all existing moral conditions and influences; and therefore He must know the moral future, like the present, as to all created beings.

But there is a further question remaining on this subject; and it is, whether the Deity knows all that will happen in the moral as well as in the physical world, and as to beings yet uncreated, for ever. It is thus answered by metaphysicians. If time is, to Him, as nothing, or that He comprehends all time, or rather, Eternity, in His very essence, not because He makes

the future present, as the schoolmen have said, but because He views the whole of His plan at once, and with all its results, then is the moral world comprised within this knowledge, as well as the physical one; together with the events of both, equally. Such plan is also presumed to be universal; because we perceive a plan wherever we can trace the facts of creation, and because He is not to be conceived but as working from His preconceived intentions. Or, if all that exists was preconceived, and remained only to be willed, it must be the same in every thing that is to happen for ever. Or otherwise, all future moral events, like all else, are actually in existence in God; and therefore known to Him.

The same conclusion is derived from a contemplation of His character, by the same species of reasoning as before. A perfect Being is immutable as well as omniscient. Not to know what He intended, would be ignorance; and not to do it would be mutability; which also would be caprice, because there is no superior power to influence His conduct. Or else, this would lead to the inference that He was a being susceptible of improvement; which if He had been, we might, by continual exhaustion backwards, deduce His ignorance.

This is a sufficient view of those arguments; but I may remark in addition, that because we cannot calculate on moral actions and events as we do on physical ones, we acquire the habit of viewing them as contingent, or casual, or as produced without causes. But to Him who created the mind, moral conduct is the produce of a machinery, known to Him in its actions as perfectly as is the physical machinery of the universe. And thus also for ever, under the same reasoning as before.

The moral omniscience of the Deity through all the

future is, however, that question which, as I have just suggested, becomes especially difficult when viewed in union with the free-will of man. And I cannot here avoid noticing a subject which, having occupied volumes, unproductive of conviction, on either side, to the opposing partisans of free-will and of necessity, cannot but be an obscure one; though it would be equally impracticable and uncalled for, to discuss it in this place. Yet, stated in the most brief manner, the dispute is this. If God foreknows every action, says the advocate for necessity, it must occur; and therefore man has not the power to act otherwise, or is without free-will. And the answer is this. Admitting that the action which He foreknows will occur, that foreknowledge does not influence man's choice, any more than our own knowledge of our own intentions, or of some specific act which an individual was about to perform, would affect that freedom. Or, in the words of St. Austin, "*Deus præscientiâ suâ non cogit faciendâ quæ futura sunt.*" And the same argument of necessitarianism would equally deprive the Deity of His free-will: since He foreknows what He will do.

In other words, the foreknowledge of the Deity is not the cause of an event. These will happen, through causes which are foreknown by Him; and whatever the nature of those causes may be, it makes no difference as to that foreknowledge. Hence, though human actions are foreknown, because their causes are, there may still be that perfect freedom of the will, of which we are all conscious, or in which we are instinctively compelled to believe, even while we argue against it. God foresees the conduct of man's free-will; that is all. If compulsory action has been maintained, on the doctrine of motives, it ought to have been shown that an act of pure,

or independent, or capricious volition, could not rank among those : which not being excluded, the argument becomes of no value.

The moral argument in favour of free-will, I need scarcely add, is this. Without it man is not a responsible being, and can therefore be no object of Divine justice. And thence we can form no conceptions of a religion separate from the free-will of mankind. It is not my business to extend these remarks to that system of predestination with which the doctrine of necessity is connected. Suffice it, that in as far as this pernicious doctrine is now argued from a presumed authority in Revelation, it rests on the palpable misrepresentation of some brief statements sufficiently plain, while it is contradicted by the entire mass of that authority.

The quality of the knowledge, or Omniscience, of the Deity must already have appeared. Being universal, for place and time, it is also not successive as to objects and events, but simultaneous. Every thing in the universe is known to Him at every instant. In ourselves, succession is a necessary consequence of the mode in which we must acquire knowledge, through senses limited by time and place. The Deity has no such limits.

I have already suggested that no physical proofs of the Omniscience of the Deity can be produced : so that, had I here limited myself to proofs alone of His attributes, there could have been no chapter under this division ; as there can be no *à posteriori* proof of His universal knowledge. But the plan of this work has not been thus narrowed : and the extent and nature of this knowledge can therefore be illustrated, or rendered impressive, through certain views of Creation ; as has been here attempted on other subjects. A mere term makes no impression, and excites no feeling : the *à priori*

argument may convince us of God's omniscience : but this cold conviction is of little value, and less interest. Hence I have appended two chapters to this division ; that the reader's thoughts may be more decidedly turned to the nature of this attribute, and the more firmly fixed on a subject of not less moral than philosophical importance.

But the connexion between the Omniscience and the Omnipresence of the Deity is so intimate, that I need not disjoin them : the more especially, as the only illustrations that could have been applied to the latter, apply equally to the former. A percipient Being, present everywhere, is, as I have already remarked, necessarily all-knowing. Nor were any separate illustrations required, under this attribute. The essential question, as omnipresence is concerned, is a question of space : and it becomes therefore sufficient to refer to those chapters, under the attribute of Power, where the magnitude of the universe is inferred through numbers and spaces.

Commencing with the usual *à priori* argument, the universal presence of the Deity is as necessary as His eternity. If he could be absent any where, this would be imperfection in a perfect Being. It is but the identical proposition, once more. And the usual " many words " of metaphysics carry us no further, when they expand this, far more fully and circuitously than in the following manner. If He were absent anywhere, He would be non-existent there, at some moment of time : and He who exists in all time, cannot be non-existent in any portion of it. Again, His existence being necessary, it is necessarily an existence in place, and further, in every place. Or, once more, because His power acts every where, He must be everywhere. I need not repeat more of this argumentation ; of which, even

the acuteness of Clarke seems scarcely to perceive that it is but re-stating the same proposition in new forms : not an unnatural consequence of ardour in enforcing truth. Nor need I encumber a page with the far more idle phraseology of the schoolmen respecting the relations of the Deity to space. If any one can find an interest in the expression that “ His centre is everywhere and His circumference nowhere,” it is right that he should be pleased : but that is enough of this language for my purpose. And if there are persons who admire the often quoted passage of Newton respecting time and space as related to the Deity, I am also as willing to admire it as any thing else which I do not profess to understand. “ *Æternus est, et infinitus, omnipotens et omnisciens : id est, durat ab æterno in æternum, et adest ab infinito in infinitum. Non est æternitas, sed æternus et infinitus ; non est duratio et spatium, sed durat et adest. Durat et adest semper ubique ; et, existendo semper et ubique, durationem et spatium constituit.*” To say, after Clarke, that He must be omnipresent with all His attributes, seems a pure superfluity.

Having just said that no separate chapters were required for the physical illustration of this attribute, I may here briefly point out the manner in which some of those which were necessary for other purposes bear on it.

The question of Omnipresence, in its absolute sense, is involved in that of unbounded space ; of an infinitude of extent in the universe. This is the business of metaphysics. In a more intelligible, and therefore a more limited view, it is, for the Deity to be present wherever any created thing can be proved to exist : and in this sense alone, therefore, can it be illustrated. The method of illustration consequently is, to show the actual extent of creation, as far as that can be done :

when the inference of the similarly great extent of the presence of God, or of what has been termed His "immensity," follows.

This illustration may therefore be sought in the chapter of the celestial mechanism, as it also may in those which relate to the multitude of animated beings. It would be mere repetition to state the facts here, in another form, for the present purpose: but a general idea of the mode of viewing those subjects with a reference to this question may be of use.

Mathematics infer that the planetary system was arranged, or created and put into motion, at once: because a permanently balanced system of bodies and motions must have been thus balanced from the commencement. Its diameter is 3,600,000,000 of miles, taking Uranus as the limit, and it contains thirty spheres; while if we add the comets it includes more than ten times that number, within a space so much larger, that astronomy does not conjecture what that may be. He who arranged all this, must therefore have been present, at one instant, over all this enormous space, because His power, or action, was exerted over every body in it, at once: or, metaphorically speaking, His hand then created all those bodies and launched them in their orbits. And this, even in a metaphysical sense, is Omnipresence: because it is the act, not less than the power, of being in many places at one moment; while He who can be in many places, may equally be in all. And if he may be in all the universe at once, so must He be in every part of it wherever His power is exerted: whence by extending our views to the remotest ascertained stars, or *nebulæ*, we not only acquire a tangible conception of the magnitude of the Divine presence, but produce a physical proof of it.

The presumption, if it be not proof, that the force of gravitation is the immediate act of the Deity, leads to the same conclusion. This is acting throughout the universe, at every instant, in every place where a star can be proved to exist: and thus He is, equally, at all times present at every point of the universe. But under any view of the cause of gravity, it must be the same. Should it be the produce of some prior secondary power, His energy or action must still be present, in the same manner, at whatever distant interval from the effect we may choose to assume. And the same reasoning may be applied to the chemical power in the universe; which exists everywhere, and is ever in action.

In a future chapter, I have proved that the imparting of lives to new creatures is an immediate act of the Deity; and for the purpose of establishing His perpetual personal government, or providence. But the same fact is equally applicable to the illustration of the present attribute. He communicates lives, in uncountable myriads, at every instant of time, throughout all the inconceivable universe: and thence He is present at all instants, in every point of that wide space where an animal can be inferred to exist. This is a view which will perhaps convey a notion of His universality of action and presence, even more accurate, and more closely brought before us, than the former ones: while it also impresses the feeling of that wide presence, under divisibility, as the others did under extent. And under those two views therefore, physics prove, as well at least as they can prove any other of His attributes, that the Deity fills all known space, at every atom of all such space, at every instant: which is as perfect a notion of Omnipresence as can be conveyed.

It remains to draw some moral and practical conclu-

sions from the Omniscience and Omnipresence of God ; and this has been done in the following manner. Having proved that He is morally acquainted with every thing, in the thoughts of men as well as their actions, it is our business to make this conviction ever present and ever active: since this must lead us to a true practical piety as to Him, and an unvarying and equally practical virtue as to men. In this is implied worship, or reverence ; with the fear of displeasing Him, which is the proper “fear of God,” together with the love of obeying Him, which is the proper “love of God.” And it also forms the basis of that dependence, which is our “trust” in Him who thus knows what we want and deserve ; rendered perfect by the conviction of His rectitude, power, and goodness.

But as I consider that the chief importance of a work of this nature is derived from its tendency to produce the constant sense of God’s presence and observation, and as the present book was written far more with a view to this very end than any other, I must be allowed to state this in somewhat more detail.

Independently of religion, there are two great restraints to misconduct in men. The first is human penalty, or punishment. The other is the disapprobation of mankind ; and its operation is on our happiness, because without some portion of their regard we must be miserable. Now if this last motive could be rendered sufficiently efficacious, the other class of restraints would become unnecessary. And, as far as concerns the present view, the way to render it such would be, to convince man that the eyes of all mankind were on him, and that he could perform no evil action without its being immediately known to every one : while the effect would be perfect, if, to use a well-known

supposition, he had a window in his breast, so that even his thoughts should also be exposed to all men.

Now this, Religion, not less than the preceding reasonings, assures us to be the fact between ourselves and God. I have here deduced it, through natural religion, independently of revelation, as a purely philosophical fact: and it is one instance of many, which shows how natural religion may, or ought, usefully to influence those who refuse the testimonies of revelation. All our thoughts, as well as our actions, are ever open to His immediate and constant knowledge, or we are perpetually under the eye of an observer: that Observer also being one whose observation concerns us most, or absolutely; since He possesses that power to punish and reward, which even natural religion teaches us to believe; as revelation assures us that it will be exerted, should the power of inferring an ultimate state of retribution be refused to the former.

But if the efficacy of this check, which, to a reasonable being, ought to be absolute, is feeble as it is acknowledged to be, one great cause is, the distance or remoteness of the expected reward or punishment, rather than any doubt or uncertainty respecting it. And that must be the most common cause; since this want of efficacy exists, even as to those who entertain no doubts of a future judgment. But there is another cause, and which, numerically considered, is perhaps the most influential; while it is this one which especially concerns the present inquiry. That cause is, neglect, or forgetfulness; not with respect to the existence, but to the perpetual presence and knowledge of the great Observer, or to His actual observation.

It is especially important, therefore, that this conviction should be impressed on the minds of men at every

instant, and that it should be attempted, consequently, by every means in our power. The sense of the unintermitting, incessant, universal observation of the Supreme Being, is therefore the great point to be secured, as a basis of practical religion, or virtue : and thence the superior practical importance of the two attributes under consideration, as being the guides of man's life. The wisdom of God will inspire reverence and admiration, as His power will produce fear or instil hope : and His goodness becomes the source of gratitude and love. But these, alone, tend but circuitously to that rule of living which we derive, directly and immediately, from the sense of His perpetual presence and universal knowledge. And the living conviction of these attributes serves also to correct or check the evil which arises from the first cause of moral negligence or delinquency, just noticed, namely, the distance of the judgment : because we can thus renew the frequent impression of its certainty, which is equivalent to the bringing it within our reach.

The question remains ; by what means this sense of the constant observation of God can be rendered active in man. This may admit of more answers than one ; and it is plain that the means cannot be too much multiplied. But the nature of this work confines the notice of those to the visible facts of creation, or to the material universe : and they will be found therefore in its collected facts, be the other purposes for which these have been here primarily selected what they may. There are none from which the universal knowledge and presence of God are not so obviously deduced as are His power, wisdom, or goodness : inasmuch that the reader cannot even think of creation, far less contemplate the works around him, which have thus been

pointed out, without a deep sense of that omniscience and omnipresence. And that this offers the most perfect and efficacious method, must appear, without the necessity of explanation: whence also we derive that great argument for the study of Natural History, or Creation, which I presume I need not here expand or enforce.

But, under these pursuits, our object should be to connect the Deity with all the objects and appearances that surround us, to whichever of His attributes these may be referred; so that, in contemplating them, we may always turn our thoughts to the hand which appointed every thing and maintains all. Thus we excite the idea of the presence of the great Governor of the universe; while by producing these objects in sufficient number and frequency, the constant sense of His perpetual observation follows. And that this is best effected through the works of creation, is plain: since we can do nothing, at any instant, without some connexion or interference with the world of physical nature around us.

And it is the best engine of this association, for other reasons. The moral world is engaged with our interests and passions; and these motives of our conduct are often, unfortunately, so powerful, as to make us neglect the great Observer of our actions, or wilfully to blind ourselves to His superintendance. In the physical world, there is nothing to produce those disturbing passions and motives: and thus it acts, if it acts at all, with undiminished energy.

This argument assumes, of course, that religious motives do exert a power over mankind: or, that he who is sensible to the sanctions of religion will find a perpetual motive to good conduct, and a perpetually restrain-

ing force as to evil, in a steady sense of the observing presence of the omniscient Deity. What more it may effect, as to our simpler relations to God himself, I need not specify, since the inference is equally obvious.

It is for this reason that I have extended those views of Creation, of which this work consists, far more widely than any proofs respecting the Deity and His attributes could have required. By means of that great engine, association, I have attempted to bring them before the mind, firmly and habitually in conjunction with their great Author: and thus have I attempted to impress the perpetual feeling of His presence, at every instant, every where, with every man; and of His knowledge of the thoughts and actions of all men, at all times, and in all places.

He who can learn to see Creation thus, and thus to feel, must ever also feel the impossibility of escaping His observation, of hiding himself from the All-seeing Eye. Thus will all Nature become that temple of the Deity to the heart of man, which it has so often been termed by the poet, not always looking beyond the splendour and interest which this image conferred on his expressions. And not only will he see God in all things, but, in all things also, he will find his rule of life, written in characters to which he can never shut his eyes. Not an object will occur to him, in which he will not see the hand of God, and feel that he is under the eye of God: and if he but turn to contemplate the vacancy of the chamber around him, it is to feel that he is in the presence of his Maker; surrounded, even to contact, by Him who fills all space. Feeling this, can he dare to be evil?

CHAPTER XIV.

SKETCHES RELATING TO HUMAN KNOWLEDGE.

ADOPTING that definition of the Divine wisdom which terms it the right application of the knowledge of the Deity to His designed ends, the evidences of that attribute must be the same as those of His knowledge, because the latter is only known as the former has displayed it. But if we use the term wisdom in its more commonly received sense, as including knowledge, it is still more plain that the same proofs apply to each attribute. Hence I have placed those which have been here selected, under the head of wisdom, to avoid a capricious distribution: and thus the Knowledge, being the Omniscience, of the Deity, could have admitted no other examination than that contained in the preceding chapter; leaving the present a vacant division.

But the term Knowledge is frequently used in a more limited sense, as including an acquaintance with all the branches of human learning; or, as still more narrowed, with the sciences only: while, under this last view, that of the Deity admits of some illustration, equivalent, in its effect, to evidence or proof of this Omniscience. And the method of illustration should be, to review all the sciences known to us, in all their details; showing, first, therefore, that He knew whatever we had learned, and secondly, that as Creation abounds in facts, under science, which we cannot explain, while aware that

they could not exist without similar knowledge, He also knew what we did not, or all the desiderata remaining in the human sciences; things which man's races have never yet learned, and probably never will. Our own knowledge thus becomes the point of reference for that of the Deity; as, in nothing can there be any other than ourselves: while, in this case, we as safely infer His knowledge from what we do not, as from what we do know; inferring it also much more fully, because our deficiencies far exceed our acquisitions. In this department, consequently, that must be Omniscience: because, finding, in the ever-increasing number of the effects of His wisdom, the yet unlimited extent of His knowledge, we cannot conceive any possible one, though we may not know of the existence of further facts through which to extend its further range.

But illustrations to this extent are evidently impossible; since, in the first place, we are unable to classify the objects of human knowledge, notwithstanding the attempts of Bacon, D'Alembert, and others. And although this were done, even the slightest selection from such a range and space would be inadmissible: as the whole, I need not say, would include that history of human ignorance, which so far exceeds in extent the history of its knowledge. It is that work which few men could execute, in any manner; while, though executed, it would not be understood by any but those who were perhaps themselves equal to the execution. In reality, to be of any value on the present subject, this is a task which every one should perform for himself; because no man can judge truly of the Divine knowledge except through what he actually knows. No person can transfer his estimate to another, unless he could first communicate his own talents and acquisitions:

whence it is also evident that the man of knowledge and mental superiority will take a more sublime view of the Deity, than he of inferior acquirements and understanding, and that such views will enlarge in proportion to the extent of the attainments and the more commanding powers of the mind. I need not say, I presume, that all improper bias of the temper or the understanding on the subject of a Deity is supposed to be absent in this case.

The *à priori* argument, as I have already remarked, produces no impression, whatever force it may possess. It can be of no value, especially, to the ignorant, incapable of judging in what knowledge consists, what are the nature, extent, and multiplicity of its objects. Such a mind, measuring by itself, can form but a Deity of its own creation; little other, it may happen, than the Supreme Spirit of the savage. And if the estimate increases in proportion to the knowledge, as only the highest attainments can ever approach towards a just one, immeasurably wide of the reality as it must ever be, when God can never be truly known but to Himself, we arrive at a conclusion too important to be passed by. If to know God is to know all His attributes, and if to estimate the one before us requires knowledge, how can it be maintained that the cultivation of human learning and science is unessential, or opposed to a knowledge of God? His knowledge is absolute. Without knowledge, man cannot comprehend that attribute, and thence cannot comprehend Him. Uneducated man cannot therefore comprehend God; and it being his duty to do this as far as is possible, it is therefore that duty to acquire all the knowledge in his power, that he may learn to know God. Yet is this plainest of logical conclusions daily controverted by those who,

in their own ignorance, assume to censure the exercise of human reason and the cultivation of philosophy. The same remark is indeed applicable, as all the Divine attributes are concerned : but it is especially striking in this case, from the identity of the principal terms and ideas.

There is another consideration, however, scarcely less necessary for the present purpose than a review of the existing human knowledge : and this is, the time and labour through which the accumulated race of man has acquired what it possesses. The history of knowledge should therefore be added to a survey of what is known. I need not say, that even the most slender attempt towards this, were it but on a single subject, would be here impracticable : since, under one alone, it is seldom known, even to those who are familiar with the science itself ; as, for knowledge at large, it is a work little likely to be ever executed. Yet the value of the argument is not destroyed by the want of illustrations ; since any one who is informed respecting the origin and progress of a particular branch of knowledge can apply it for himself, as I could not here venture to do, even in the briefest manner ; while all have a general conviction of the slow progress of knowledge in all its departments. That which has been gradually accumulated and developed by the labours of thousands, through ages, was for ever known to God ; present to Him, in one entire view, as a part of His nature. To distinguish what each man has done for knowledge, would therefore give the true measure of the human intellect as a point of reference for the Divine one : the existing mass of knowledge is a false ground of comparison. In his own science, the mathematician of reading can do this, with sufficient readiness ; while, though it were here done,

it would be purposeless to all but him. But all the sciences have not kept pace with this, the most easy, because the most precise of the whole : there are some in which scarcely a step has been made, to this hour, by the entire mass of human industry and reason. To know nothing, and to know all, is the ratio of nothing to infinitude, if I may use such a phrase : and it is here, therefore, that the immeasurable distance in knowledge between the Creator and His creatures is best seen.

The utmost attempt I can here make on this subject, is to indicate the route which every reader can follow, in proportion to the quality and extent of his knowledge. And though my limits compel me to the barest hints, so far from admitting a selection of details, from even one science, the utility will be the same ; since he who would feel on this subject, must think, not read. And I may commence with mathematical science, as offering one of the simplest subjects for such an example ; selecting also a few of those facts which are known to those of the least attainments, because thus most likely to be widely intelligible.

It was after a long period of previous labour and of repeated syllogisms, that men discovered those well-known properties of a right-angled triangle, the credit of assigning which is given to Pythagoras. It required further labour to found that science of plane trigonometry, through which we now measure the distances of inaccessible objects, almost by the eye alone, by means of inferences which never fail. Yet the Omniscient, the Eternal Geometer, as he has been termed by Plato, had known this from all time ; as He had, equally, for ever known those ratios of lengths on which man has founded the most useful rule of his arithmetic. Had this remained his boundary, he might have sup-

posed that he had scanned all the mathematical knowledge of the Deity; but he still proceeded to labour and reason, and still his knowledge grew; while, ever growing, the continual discovery of new relations of quantity and number enables us more truly to estimate the Divine knowledge, in extending our own.

Passing here much intermediate matter, yet still adhering to geometry, it was discovered through further labours, that the revolution of a right-angled triangle round either of its principal sides produced a solid, which, on being cut in various directions, yielded planes bounded by peculiar curves. It was a further task to discover that they could be classified, so as to give three great families, under which, although the members often differed widely to the eye, each was endowed with a peculiar set of common properties; and the end of man's triumph was to ascertain the definite natures of the ellipse, the parabola, and the hyperbola.

Could we now conceive that this had not been done, it is difficult to imagine how we could have conjectured results, which, even now, in the case of the extreme ellipses at least, appear so improbable, that it requires demonstration to convince us of their truth: but the Omniscient had, from the beginning, been acquainted with all these properties, and more which we have not yet taken the trouble to search out. Of one of them also, He had always known what man did not discover for many centuries after the fundamental investigations; since He had made use of it in His own mechanisms. Yet when man had at length ascertained this fact, priding himself also on his ingenuity, is it not true that he more than once forgot that this was the mathematical knowledge of the Creator, that He had designed because He knew? If he found that such was the orbit

of a planet, it was because the All-wise had for ever known that this was the expedient line to adopt ; and if, out of all the possible forms of the ellipse, He chose but a few, peculiarly also disposing of those few, it was because He had eternally known, what man was far gone in his races before he could understand, even when he did know it, namely, that such nicety of choice and arrangement was essential to the preservation of His great mechanisms.

Of the parabola, man found out at length, that if he could construct it by proportional lines, so was it the curve produced by combining the motion of gravitation with that on any line between the perpendicular and the tangent to a point on the earth's surface. Still, it long remained a useless curve, notwithstanding its numerous properties ; since, even in this remarkable one, there is no practical utility, as the science of projectiles knows. Thus might we have decided that it comprised none ; ever forgetting what may lie hidden in the depths of Universal knowledge : nor are we perhaps cured of thus estimating that knowledge by our own ignorance, in finding that by its aid we can construct the only surface which will cause the parallel rays of light to converge to a point after reflection. May there not be far more in the parabola which we cannot conjecture or foresee ? It was long before we discovered that the not highly dissimilar curve which passes into it by an imperceptible gradation, was empowered so to determine the lengths of straight lines, that certain ratios should be the constant equivalents of others. Yet we at length found in the hyperbola, that great engine for abbreviating labour, the logarithm, which the Omniscient had reserved for our use till He saw the fitting time for its disclosure : a disclosure to assist us in more

rapidly approximating to some estimate of His knowledge, and of His proceedings in the geometrical arrangements of the Universe.

These alone were immense discoveries: and long, long, was man in making them, slight as they may now appear to us who have but to open our eyes to them: but they are the smallest part of what we now know to be His knowledge, because we have since attained to know it ourselves. Therefore must we be sure that He possesses mathematical knowledge, of which we cannot even conjecture; because mathematicians at length perceive that their science is inexhaustible. He sees, as He has seen from all times, every possible relation of number and form and magnitude: there are millions still unknown to us; while, as we proceed to discover them, we shall attain that further conviction of His knowledge, for which at present we must substitute simple belief. That which is known is itself such, that there is perhaps not one among millions to be found, who can, by the most sedulous and continued exertion, bring it before his mind, even in slow succession, through the years of a long life: yet this, and far more, is known to the Omniscient, at every instant: ever before Him, as the simple circle, in its simplest property, stands displayed to the eye and mind of a mathematician. In that simple figure, the latter is yet unable to discover the ratio between two lines of an invariable relation: the Omniscient alone can assign its area.

We begin to see still more deeply into the knowledge of the Deity, when, passing pure geometry, we examine into the relations between numbers and magnitudes: though it is a subject which cannot be generalized under common language, to the apprehensions of ordinary readers, while the mathematician versed in the higher

calculus of algebra needs only be desired to reflect. It was a great discovery, that numbers and their relations could be substituted for magnitudes and the relations of magnitudes—that even for numbers, there could be substituted representatives—that thus the mind could learn to manage what the eye could not see, and that even a sort of metaphysical logic might be employed, where the tangible boundary of geometry had been passed. But this also was in the knowledge of Omniscience, long before it was in our own: before all time, He knew all these relations and powers and properties; as, even yet, He probably knows of useful proceedings depending on those powers, superior to those towards which we so slowly approximated. What even does man do now, with this machinery of knowledge, after having found out and constructed it? He has ascertained that it is a machinery of sound logic—that if well constructed, and put into right action, it will tell him what he desires to know, if he will first tell it what he does know. Yet, of the long train of all this wheelwork of syllogism, he cannot bring the successive concatenations before his mind at one view, nor even in any succession. The working of the machine is a mystery to the very hand which arranged it and moves it. Yet who shall doubt that the Omniscient Mathematician sees every reason, every connexion, at every point and step, and that He sees also the whole train of action, through all the complicated relations of numbers and proportions, at one glance? even as he who is extracting knowledge through the differential algebra, would see it detailed in numeral figures, were it possible that his eye and mind could grasp such multitudinous sums in all their relations.

But the nature of the Divine knowledge in this science

assumes an even higher aspect, in considering the subject to which this, which is but the machinery of real knowledge, is applied; in contemplating the laws of motion, with the influences which, through them, the several classes of bodies in the universe exert on each other. Under every branch of dynamics, the discoveries of man have been late, as, in some, they are still extremely imperfect: while if this term may be somewhat extended, as, under its literal meaning, it may safely be, there is much of action in bodies, respecting the nature and source of which we do not possess the slightest knowledge: though under no want of great and successive labours applied to this subject. Our own day however has witnessed the solution of those delicate and difficult problems which concern the conduct of the celestial mechanism: disclosing a portion of the Divine knowledge in mathematics, so little suspected even by Newton, that he considered the frequent interference of the Creator necessary to correct the irregularities of the planetary motions: in this forgetting, that he was measuring the Supreme by a standard drawn from his own imperfections. Of that knowledge in Him, we are now convinced, because it has become our own: but we should repeat the same error, did we not believe that He was the possessor of a still more refined dynamical one, at present exceeding all our conceptions; since it is thus that the Eternal Mathematician must regulate that moving and concatenated universe of spheres in which our own system is an insensible point. Do the comets of that system interfere with the order of its planetary bodies; or, if not doing this within the limits of our own observation, may not that happen at some future period? Mathematicians have been glad to escape from a problem which is too difficult to inves-

tigate: but the Creator could inform us of all those influences, did He so choose; as it is not improbable that He will communicate this knowledge at some future day, in the same manner as He ever informs us of that which He intends us to know: selecting among men that agent who is too apt to forget that he is no other than the commissioner of the Supreme, and that all his labours would otherwise have been vain. Our own day has explained the balancing of Saturn's ring; it is our knowledge, convincing us of His: but our ignorance ought to have drawn the same conclusion long before.

I may turn to a branch of this science, in which our ignorance far exceeds our knowledge. Using the term hydraulics as comprising everything in which the action of fluids is engaged, we can as little doubt that these endless and complicated facts are regulated by definite knowledge, as that they exist: admitting this, in reality, when we use the term laws, and seek to find out what those are. Our direct proofs, however, of the Divine knowledge in this department are very limited, because they are necessarily bounded by our own. Yet we have ascertained a few of the rules which regulate the motions of fluids through tubes; and thus we discover its perfection in the hydraulic mechanism of the vascular system in animals. Thus have mathematicians ascertained, more or less accurately, the figure of the solid which meets the least resistance in passing through water: and thence, equally, do we discover the accuracy of the Divine knowledge in the construction of fishes. But beyond this, there are endless facts, of which we seek the rules, as yet, in vain: while the search is an admission of that knowledge, the depths of which we cannot fathom; since every law, or rule of conduct, in creation, is but the definite and consistent

application of the knowledge of the Deity. We have learned of late to raise water in a vertical tube, by checking the flow in a connected and nearly horizontal one; and we have discovered how to multiply force, by causing a small column of water to act on a large one. We thus at last know, what He always knew; but we do not yet know how to construct a ship possessing the best balance of the several properties required for this apparently simple solid: we cannot even execute the far more limited problem of constructing one which shall pass through water with the least resistance, though we have His models in the fishes before our eyes. Yet we do not doubt that there are rules by which all these things are regulated: and we can as little doubt that the Creator could produce, through those rules, which are His knowledge, a hundred forms of ships, were as many necessary, each being possessed of the required qualities in different proportions; just as He has produced a hundred kinds of fishes.

If this is of the Divine knowledge which our ignorance proves, we have scarcely another proof in the case of light; so deep is that ignorance on this subject. We are assured that this marvellous power is managed by rigid laws; under various knowledge, because there are apparent causes united with regular events: but, for the most part, we see nothing but effects, the causes of which we cannot conjecture. Yet the Creator of light knows why it moves, why with such velocity, why it thus moves without momentum, why the millions of crossing streams never interfere, why the light from one source fills every point of space, and why those from millions of sources do no more. He knows why it is reflected, where it goes when it disappears, why it is ever produced yet never exhausted, how it conveys

the image of a form, how it becomes fixed in certain bodies, to be again evolved, how it is secreted by animals, and how a nerve feels that which is without momentum and gives no impulse. He knows why it passes through transparent bodies; we merely know that it does so: why it is differently refracted by different substances, why separated into different parts and colours by others, and much more; respecting all which, we barely know that such are the facts. It is not long since we knew the mere fact of its polarization: and whatever more we may know at present, we can neither conjecture the means, nor the utility of a property too remarkable to be without a purpose. Here our ignorance is even more strikingly the measure of His knowledge: our own is nothing; His is everything.

This is the fact, perhaps even more remarkably, in the case of sound. His knowledge appointed, and directs it, under complications of motions respecting which we know nothing, and can scarcely conjecture; though sure that they must be under causes and rules, not less steady than those which govern the celestial mechanism. If there are a few known facts, which we please to term laws, they are as nothing amid the mass of our ignorance. There is not even a theory of its cause and propagation, which will stand the test of the slenderest examination. He alone knows how He produces it and causes it to move, how its relative velocities are determined by the nature of the bodies which it passes through, by what means many sounds, like many lights, can cross each other without mutual interruption, and through what power solid bodies reflect it, as they reflect light. This is a portion of His knowledge which He has not yet allowed us to discover: we merely know that it must exist.

We know as little of the details as of the fundamental principles: we must continue to estimate His knowledge in the same manner; through the constancy of definite facts under unknown causes. There is a least possible number of vibrations in a given time, requisite for the production of a musical tone: but we know not why this is, nor why each of hundreds of other musical tones requires its definite number of vibrations. But admitting that the possession of this fact was knowledge, we are utterly unable to conjecture by what means the Divine science produces a hundred different qualities of a single tone, and these not less definite, under definite causes, than the tones themselves, while we are sure that the number of the vibrations, of the presumed cause of all sound, is the same in each case. A given insulated column of air produces a given tone; by vibration it is said. But what can be understood of the vibration of a continuous body, be it this column, or a string, or a plate, voluntarily dividing itself into parts, and those parts such as always to perform the numerical vibrations which generate other musical tones, while never admitting of intermediate ones? We offer words here, and deceive ourselves into the belief that those are knowledge: in other cases, there are not even words to offer, while the facts are overlooked or suppressed; suppressed perhaps from the vanity which will not confess ignorance, but more often overlooked, because men will not consider, that although they are ignorant, the Deity must be wise, or these things could not be. Even thus also does His wise and just government punish men for their faults: little as they perceive it, yet enabled to perceive it, if they would reflect. In every thing, He is ever ready to teach those who will come to Him for instruction: but He withholds Himself from the vanity

or the pride that will not acknowledge Him, and from the indolence that will not seek instruction under His appointed law of labour. Why do partial issues from a vibrating column of air produce different tones from the original one, and under numerous combinations which can have no reference to the shortening of that column; or by what laws do irregular masses of included air act in producing tones? Can it have been forgotten, that this is the problem of the human voice? It ought not to be forgotten at least, that when He determined to render those voices dissimilar, for obviously indispensable ends, He exerted the most refined knowledge on a branch of the science of sound; while men do not seem even to have imagined that there was such a department, so far have they been from attempting to estimate His knowledge in this manner.

I might easily pursue this view, in equal detail, through Pneumatics, where our knowledge consists in little more than the bare fact, or law, as it is termed, that the elasticity is equivalent to the pressure, to the density or the quantity; thus explaining other concatenated facts. The Divine Artist possesses a far other knowledge than this, by which He regulates the action of the air on fluids and on solids, since that knowledge directed the forms of His birds, and more; as it produces and moves those winds, of which philosophy can give no account. And the consequent rules are dynamical laws, since they relate to matter and motion: while He possesses a perfect anticipation of the effects, where He puts those causes into action. But I need not proceed in the same manner. In every case, the ends to which these powers are directed show that He intended the effects, and their production proves that He knows and commands the means; while this knowledge must,

in every thing, be as refined and minute, and as deeply philosophical, as it is multifarious and extensive. When we shall have discovered its nature, we shall know how to value and admire it, as we now can estimate the mathematical knowledge which He has applied to the celestial mechanism : in the mean time, we are sure of its existence, while we can conceive something of its extent, though not its exact nature.

It is not long since we were ignorant of the existence of Electricity, and but a little while since we have discovered it to be one of His great agents in the universe. That it has its rules, we know, because we have discovered some of those. But its Creator alone knows where He hides it from us, and what its nature is, in what manner it is moved, and for what purposes : for His hand moves it, that it may perform His biddings. In the even more mysterious power of Magnetism, we cannot but see that much knowledge is implied ; since this we are now seeking, and cannot find. We have discovered in succession, its action on iron, its polarity, with the variation, the dip, and the diurnal changes of this, and are daily approximating to somewhat more. Yet all is little : we scarcely even pride ourselves on it, ever ready as we are to do this ; suspecting that there is far more of knowledge hidden from us on this subject. But under limited facts we cannot conjecture the extent of the Divine knowledge respecting this, not the least extraordinary among His obscure agents.

We emerge a little from this obscurity, when we come to inquire of the Divine knowledge which must be engaged on the subject of Heat. It was slowly that we discovered the few rules now known, under which its movements are regulated ; yet even those can scarcely be termed knowledge. On its most obvious mode of

communication we have still but collections of insulated facts ; while they are such that we can hardly extend them beyond the bounds of our experience. This, in philosophy, is not knowledge ; since it is not even a knowledge of rules, far less of their nature and causes : it is not that through which the Creator of heat acts ; and thus we know that He must possess much, respecting which we do not attempt to form conjectures. He knows why one mode of matter transmits heat more rapidly than another, because He commanded the means ; as He equally knows why and where it must be incapable of doing this, and for what purposes He gave this diversity of powers. Of the communication of heat by radiation, we equally know of a few facts ; but this is all. On this subject alone, the details of His knowledge would perhaps surprise us by their numbers, as they do wherever we have attained to know them best : in mathematics and in Chemistry.

Under this last science, every one can compare the knowledge of our own day with what was known twenty centuries, or half a century ago. Even at the latter period, it had scarcely proposed to distinguish between elements and compounds ; feeling under equal uncertainty as to every thing. We have now added innumerable compounds, and believe that we have added, as we have distinguished, elements ; while still proceeding in an apparently interminable accumulation of both. The mass of facts is already such, that no memory can contain it ; they are accumulated under successive records, and it would be the labour of a life to verify, from those records, that knowledge which no one man can be said to possess, however existent it may be. How many more must there be of which we know nothing ? Yet the Omniscient has for ever

known, alike, the discovered and the undiscovered; every actual substance, and every possible one, the causes that have produced and may produce them, with all the consequences, and all the uses that may be derived from them. This, like all else, is ever before Him; as it is His chemical knowledge that appointed all, and continues to direct all. But it directs these things through means, causes, knowledge, of which we can form no conjectures. We know, in some imperfect manner, what His knowledge of the facts must be, because we know of their existence ourselves; but, of the rest, nothing: since our theories, whatever they may conclude respecting heat, or conjecture with regard to attraction, bear no resemblance to knowledge, and can give us no insight into that of the Omniscient. Yet the slenderest chemist knows that every event in his science is as certain as are the planetary motions; as philosophy can thence assure him, that the knowledge and the conduct of the causes are not less determined, and must exist somewhere, though they are a mystery to him. In the Creator of Chemistry, the knowledge of all effects is the knowledge of all causes.

Hitherto, this mode of estimating the knowledge of the Omniscient has proceeded on a joint view of our own knowledge and our own ignorance: in the first case, we have seen that it must have existed with Him before it was ours; in the other, seeing a little way ourselves, we have as safely inferred the existence in Him, of knowledge unknown to us, because we are convinced of its necessity. But though we go beyond this, and inquire respecting that of which we are utterly ignorant, we must equally conclude that there is absolute knowledge in the Creator of these things; from knowing that a system of plans and uses could not have been

formed without it, and that the intended and unfailing effects demanded numerous details of various knowledge, under great precision and minuteness.

I allude to the production and conduct of the animal and vegetable organizations. Of the intricate chemistry by which these are formed, and under which they proceed, we know nothing; though it is one department of a science in which we really possess a great deal of information. Nor is it that a single one grows and proceeds, with a precision and a constancy which assure us of a correspondently accurate conduct in the laws by which it is ruled, since there are hundreds of thousands of such organizations, all differing from each other, for ever produced from an unassignable point, by modes of this organic chemistry, with a certainty which has never failed since the first was created. He who commands all this, knows also how He effects it all: for without knowledge it is not effected, though it requires but the effort of His will to issue the multifarious and minute laws by which it is all governed.

I need not proceed further with these illustrations of Omniscience. It will not be said, that the mere details of existing facts do not prove this species of knowledge in the Deity, even admitting Him to be their cause. He who knows what knowledge is, knows that he has acquired it by classifying the facts of which he has possessed himself, discovering their connexions, and, as far as he can, ascertaining their causes. The Being therefore from whom those facts originate, must equally have classified them and ascertained their causes, could it be supposed that He had not acted through such knowledge; else would He be inferior to His creature. But He must be possessed of more of this knowledge

than man, in proportion to the facts which He knows, which are those He has commanded; while, having commanded all, He must be Omniscient in this department of His universal knowledge. If He were not, then it must follow that chance has regulated all things. The very hypothesis of general original laws admits this species of His Omniscience, by the fundamental assumption; though it may dispute His universal knowledge of existing and passing events, by denying His personal superintendence and perpetual action. Nor must it be said that these illustrations are superfluous, because the admission of His Omniscience suffices respecting this species of knowledge, as well as that of moral or other events. They are not superfluous, when the term Omniscience is but a sound, exciting no reflections, or perhaps exciting those only which relate to the moral government of the universe. They are not such, when even Newton could commit such an oversight as to conceive the Deity deficient in mathematical knowledge; they are an answer to those who imagine the world to be governed by chance or by self-acting laws; and they cannot, at least, be without some use to the ignorance which is content to see that the world proceeds, without inquiring how.

The object in view in this chapter is ended. The extent, the magnitude, the comprehensiveness of the knowledge of God, require to be examined in a very different manner, and in one which I do not think it necessary to adopt, since it would be to involve the repetition of what this work furnishes in every chapter. It is to range, in imagination, the endless, boundless universe; to examine every sphere of incalculable millions, with all the mechanical actions and mathematical laws under which their order is preserved; to consider every atom

in each of these, and every action under chemistry which is for ever taking place among them. It is, again, to bring before the mind the entire mass of the forms of organic being by which those are inhabited, and every individual in all that mass, with every detail of the structure and proceedings of each, and every portion of the moral governments appointed for them, to the very individualities of their separate mental powers. The imagination cannot do this for one globe, not for the smallest portion of our own earth : and though it should have done it for the entire universe, it has but commenced. The Universal Knowledge, knowing all this at every instant, even as we see the sun at noonday, sees and knows equally all that has been, and all that will be, to all time, not in the physical universe alone, but in the moral also ; knowing the minds of all, even as He sees the motions of the spheres, knowing how they have acted, seeing what they think, and foreseeing, even as if it were present, what all and each will think and do, as long as they exist. This is the knowledge of God : but who shall hope to approach to a contemplation of the incomprehensible Omniscience ?

CHAPTER XV.

ON THE CO-EXISTENCE OF IDEAS IN THE
DIVINE MIND.

IT remains that I endeavour to place the Omniscience of the Deity in another and a somewhat different light; though here also I can but suggest the course of thought which he who would reflect justly on the Divine knowledge ought to pursue, in offering a few examples of the mode in which it may be contemplated under this view. The title of this chapter alludes to the simultaneous existence of ideas, or conceptions, in the Creator's mind, antecedent to their demonstration or execution. It is a view, in reality, of the comprehensiveness of the capacity of the Omniscient, added to the sum of His knowledge: or of His power of reviewing and calling into action all the stores of that knowledge, at any and every instant. In man, this command over knowledge constitutes recollection; while, if perfect for his small store of ideas, it is a rare power of mind, as, in him also, it is a work of much time as well as of exertion. In the Deity, all His knowledge is always present. To the Perfect Mind, there is no time: it is the universal and simultaneous perception, knowing all things and all relations; demanding neither memory nor recollection, which are imperfections in the structure of mind, the substitutes for what is not, or could not be, granted to man.

But whatever the arguments of metaphysics prove,

their effect is not felt. I but follow the plan which I have adopted throughout, in showing by evidence, what they infer, or in illustrating by facts what they prove through reasoning. Physics cannot however prove to the full extent of the inference : they cannot show that the Deity saw, at one instant, all that was necessary for the construction of the universe. But they can show this as to certain portions of His works : and that is all which an illustration requires, as used to strengthen the *à priori* inference. He who could conceive, at once, all that was necessary for our own planetary system, cannot be supposed bounded, in any manner, in His power of simultaneous perception. Mathematical science finds reason to believe that this mechanism was the result of a single act of the Creator's will, because the mutual action of the parts by which the structure is supported demands such a mode of production : but although this conclusion were refused, on the grounds that the general historical authority for the creation of the earth is authoritative as to all the details of the planetary system, we must still believe that the entire plan was for ever existing in the Omniscient Mind, because it could not have been executed through approximation, trial, and corrections.

It being equally admitted, under the metaphysical proofs of the nature of the Divine Mind, that the Creator must have known, from eternity, every thing which He intended to do, and the relations which every thing thus proposed would bear to all the parts and the whole, it is but an identical proposition, that every idea of the myriads thus involved was present to Him at that act of His will which was Creation ; as they continue present, and will, at all times, respecting all that ever was or ever will be created. Otherwise, there would be defect

of knowledge, or ignorance, in the Deity ; which cannot be : or else, the minute details of creation, being those which involve this inconceivable multiplicity of ideas, would be the result of chance ; thus rendering such knowledge, on His part, unnecessary. But this hypothesis has been already answered ; not only under the general view, but as to the most minute details. The former analysis of a peacock's feather, under the doctrine of probabilities, or chance, demonstrates that minuteness of knowledge which I have here inferred through metaphysical reasoning.

And it is the co-existence of this inconceivable multitude of ideas, inferred by metaphysical procedure also, which is the subject here chosen for illustration ; because the demonstration of multitude may produce an effect on the mind, which a more restricted view might not ; as the *à priori* argument rarely produces any, since it cannot give the needful ideas, or knowledge, to those who do not chance to possess it. It is a subject, however, on which I find no metaphysico-theological writers to quote ; as it does not appear to have engaged any attention : yet I willingly refer to one ancient philosopher, because I do not think that any one could have better expressed this feature of the Divine Omniscience. There is much more of deep thinking, both in natural science and in metaphysics, in the philosophers of that country and period, than is often perceived, or suspected, by those who read The Book in which their writings are collected : reading too often, as if they read not. “Thine eyes did see my substance, yet being imperfect, and in thy book were all my members written, which day by day were fashioned when as yet there was none of them.”

Now, to conceive, in any manner, this quality of the

Divine mind, or to form a tangible notion of its action, in even that simple case which includes the arrangement of the planetary system, we must, as usual, commence from ourselves, the ever unavoidable basis of judgment in all that relates to the Deity: while the most familiar illustrations will be the best, since every one can understand them.

It is easy to acquire some notion of the multiplicity of ideas required for erecting St. Peter's church at Rome. To design the whole and all its parts, external and internal, to reduce all these things to the drawings and sections by which the work must be executed, to calculate on effects, uses, communications, to insure geometrical strength under all this, to select all the classes of materials for necessity and ornament, in stone, wood, metals, minerals, colours, to contrive and design furniture, constitute but a small portion of the whole: while there is yet wanting the knowledge whence these materials must come, how they are to be wrought, by what powers the work is to be erected, how that machinery is to be constructed, and, to pass over much more, by what economical arrangements the means of erection are to be procured and distributed, and the work conducted. Even this, slightly sketched as it is, comprises an immense mass of knowledge; small as is the work compared to those of creation, and limited as are the ideas in comparison with those engaged in the Creator's works. Yet this knowledge was never present at one time in the architect's mind: while, even as it did exist, it was but the recorded accumulation of many minds, of which not one could comprehend, at one time, its own limited portion.

The steam-engine will serve to illustrate this in a different manner. No machine can well be more sim-

ple in its principles and action : while, although both of these belonged to facts long familiar, it required the accumulated thought and toil of men, through more than a century, to render it the effective power which it now is, under the trial and rejection, or modification, of hundreds of ideas. So far from previously conceiving the whole, scarcely any man conceived perfectly, before execution, any one part of it as it now is. Yet though one man had done the whole, and done it perfectly from the first, what, even then, would have been the number of his ideas, compared to those required for constructing the most simple vegetable or animal on the earth ; though the Creator had done but this ?

If it is thus that we can perhaps most easily and effectually contrive to feel what the nature of the Divine Mind must be, as its knowledge is concerned, it is by examining the works of creation in a similar manner that we shall attain to some more accurate conception of the multiplicity of its co-existing ideas ; while the reader, according to his own knowledge of the universe, can extend the few examples which I have selected under different modes of contemplation.

In the planetary system, as I already suggested, the size, the density, the form, the place, the orbit, the inclination, the velocity of circulation, that of rotation, and more, were, for every one of those bodies, primary and secondary, co-existent ideas in the mind of the Creator ; as were all those which relate to the sun and the comets, and as were also all the resulting consequences, under whatever positions these numerous spheres might hold towards each other through all time ; since this mechanism was constructed that it might be durable under all those possible conditions. Small as this piece of mechanism is, compared to the

whole of the great celestial machinery with which it is connected, it involves a mass and a multiplicity of facts, as of calculations, which man is but now approaching to understand, after labours that have been accumulating since his creation. And even yet, knowing hardly any thing of five hundred bodies which it includes, there is much to be learned before he will be enabled to compute, in the slowest manner, the ideas which must have co-existed in the mind of the Omniscient on the subject of this single piece of machinery. Yet it is but an insensible atom among the countless myriads of similar systems which unite to form the great machine of the universe, so that for each separate one of these, the same number of ideas must have been simultaneously present to Him who appointed them all; existing in the Omniscient mind when it arranged them—existing there for ever.

But though we struck out this incredible mass from the total sum, it would not make a sensible difference in the numbers required to express the amount of the Divine ideas respecting His physical creation alone. There is not one sphere among these countless millions, which does not include within its own little space more ideas than are implied in the mechanism of the whole universe of orbs; if indeed we may be permitted thus to draw comparisons between the equally unknown. But though we might institute some computation of these, for the earth at least, through our knowledge of its contents, no imagination could contemplate the mass, nor even a small portion of it: yet some aid can be afforded by means of a descending or exhaustive analysis; reversing the method which I have adopted in attempting to convey a notion of the magnitude of the universe.

For this purpose, if I commence by rejecting all that relates to the inanimate earth, in the great powers of light, heat, chemistry, and more, by which it is governed, all that relates to its two great elements, the distribution of its surface, its materials, and their mutual actions, the reader can easily perceive in what manner he could compute, or rather imagine, the included ideas, should I desire him to select but one substance, such as silver, from only one class of those materials, and examine, even in that single substance, nothing more than what belongs to its chemical relations; or if I were to direct his attention to no more than the hundreds of forms of calcareous spar, each of them defined by rigid geometrical laws. It is but to proceed thus through the whole history of the earth: it is the exhaustive analysis through which he might rise to a conception of the ideas included in it, and, as portions of its structure, existent, at its creation, in the mind of the Creator.

But leaving this to himself, I may take the animated world; and, successively rejecting the superior classes or portions, proceed downwards to the lowest convenient term; thus giving him the model which he can follow in his own manner, as thus only will he succeed in attaining the needful conceptions on this subject. The forms of animal life amount to many hundred thousands; and the naturalist well knows, that although adding all his own study to the accumulated knowledge of those who have preceded him, he cannot distinguish the smallest portion of this number, even when before his eyes, so as to know in what they all differ, or even how any one differs from all the others. Could he do this, he would be that which he strives to become; though even then he would be little more than the na-

turalist nomenclator. But whether he has thought of it or not, he thus admits in the Creator a multiplicity of co-existent ideas which, even on so limited a portion of nature, he cannot discriminate when they are before him, while all his races have never yet succeeded in numbering them. He who planned these structures saw, as He appointed, at once, every thing in which they should differ; and, if I may here use an admitted anthropomorphy, we must see that He could now produce, from His memory alone, a perfect model of every form in creation, to its minutest parts. But, for those, we must multiply by millions, that we may attain to some conception of the included ideas; since every part of each form consists of inferior ones, in a successively downward series; while the most minute of these constituted a distinct idea in the Creator's mind, before He produced its image.

It becomes again necessary, therefore, to limit the range of inquiry, by selecting a division of the animal forms; or rather, to limit it a third time, by taking nothing, in the birds, but the mere clothing, being, among other things, a contrivance of differences for the sake of distinction. Yet even this inferior department is unmanageable; so far beyond all computation is the number of separate ideas which enters into the constructions of the feathers throughout the whole, while every one must have been conceived under a separate idea for each of its minutest parts, before the general plan for all the distinctions could have been laid down: existing still in the Creator's mind, in the same manner. I must therefore select from even this selection; and, to take a single feather, will be to exhaust this analysis to its lowest term. To the superficial and unreflecting, the feather of the Argus pheasant is a painted feather, and

no more ; he forgets that it is a work of art, though the Creator's work ; and that it was not put together without a distinct conception of every atom of its numerous parts, any more than a watch or a cotton-engine was constructed without a drawing for every axle and pivot and wheel and tooth. The artist who may attempt to imitate it in colours, will soon discover how many ideas are necessary to the execution ; and far more would this be found out by him who should endeavour to fabricate a model of it. It seems to be trifling with common sense, to say, that if it had not been thus conceived, it could not have existed : but that common sense will not be offended, when it recollects that the superior sense of philosophy has denied this conclusion.

The reader might equally turn to the former analysis of the feather of the peacock, including a multitude of ideas which no man would willingly undertake to number : while if he will examine the whole clothing of the animal, point by point, he may ask himself the question which I need not repeat ; as he may, after this, attempt the larger sum which includes the whole feathered creation. This is to return from the point to which I have brought him ; but it is to return upwards, through all the animal organizations, under all their lowest details, including their internal structures and actions with their external forms : while the constancy of the latter, and the precision of the former, will assure him that there was not the minutest circumstance which was not preconceived in the Creator's mind, could he still have any doubt on the subject. The steam-engine is repeated in successive ones, and its action is ever precise, for no other reasons than this, as in no other manner could it be what it is ; and that which the less demanded, was assuredly required for the greater.

The vegetable kingdom will afford an illustration under a somewhat different form: since I can here point out that comparison of simultaneous ideas, which the extent of the animal world did not so well admit. There is here a plan of some kind, though we cannot trace the whole, and it involves millions of ideas; as, without the previous possession of all the included ones, no plan can be designed. Imperfectly understood as it is, we can see that it consists in some system of continuous subdivision, till it descends to a single species, and that the associations and the distinctions are produced through the forms of almost innumerable parts, under similitude and dissonance. The botanist nomenclator knows well what difficulty he finds in perceiving all these distinctions, among even a few species; as he knows the variety and multiplicity of minute circumstances on which they are founded; and he therefore will best estimate the mass of ideas contained in the whole. Differing in one thing, a single plant may differ from others in many; in flowers, and in slight variations of a flower; in leaves, and in their minute incisions and evanescent outlines, as in far more which I need not here note: while, when differing on one point, it may resemble other plants in many parts, and a few in nearly all: and thus under a much further intricacy of relation than it is necessary that I should notice. Hence, independently of the endless forms, each comprising numerous ideas, we must attempt to conceive the comparisons and calculations implied in planning the combinations, through resemblance and dissimilitude, under which the arrangements of the vegetable world have been made; while in this, there is necessarily involved a previous joint view, or simultaneous perception of every included idea. Man, attempt-

ing similar things, must have recourse to mechanical arrangements as a substitute for that simultaneous conception which is not one of the allotted powers of his mind; while this becomes a tacit acknowledgment of the existence of that power in the Omniscient.

But under this mode also of viewing the co-existence of the Divine ideas, it is best to select a single example; and I may take the rose, as being one of those plants in which the distinctions of species are very delicate or difficult, while being once known they are recognized with certainty. This, in itself, marks that precision of ideas which nothing but the most entire knowledge could have possessed; while philosophy will acknowledge, that an arrangement of this nature could not have been made, unless, with that precision, every minute circumstance had been present at one view. In this flower, so marked as a genus that no one can mistake it, the variations and combinations of parts which give individuality to the numerous species are often so minute and evanescent, that they escape all but an acute botanist; nor is even he always secure, unless he can bring these parts, or ideas, into comparison. That is, we cannot retain in our memories the simultaneous ideas of the Omniscient mind on a subject so narrow as this; since our senses, with our utmost attention, must be taxed to discern this infinitely minute atom out of all that was for ever known to the Creator as it was executed by Him: being, in this case, as in others, assured of the knowledge, and of the intention thus to produce individuality, because each species is repeated, through its seeds, for ever.

Thus, what metaphysics infer, natural science proves; while if the cultivators of this have seldom raised their minds beyond it, to Him through whom it exists, so

have metaphysicians overlooked or remained ignorant of that which might often have aided them with proofs of those prior conclusions in which they rest, and, for the most part, with little effect. It is truly said, of all the human sciences, that he who limits himself to one, will throw little light on it; nor is it less true, that scarcely one can be duly illustrated without the aid of all the rest.

As the reader can now pursue for himself those trains of thought respecting the physical universe, I may turn to the moral one: that in this also he may see how he can reflect on the question before us. The living and moving world of animals, being a sentient, is also a moral one, a world of mind; of thoughts, wishes, purposes, efforts, enjoyments, while also replete with inventions and adaptations, contrived for the due ordering of this great mass of will and power, under relations to existing objects; so that no desire should want its pursuit, nor any moral movement be without its means and its end.

I stated a human case, as a basis for the former illustrations: I may here follow the same plan. To expedite an army across the seas, is a frequent occurrence; while the reader must reflect for himself on the enormous mass of knowledge, the thousands of distinct ideas, in morals and physics, which must have existed somewhere, before this could have been effected. Yet of all these, but few ever belonged to one man; as no man could have conceived the whole, in even the slowest succession of detail: it is the united toil of hundreds, as, in them, it is but recorded knowledge: not seen, but sought when required. Yet all this bears not the smallest proportion to the ideas alone which produced those materials and gave those powers; as these con-

stitute but an infinitesimal among all those in the Omniscient mind on analogous subjects. The great army of animals which occupies the earth, must be housed, and clothed, and fed: its commissariat is perfection, though but a small portion of the total government; while the multiplicity of ideas implied in this alone surpasses all conception, when that army amounts to myriads which must be numbered by the sands of Africa, under hundreds of thousands of different kinds desiring different food.

But it is a people also appointed to love and to hate; to wish, to seek, to find, to labour, to plan, to build, to circumvent, to war, to fail, to succeed, and to enjoy: while separating into parts and states, yet coalescing in a universal balance of mutual services and mutual control, under one great government where all are satisfied and none rebel, where all are for ever in order and for ever happy, though subject to perpetual changes, which seem as if they should subvert, in every year, this perfect arrangement. No power of meditation can approach to a conception of this, the political government of the Omniscient; but he who would make the attempt, must not forget, that every idea required for it was preconceived and arranged in that Mind, before a single one of all these multitudes was created; before all these countless myriads of different and discordant powers, and wishes, and wills, were thrown loose from their Creator's hand, to settle under the government which He had pre-arranged for them; His ever orderly and obedient subjects, as long as their races shall endure on the earth. Is there a man who can look at Creation twice, and not look at it, the second time at least, as a legislator and a politician? Let him judge the Divine mind under this view.

But it is not merely that the Creator governs, that He knows and directs all the details of His political system for this moral universe : all the ideas of each of His subjects are known to Him, as they arise, and before they arise. We cannot contemplate, even in our own minds, more than the passing idea of the moment ; as, of that which passes in another mind, we know nothing. Those of man, of every animal, are for ever before Him at the same instant ; as there are before Him those which have been, and those which will be. Yet is all this, all that we have seen in the physical as in the moral world, but an atom, to be struck out of the mass of ideas in the Omniscient mind, without leaving a perceptible difference in their multitudes. There is not an inhabited sphere among all the millions of the universe, of which that Mind does not know all that it knows of our own ; and there is not one which does not demand for itself all that is required by that earth to which our knowledge is limited. We term this capacity of the Deity infinite, His mind omniscient : but we forget to note the value of those terms. Let him then who would estimate His ever present ideas, turn to the unbounded heaven of stars, and by them multiply all that he may already have conceived respecting our own earth. This is to endeavour to approach, at least, towards some valuation : the mass of ideas ever present to His mind is the true measure of His omniscience. To those indeed there are no bounds ; the infinite cannot be measured : this is the incomprehensibly Omniscient God.



DIVISION III.

OF THE

WISDOM OF THE DEITY,

&c. &c.



CHAPTER XVI.

OF THE WISDOM OF THE DEITY.

IF wisdom has been defined as being the right exercise of knowledge, it is not a definition of very popular acceptance. The knowledge of God, being universal, is treated of under Omniscience: there including, as it is confined to, that power or quality which knows, first, all that is, and, in addition, all that was and all that will be. Extending the above definition, His wisdom includes, together with the exercise of that knowledge, the knowledge of causes and of effects, of means and ends; and thus it conforms, if I mistake not, more nearly to what we term wisdom in man. In physics, therefore, the wisdom of God should be a universal knowledge of the best manner of producing any desired effects, and those effects the best ones: in morals, a similar knowledge of the best means of producing moral ends, and also of the goodness or fitness of those ends. Or, briefly, if the Wisdom of the Deity be perfect, or, as the awkward term is, infinite, it will be to know the best means of producing any end, while also knowing that such end is the best. To add, as some have done, the best application of means, is a superfluity: while when Clarke, to whom we owe the above narrowed definition, includes a right intention, or will, in selecting the best ends, this is, obviously, to confound with it other attributes; equity, rectitude, goodness.

A priori, under that identical argument which I have criticised in a preceding chapter, God ought to be perfectly wise, on the general principle that if He possesses any quality, it cannot be less than entire, or perfect; just as His duration and presence are unbounded. But this will appear most securely and palpably, if we examine in what wisdom consists, under a more detailed view than the one just given. In us, where it is confined to particular subjects, and further, to partial views of those, it is comprised in this, namely, on any given physical subject. The philosopher who knows the existences and powers of certain bodies, what they are, how they act on each other, and what they effect—who, in other words, knows all the relations of such bodies, their fitness to produce certain ends, and the ends which they will produce, is, thus far, wise, whether he can dispose of them for such ends or not; since, to do this, implies power, not wisdom.

Now it is certain, or admitted, that He who made all things, and appointed all causes, and dependencies, and actions, must know all, just as the philosopher knows a few: as it is equally plain, that if the latter knows the right, or best, way of producing one end, the Deity must know the best way of producing all. This is entire, or perfect wisdom, and must be His wisdom: while, if He cannot therefore be ignorant, neither can He want inclination or power to produce what is best, because of His attributes of perfect rectitude and omnipotence. In the case of man also there yet remains passion, to oppose his portion of wisdom: in God there is none: so that in every view, moral and physical, and to all ends under each division of events and ends, His wisdom must be perfect. That His conduct must also be right, is certain: but this, while it is the

consequence of right intention, ought not, as I have just remarked, to be included under the effects of His wisdom, though thus united to them by the metaphysician just named ; since it is a corollary derived from the proof of another and a distinct attribute ; His rectitude, or justice, or goodness.

If this question be presented in a more negative form, the same conclusion follows. Man is wise ; yet partially, or within certain limits : beyond this, he is deficient, or wants wisdom. Being thus, it is because he is wanting in knowledge of the facts, or of the causes and actions, or of both : whence he wants the knowledge of events or consequences ; being therefore defective in the power of sufficiently comparing and inferring. Or else his reason is perverted or obscured by passion. The Deity is ignorant in nothing, and is without passion ; as He also possesses perfect reason, since He has given all reason. He can never therefore infer wrongly ; or He must possess unlimited wisdom : while that wisdom cannot fail to be exerted, because He commands every thing ; nor to be rightly exerted, because, with perfect rectitude, there is entire power. He is therefore necessarily all-wise : in the same sense and manner that all His attributes are necessarily what they are, or that He necessarily exists.

And this is the true sense of the term Necessity as it is applied to the attributes and the conduct of God : while it is a term which I must here explain, as far as my very limited plan allows, since the opportunity has not yet occurred, and since it has been applied to all His attributes as well as to His existence. A term of the schoolmen, ever accumulating words to no end, yet obscuring plain sense by this abuse, the double meaning

which it includes, or admits, has also led to a confusion of ideas, and even to mischievous inferences; as if there were any analogy between this necessity, and the Necessity, or Fate, of the pagan philosophy.

His existence is of necessity, because He could not but exist; it is an identity even in terms: and His attributes are equally of necessity, because they constitute His existence, which is but an existence of attributes. In the same sense, not in the vulgar one, of an overruling force, His conduct is not less necessary, because it is the result of His perfections. Not to be necessary in this case, would be to be influenced by caprice, or by passion; neither of which can occur to Him.

Nor let this explanation be mistaken as if it affected the freedom of God, or controlled His actions. The wide application of an habitual, and somewhat vague term, is apt to mislead us. There is the necessity, for example, to do right: but that necessity, nevertheless, is His free will; because His will is to do right, or because such is His nature. But as His wisdom and power can do right by ways without end, all possible freedom of choice still remains. Or, taking a wider and another view, the necessity of His conduct, in any manner, is the result of choice which always knew its own motives: His actions are the produce of intentions formed from all time: they are necessary, because they are consequent on His own rules of conduct, or because they constitute that government of the world which His wisdom established, and which, He being eternal, He must have established from Eternity. The meaning of necessity in this case, and its difference from the Necessity of paganism, will appear more clear by the contrast. Under this, according to the Greek, at least, if not to the Roman philosophy, the Deity was bound

down to a specific mode of action, and to specific actions: being thus rendered the servant, instead of the master; the agent of an ulterior Supreme will: since some supreme will must have established the laws through which certain events must, of necessity, take place.

If, in other cases, I have drawn some moral or practical conclusions from the several attributes of God, thus demonstrated or illustrated through metaphysical reasoning, before proceeding to those physical proofs and illustrations which constitute the essence of this work, I ought not here to omit the perhaps most obvious remark which flows from a consideration of the entire wisdom of His nature; often as it has been made by theological writers. In as far as the world has been made and is governed by perfect wisdom, it cannot be deficient, or faulty, from defect of knowledge and wisdom, nor, under omnipotence, from want of power. If our own limited works should not be deficient from the want of any of those qualities, they may still be imperfect, or the reverse of good, from want of rectitude, or good-will, or from passion, opposing or diverting reason or knowledge, or counteracting good-will. In the Deity, those causes are precluded: and the obvious consequence should therefore be an undeniable one. Whether therefore we comprehend the rectitude of the appointments of the world, or not, they must be right, there is no cause to produce wrong: while we must not forget to distinguish between absolute wrong, and that which appears wrong to us; as we ought also, in justice, to attribute this last to our own deficiency in wisdom or knowledge. But I need not here pursue this question, as it will meet us again under the attribute of Good-

ness, and the great question of evil. It is evidently one of those *à priori* inferences which may be disputed, to at least the professed extent, on the ground of our incapacity to judge of the exact nature of God's attributes: as also from other reasons, often produced, the chief of which I shall be obliged to notice hereafter.

The purpose of the physical chapters which follow, is to adduce instances of the Wisdom of the Deity. These cannot, however, do more than prove the simple attribute: they cannot even approximate to a proof of the universality of this wisdom. The approximation is much nearer under the attribute of Power, for reasons that will appear hereafter. The evidences under intelligence, as displayed through design, are more than sufficient as the proofs of His existence. But, in the present case, it is plain that no proofs of His wisdom can be produced, which are not measured and limited by our own: we are the judges, and can only judge as we know. The extent or perfection of that wisdom must still rest on the *à priori* argument.

If the following proofs of wisdom might often have been cited under those of Design, it was generally more convenient to place them in this division; as in some cases this was also the fittest arrangement. It is further true, that the facts of natural history can seldom be separated as might be desired, under such objects as the present, without producing the utmost confusion: while the intention to instruct the reader fails also, from the disseveration of facts naturally connected, and the interruption of what ought to be continuous: to say nothing of those inconvenient repetitions, which, under every attempt to avoid them, are already but too numerous. And further, although the proofs of these two things can often be separated, it is very often also only from

the wisdom of an arrangement that we can discover it to be a design at all. We perceive an end; it requires wisdom to attain it, through means; and the arrangement of those constitutes the design. It is therefore a careless remark, made by Stewart, when he says that design and wisdom are not the same; that there may be a design, but that it may not be wise. In the Deity, these are one thing.

I shall premise a few general remarks on the manifestations of the Divine wisdom in the physical world, before entering on the minuter details which follow.

There are laws respecting matter which need not have been, or might have been of any other nature. They produce certain ends, or good ends, perfectly and constantly: and being of arbitrary appointment, this is wisdom.

There are laws which imply a great extent of profound knowledge, perfectly directed to the production of an effect; while that effect is produced. This also is wisdom.

There are contrivances, often of a very singular, abstruse, or unexpected nature, for producing a valuable end; and there are great apparent difficulties, to us even impossibilities, overcome, and often in the simplest manner, when we attain the requisite knowledge of the facts: which is also wisdom.

Counteractions, appearing to imply the necessary defeat of a plan, are met and counteracted so completely, that the remedy is absolute: while the simplicity is often not less admirable than the efficacy. It is only great wisdom which succeeds in doing this.

To arrange and fit together the multitudinous parts of a wide design, so that it shall answer the intended ends, is an operation demanding much wisdom: that

multitude is so great in the universe, the design is so extensive, and the perfection, both in the execution and the desired results, is such, that if there is aught which not only proves wisdom simply, but approximates to the proof of perfect wisdom, we ought to seek it here.

To produce numerous, and complicated, and different effects, through one or a few simple principles, is, in philosophy, held to be the sublime of wisdom. And this is at least a frequent character of the proceedings of the Deity. This is the simplicity so dwelt on by writers, and so often sought for, or pronounced on, where it does not exist, and where it was not intended. It may sometimes indeed be, that we do not see deeply enough to perceive this simplicity: but it is also true, that in seeking for wisdom alone, philosophers have forgotten that He intended to demonstrate something else appertaining to His intentions or character. A proceeding may be perfectly wise, though it is not simple: His unbounded mind knows how to combine perfect wisdom with intricacy of execution: while, as I shall hereafter show, such combined demonstrations of more attributes than one occur largely throughout creation.

CHAPTER XVII.

ON THE MORTALITY AND FECUNDITY OF
ORGANIZED BEINGS.

BEFORE inquiring into the wisdom and the care under which the Creator has provided for the continuation of the races of animals and plants with which the earth is filled, it seems necessary to answer a question which has sometimes been asked:—Why was not the entire mass of animal and vegetable life rendered permanent, since replenishment was the object, and since all the contrivances for perpetuation tend to this purpose? Why at least was this not the case with animals? as to them, the end of the Creator was to fill the earth with sentient beings furnished with the means of enjoyment: while the cessation of this, in that of their existence, is an evil, often attended by the more direct evil of positive suffering. And His object being the happiness of animals, this would equally have been attained, had the races which were first appointed continued to occupy the world still, being thus, if not immortal, as durable at least as the earth itself.

I do not perceive that my predecessors have answered this question as it admits, and as it, in fact, demands; since the majority of readers are thus left without just ideas of the plan of Creation, and without even a clue to those philosophical views of the system of the Creator, without which they must be perpetually harassed by doubts, even on some of the plainest subjects which

have been brought under their notice. It is never easy to view any system, though but a human one, in all its bearings: it requires the most extensive knowledge, and the deepest exertions of thought, even to approach to a comprehension of the Creator's designs, though but partially, and in the smallest portion of His works; as, to scan the whole, has not been allotted to us, and, in this life, never will be. Even of what our race will some day know, much remains dark to ourselves: but he who cannot inquire for himself would be unfairly treated, did not a writer attempt to place before him what can at present be inferred respecting the Divine government, when any question relating to that occurs.

It is no answer which I find in Paley, that on the mortality and renewal of man, depends all the happiness which results from domestic relations and the ties of kindred; because it is inapplicable to that vast mass of other existences by which the earth is filled. Nor is it an answer, that thus alone could the earth have been replenished after the first act of creation; because the Creator was limited solely by His own will, in producing a single pair of each kind. He who created one, might have created as many as the world could contain: or, had He not designed a system of mortality, He might have abolished the law of perpetuation at any period of its replenishment.

It has also been answered, on other grounds, that the animal structure must be expended, or destroyed, through the action of the causes by which it attains its maturity and performs its functions. The growth of an animal, it is said, is a process of constant addition to the ultimate "globular" structures, or is an expansion of a complex framework. And that expansion being attained, though there is a provision for continuously repairing

what is injured or destroyed, the same powers which once "expanded" the organizations now tend to "condense" them; whence the structure is at length rendered incapable of continuing its functions, with the necessary consequence, death.

Of the philosophy of such an answer as this I shall not now inquire: but it is not even an answer, under the mere physiology to which it pretends. They who have given and they who have accepted it, must have been easily satisfied with words. Expansion is scarcely even one of those deceptive metaphorical expressions which constitute one of the widest classes of fallacies: the animal growth does not resemble the inflation of a bladder nor the extension of a tube of Indian-rubber. As well might a house be said to be expanded by the addition of stories. Even if expanded by the force of the circulation, as is said, why does the expansion ever cease, and cease, above all, in the climax of vigour, when all the powers act with the greatest energy? As little can we understand why the same force which once expanded, should condense at another period; while, if there is nothing to produce condensation, so is there no condensation to be traced. But this word is the correlative of expansion, and each is equally unmeaning. And though the parts were condensed, there is a constant accession of new matter, sufficient to replace the atoms in greater proportion than the waste, as in the period of growth. If the means of reparation indeed were but adequate to meet the waste, at any period, why are they not such for ever? The present organization, supported as it is by a system of nutrition through food and air, would be deemed ever-during, even by physiology, did not experience teach otherwise.

If then the former answers are insufficient to explain

the joint system of mortality and fecundity established for organized beings, the physiological one is deficient in truth, and faulty in philosophy. The expenditure and termination of organizations is not a necessity, and the result of a defect, but a provision of design and wisdom : the one half of a system, in which fecundity forms the other. Accident is a cause of mortality ; but what is accident to us, is intention on the part of the Creator. Disease is a cause of mortality ; and diseases are of His appointment. But even under what is termed natural death, we see that He has appointed laws to prevent the organized structures from lasting beyond a certain period, which He has also fixed for each species, with an average precision, sufficiently familiar in all those with which we are acquainted.

This is the question which concerns us here : and though physiology should hereafter explain the modes by which these laws act, as it has not done, that would remain the same. It has indeed been said, that the duration of an animal's life is a fixed multiple of its growth, and that this proves the above theory true. But the most familiar experience contradicts this. The raven, the eagle, and the swan, are at their full growth in a year, and live for a century : the long life of the tortoise is equally well known. If man is said to live four times the period of his maturity, the horse lives seven times : and the smaller birds, completing their growth with the raven and the swan, have lives limited by periods of great inequality. The insect races afford objections without end to such a theory : and among them I need only name the bee, which, attaining perfection in a few days, exists for two or three years ; and the proverbial ephemeron, whose life is measured by as many hours. Nor can any physiological reason be as-

signed, why the dog and the horse should not reach the age of man, nor the linnet that of the eagle. Whatever the physical cause may be, the reasons must be sought in the Creator's total design, as it regards the whole organized system : while, failing to discover these, we must rest content with knowing that it was His will, and therefore believing that all is wise and good.

To comprehend the entire design in the system of life, whether animal or vegetable, is far beyond our powers : we cannot see our way clearly, even through its separate portions. In certain cases, we can indeed perceive that a low fecundity may be balanced by a long life, that a high one is useful under a system of prey, that the animal which preys ought to be less productive than the one which is destined for its food, that those for which the system supplies most food ought to be the most productive, and that those of the widest utility ought also to be the most fertile. In the same manner, we can, in certain cases, judge of the purpose or propriety of determined and varying limitations of life : yet our knowledge is so imperfect, that we cannot pursue these inquiries to any extent. And they exceed the purpose of the present chapter, which must confine itself to a general inquiry into the utility and wisdom of the system of joint mortality and fecundity ; in animals chiefly, but in plants also.

Whether a greater sum of happiness was to be produced by conferring short lives on many, or a long life on one, whether a million of beings of an annual life constitute a larger mass of happiness than one life prolonged through a million of years, is one of those idly speculative questions which must be left to those who delight in such discussions : excluding from it man, of course, since we can see a distinct purpose in multi-

plying the only being who is empowered to attain eternal happiness. My business here is to seek for reasons why a temporary life, with a succession of lives, was, not simply better than a permanent one without it, but was inevitable, as far as the system of the present earth is concerned. But when I say inevitable, or necessary, I mean consistent with the whole of a design founded in wisdom; since we must not forget that God ordained nothing, of which He did not know all the results, and that these necessities are but portions of His entire appointment. It is at present a necessity, for example, that half of the period of our moon should be a time of comparative darkness: but had He not willed it thus, that body might have been a luminous instead of a reflecting one, or the earth might have been attended like Saturn or Jupiter.

The necessity of the joint system of mortality and fecundity is resolved, therefore, into a question of utility: since it is of His wisdom to do, or to permit to be done, whatever is useful, or good. And the inquiry respecting the utility of this appointment resolves itself again into two principal questions: each however branching into many minor ones, of which I shall notice whatever seems most necessary, as far as my limits allow; as it is also beyond my bounds to pursue this subject under views that might not so well rank under these principal heads; since in no case does my plan permit me to exhaust the subject here examined. The world, in the first place, as it is constituted, could not otherwise have been kept in that state of replenishment which was evidently the Creator's design: and, secondly, the system of uses which organized beings serve in the great circle of nature could not have existed. If both these views apply to animals and plants, I need not extend the

whole of the following remarks to each of these divisions of life, since the reader can do this for himself.

If it is said that the earth might have been replenished with organized being from the beginning, a material fact is forgotten. I have shown (c. xx.) that its surface has been enlarging ever since it left the Creator's hand, (under the usual views entertained of its creation,) and that there is a system of laws appointed for its continued enlargement, or rather, that the same Hand is perpetually employed in extending it. It is evident, therefore, that a system of increase for organized beings was necessary, if the earth was to be kept in a state of replenishment.

But that enlargement is only one portion of the changes which it is constantly undergoing. If new lands are formed, they are also of a different character from the previously existing ones. The rocky precipices and snowy peaks of the Himalaya are converted into the broad plains of Hindustan, the unproductive Alps spread out into the fertile levels of Lombardy : and if that which once occupied a square mile of surface now extends to a hundred, so has it changed from a climate of almost uninterrupted winter, to one where summer is perpetual. The woodless mountains of Borneo and Java are stretched out into steaming and marshy forests occupying thousands of new miles : and in endless other modes and places the face of the earth becomes so changed, that it can no longer be recognised for that which was first appointed for its inhabitants. The climates themselves alter under new formations of land and new modes of vegetation, under the growth or the fall of forests, and the drainage or the accumulation of water, controlling the rains and the winds, and influencing the very Sun. The animals, profiting by its

vegetable produce, assist in changing the places and the characters of this: and man, above all, in making a rude earth fitted for himself, by destroying forests, draining lands, and far more, aids in producing that constant alteration to which it is subjected, and in subverting the order originally established; but established, not only with the perfect knowledge that it was to be changed, but with the intention that it should be so. Still further, islands are for ever rising out of the ocean, created under our own eyes, enlarging daily, and destined to enlarge without limit: barren rocks at their production, and barren and useless to have remained for ever, but for the system under review, and thus defeating the very ends of the extraordinary contrivances through which they are produced.

I may now ask in what manner the Creator could have peopled such an earth with an original and undying creation of animals; to omit, at present, the similar and almost superfluous question which relates to plants. The hypothesis of immortal organizations excludes the system of increase: and thus, if we consider merely the simple enlargement of the earth, it must have gradually become deficient in replenishment. The total system becomes defective: the earth is a provision for life, since we can conceive no purpose in a vacant globe; but, in such a case, there is a provision without an object.

I shall immediately inquire of other speculative remedies for this defect; but the mere enlargement of the earth is not all, as we have seen. From the beginning, it has differed in climates and soils, in a thousand ways, and thus also has its vegetable produce, the fundamental food of animals, differed everywhere. Species beyond numbering were originally created to occupy

every climate and every soil, every conceivable point of the world : and that all might be filled, their sizes, forms, constitutions, and inclinations, have been varied accordingly. Presuming on an immortal life, we must of course exclude a system of prey : but it is plain that we cannot exclude the necessity of food, without adopting a system which would render all further inquiries on this subject unnecessary. But, as I have just shown, the new lands differ from the original ones, the climates are changed, a forest is destroyed, or it grows where never forest grew before, a barren tract succeeds to a fertile one, or the reverse, water is changed into land and land into water, the character of the vegetation is entirely altered, and the food that maintained myriads has vanished. The constitutions and the inclinations of the animals must be altered to meet those changes : or rather, the Creator should never have produced that variety ; in reforming one part of His plan we must condemn the whole. But even this would not suffice. The marshes of the Don and the swampy woods of America were assigned for the habitation and the food of myriads of flies. But the marshes are drained and the woods are burnt ; the provisions for sustaining all this life are at an end. Being immortal, they must migrate ; but whither ? while even then the change of circumstances demands a new set of inhabitants, or a portion of the earth becomes a blank.

I need not illustrate this further, even under the admission of races feeding on vegetables alone, though I have elsewhere shown (c. xlix.) that the earth could not have been replenished under such a principle. It is already obvious that it could not have been occupied by an original and undying creation of animals, without some further provision. And the same reasoning

applies to plants, as easily to be conceived immortal as animals; since, in both cases alike, nothing but continued new creations, or a principle of reproduction, could have sufficed to fill the new blanks, or meet the varying changes of the earth's surface. And it will require but a slight further consideration to see that the entire system could not have been other than it is: which, speaking with reference to the Almighty, means only that it has all been contrived in perfect wisdom, and that we cannot hypothetically change the smallest portion, without immediately perceiving the evil consequences. Though admitted also, that animals might have been made of an immortal organization, that the difficulty of feeding them and the perpetual changes of the earth might have been obviated by Almighty power, that all might have fed on plants, and all indifferently on all plants, that they might even have lived without food, the least reflection will show, that not only is this to form systems so different from the existing one, that we might as well speculate on a heaven of angelic natures, but to produce schemes requiring a perpetual succession of miracles, or of interferences with any established order. And while this demands the constant interposition of God, or a providence, in the most rigid sense of that term, that is one of the views which are held in particular disesteem by all those who would thus amend the order of nature. All hypotheses of this kind are connected with a system of general laws and non-interference: so difficult is it to be consistent, in remonstrating with the plans of the Deity, and in inventing systems of that philosophy so often stigmatized by a term which I suppress whenever that is possible.

There are but two apparent modes in which the Cre-

ator could have maintained an enlarging earth in a state of replenishment ; presuming that He had not chosen to adopt the existing one : and I may take the simplest view, that of its mere enlargement, neglecting, or granting, all else already noticed. He must have created new species, equally immortal, to fill those new blanks, or He must have empowered the original species to increase in the exact proportion and at the exact times required. Under either mode, the difference, as His conduct is concerned, is nothing : it is that interposition which all similar schemes wish to disclaim. It is at least to suggest to Him another mode of governing the world, than the one He has chosen : and if to this simplest view I add the other difficulties already stated, it is to propose a government so complicated and operose, that even the wisdom of man would reject it.

But there were still further difficulties to be surmounted in maintaining the earth in a state of replenishment under a system of immortal organizations, without an even greater accumulation of perpetual and hourly miracles. Though animals had not preyed on each other, nothing less than miraculous interposition could have prevented them from being destroyed by accidents. The elephant must have trampled down its millions, the winds must have blown armies of insects into the waters, the evaporation of lakes must have left dead fishes on the shores, the animals feeding on plants must have devoured what they did not desire as food, and the whole system must have gone into disorder. Even man could not have retained his place on the earth : his very race might have disappeared from it in time ; unless all else had been appointed in conformity, and this globe had been the heaven, of the nature of which speculation may dream with as much reason as it dreams of amend-

ing the present system in the least point. And if, without a most complicated contrivance of miracles, death must have existed, the scheme in question has the additional disadvantage of an inequality of allotment inconsistent with the Divine wisdom and justice.

Under the mere view therefore of the replenishment of the earth, and independently of those uses served by animals and plants which form the second great argument in favour of the present system of joint mortality and increase, this, which has been adopted, is, to our conviction, the best. Looking first at the law for increase, it is the only one, as far as we can discover, which would have served to fill the earth with life, under the circumstances already described. As the vegetable world simply is concerned, the earth enlarges, soils are altered, climates change, accidents or uses destroy, and all this must be provided for. The growth of lichens and mosses produces a soil on which these plants will no longer live; and a new one succeeds, filling the blanks, and forming a more useful tenant of the earth. Worthless trees invade a worthless soil, and are exterminated or die, to give room to a better race, ever ready to fill the vacancy which is left. The original spot might have maintained reptiles and insects; the amended one serves to nourish other races of animals, and, in these, if one tribe dies, or is driven away, by changes in the earth itself, or changes in its vegetation, others suited to those alterations are at hand, and the blank is scarcely discovered till it is supplied. Thus is the earth for ever replenished, and creation ever full. Nothing but the present principle of increase could have effected this; and nothing but its profusion could have accomplished it with the rapidity which we see.

. And to such a system of increase, one of a corre-

sponding mortality was indispensable : under this first argument, it is the great reason for that mortality, absorbing all others : or it is the prime intention, and the latter was an indispensable accompaniment to it. Had an ever-during life been granted to the species originally created, any mode of increase not guarded by an hourly miracle would have either failed to produce the desired effects, or else have over-stocked the world, so that, in animals, death must have occurred for the lack of food : without at least such further schemes as it would be nugatory again to suggest. Thus also in plants, the organization might, even more easily to our apprehensions, have been such as to have induced no natural death, while also less subject to destruction from accidents : yet the principle of increase must in them also have led to it, even from want of space, and the more obviously, when, of their seeds, destined for the food of animals, many must have escaped destruction, and thus have crowded the earth to the necessary death of some. And thence, in them, and in animals equally, the best or only remedy was the system of limited duration, or mortality, under which the aged should be removed, and removed in preference ; because, under a long exposure to accidents or injuries, though the original organizations had been perdurable, the probability was that they must have been at least deteriorated, and thus rendered less efficient : unless, again, under a totally different system, or a perpetual miraculous interposition.

Such are the reasons for the mortality of all organized beings, under the first of the two considerations which I commenced by stating, namely, the intention of the Creator to replenish the earth with life. And thus also is our reason compelled to acknowledge the wisdom of

God, whenever we venture to speculate on even the minutest alterations in the system which He has established, though we may not always perceive the results till they are thus analyzed for us. And if we cannot always bring the objector into a similar dilemma, we may still safely conclude, that every thing belongs to one great whole, the plan of God, arranged by wisdom, and, as we must believe, in goodness also, whatever remonstrances we may occasionally feel inclined to make: and that nothing, even of what appears to us most questionable, could have been otherwise, without assuming an entirely different plan on His part; which is equivalent to saying, ultimately, why is man inferior to the angels, why are the angels inferior to God? This must ever be the conclusion of our doubts respecting the system of which we form a part: and if the analysis is sometimes more difficult than it has been in the present case, analogy should induce us to believe that it might be made, under more knowledge; or at least to acquiesce, from the general conviction of our own ignorance and errors, and of His wisdom and goodness.

From the preceding remarks, if I may digress thus much, we may deduce an answer to a vulgar objection currently made to the well-known doctrines of Malthus respecting excess of population. It is said that "God has not sent more people into the world than He has use for;" if this proposition might be better expressed. Doubtless, this is true, inasmuch as He always acts in wisdom; but it is not true in the sense of these very uninformed and indifferent reasoners. This question, as to man, must be viewed as I have viewed it for animals in general: since in whatever else man's destiny may differ, the prime object is the same, namely, to fill blanks and to replenish the earth. But though

the wisdom of the design is unquestioned, the fecundity of man errs in practice, as does that of all other animals; and very essentially, as far as his individual happiness is concerned: whence there arise, at certain periods and in certain places, excesses of population, because the adaptations and corrections are not perfect or efficient: while we can see that they were not designed to be such. All through creation, under a design which, in the total, is wise and good, failures and evil are permitted, or commanded, as I need not here repeat. And it is a sufficient proof of the existence of excesses of population, that they must have been foreseen by the Creator, which is equivalent to their having been at least permitted, if not intended; since He has made provision to meet them by ordaining mortal and extensive diseases, and notably, wherever mankind becomes condensed, whether under unusual productiveness of the soil, as in the case of alluvial lands, or from whatever cause. This is the real nature of the Divine government on this subject, deduced from the facts of creation; and thus is demonstrated the ignorance of the objection to which I have now replied.

The systems of uses derived from animals and plants, form the second great reason for the joint fecundity and mortality of organized beings. Under the first argument, the latter was viewed chiefly as a necessary accompaniment to the former: under the present, the mortality itself was the prime object; since the uses are derived immediately from it, while the fecundity is but the preparation: while also, those two views, united, leave the arguments for the total system complete.

For fuller details on these subjects, I may refer to what I have elsewhere said on the feeding of animals and of plants, the system of prey, the history of water

and the atmosphere, that of the earth, and more : though I must still note the principal facts as they bear on this question, since it is never easy for a reader to do this for himself, while they also belong chiefly to future chapters of this work.

The germs of plants are produced in myriads, without any design that they should grow into representatives of the original : this excessive fecundity is designed for the support of animals, and the mortality of the former is the life of the latter. In other ways, the living and completed organizations are destroyed for the same purposes. It is the same with respect to animals, under that system of prey which I have elsewhere proved to be necessary for the replenishment of the earth and the multiplication of enjoyment. The appointment of an extraordinary fecundity is the first step : but it is from the mortality of one species that another receives the means of existence.

But independently of this immediate and direct destruction of one organization for the support or production of others, I have elsewhere shown, that there is a more remote, or an indirect, circle of mutual aid established between animals and vegetables, under which new lives, with new bodies, spring up from the cessation and ruin of previous ones. This is the great chemical round, between animal and vegetable life, between decomposition and recomposition ; where, though under a system of mortality, the reign of death is of short duration, and where nothing dies that shall not revive again into new life. Here too is that mortality the immediate source of newer and better organizations : of fresh and perfect forms, to replace those which have suffered, or to supply the new vacancies of the earth, or to furnish other substitutes for those which have been deprived of their places or their food.

Elsewhere too I have shown, that the coal which now forms our fuel is the produce of the destruction of plants, preserved from former worlds. It is the immediate result of mortality ; but it is primarily the produce of a fecundity exceeding all the other uses which animals could have derived from it, and, we may safely infer, directed to this very end. It is the most striking case of uses, independently of food, derived from the fecundity and mortality of plants, as that of peat may be added to it. And similarly, it is to the enormous fecundity, succession, and destruction of life, that we owe the limestones of the earth, with all the uses which we derive from that which is ever increasing to lay the foundation of a future and a better globe. It is the same principle, too, which is now producing new islands, new continents ; extending new territories for new races of life, and, under one great scheme of joint life and mortality, laying the preparations for an endless succession of new lives under new forms. This globe, the present earth, with even future earths, has been ordained to depend, in part, in its very structure and materials, on the succession and destruction of animal and vegetable lives, as its surface has been committed to the toils of man chiefly, for its modification and improvement. Organized beings are the agents and the laboratories through which its constitution, its value, its very form, bulk, distribution, are modified now, and are destined to be still more modified in future ages and future worlds ; as we ourselves have received our own, constituted as it now is, through the actions, the lives, and the destructions of former animals and former plants, passing all numbers, and all time, of which we can conjecture : the produce of lives and deaths in myriads, stored up through uncountable periods, and which,

benefiting us by their living and their dying, will carry on those benefits to an almost endless future, with the additional ones that new lives and new deaths are for ever contributing to augment the store of good. If geology has not hitherto viewed the earth in this light, it is fully time that it should. It has long known the facts, without thus reasoning from them : and if I have noticed them in a specific chapter, the reader of that chapter only might not have succeeded better. It is the apology for urging them here : for it is not scientific order, but moral views which form the true object of this work. And the reasoning is of high importance as it bears on the Creator's designs, not perhaps for our globe alone, but for far more. It was created for life, but it is also ordained that it should depend on life for much of its constitution, and much of its power in maintaining life. This is a circle between life and death, and between death and life again, far more wide, far more intricate, and far more wonderful, than the great chemical circle of the atmosphere : for it embraces successions of earth after earth, globe after globe, whereas this is limited to one. Well also may it excite surprise, when we contemplate the apparent inadequacy of the means, the singularity of the agents, and the slowness of the process ; while, did it give rise to no other reflections, it might at least teach us a pious caution in judging the plans of Him whose thoughts are so unlike our thoughts, and whose ways are so remote from our ways.

Before this great result of the system of fecundity and mortality, all else that I have pointed out shrinks almost into insignificance. Nothing but mortality and destruction could have produced these important consequences ; nothing but death following a previous exuberance of fecundity could have effected any of the great

and useful ends which I have pointed out. And for whatever other purposes already named, this astonishing, and often apparently superfluous production of lives and organizations has been appointed, it is now evident that it was necessary for the sake of destruction alone, and that the mortality of all organized beings is one of the most fundamental and indispensable laws of the universe. What then would be the philosophy that demanded an immortal creation? Blind indeed; as he must ever be, who forgets to search out the Creator's will as it is displayed to him who will seek, and who does not always neglect this from incapacity or disbelief, but because some false system teaches him, that to blind ourselves to all that we can ever see of Him, is the best way to see and to know Him, the invisible, but not the concealed.

I shall only add, that he who shall have gone through the whole of this work, will easily supply, as to this chapter, and many more, what I could not have noticed without undue repetitions. And much that may every where appear deficient or obscure at first, will become plain on re-perusal, though the reader should possess no other knowledge than what he may extract from these slender sketches; presenting, very often, a page, where a volume would scarcely have sufficed.

CHAPTER XVIII.

ON THE PERPETUATION OF ANIMALS.

I MAY now proceed, in this and the following chapter, to select some of the most striking examples of the Divine wisdom and care in the perpetuation of animals and plants. But, in both departments, I must limit myself to the provisions made for the security of the representative individuals, for protecting the germs already produced, and for insuring their arrival at that condition in which they may fill the vacancies existing or to exist. And if, in all this, we shall trace wisdom, care, contrivance, foresight, I may even say anxiety, displayed in innumerable ways, for the purpose of keeping up the races placed in the world at the Creation, we may safely infer a Providence, or a system of perpetual government, under corresponding provisions: though a certain philosophy may still assert that the needful laws had been appointed at the beginning, and that no further thought or interference had been required.

As it relates to animals, this subject consists in the care of the parents respecting their offspring, displayed in a variety of modes, in the different races. It is the instinct, above all others, which has, from all times, attracted the notice of philosophy: and that it is implanted chiefly in the female parent, is familiar. Extended even to our own species, it is a provision bearing

the mark of the Divine wisdom ; since it is certain that reason alone, even under its highest cultivation, would not have accomplished the ends in view.

I shall not here inquire of the value of a recent physiological hypothesis on the nature of the provision made for this instinct. It is the fact, not the means, which concerns us here : while that system scarcely explains the temporary nature of such an instinctive conduct. The young, however ardently loved, are loved only while they require care : and, that time passed, the passion expires as if it had never existed : while in this also we trace the further wisdom which has modified an established law.

Omitting therefore all such speculations, I shall point out a few of the modes in which the general design of the Creator for preserving the races of animals is displayed in their conduct : while they will suffice to show how a law of parental care, if we choose to adopt this term, has been modified to meet the several exigencies, if not also to display variety of resource and proceeding. There is not simply a general law, or an instinct of affection to offspring, impressed on all equally, or of the same nature in all. In some animals, other instincts, such as that of building, are attached to the merely parental one : many are doomed never to see the living produce of those germs on which all their cares are bestowed ; and there are others which display the warmest affection to a progeny in which they have no parental concern. It is vain therefore to seek, in one physiological cause, for such a diversity of effects. To him who is content to pass at once from the point at which knowledge stops, to the First Cause, it is the wisdom of God ; adopting various means to attain the general end, the security of perpetuation ; subject

however to those exceptions which I have stated in another chapter.

Though the attachments of the quadrupeds and birds are to their own young, these are not so exclusive but that even other species may sometimes be substituted; as is familiar. And the case is similar in our own race, where even the hired nurse becomes a mother in affection; as the negligent mother is apt to lose that which was implanted, but has not been cultivated. This, carelessly referred to habit, is the result of that beautiful law, through which the exertion of kindness generates love in the benefactor: while that love and its pleasures are the immediate reward allotted to benevolence, and the stimulus to future and continued conduct of the same nature.

The extent or intensity of this affection varies exceedingly in different quadrupeds; as does also their facility in admitting the progeny of other species to their regards. The records of natural history abound in familiar instances of this nature: and if I note a few, it is for the sake of the general conclusion, that useful purposes are unquestionably thus served, and that if we cannot now explain those, the cause must be sought in our want of sufficient knowledge. The cow does not easily admit another calf unless it is first clothed in the skin of its slaughtered one: in sheep, the affection is so ardent that it survives the death, and even the putrefaction of the lamb: not ceasing till that is removed, when it is immediately forgotten, as in every case of separation: so little of memory is there connected with this instinct. In the monkey tribe the affection seems peculiarly strong: while if, in other cases, the mother is less attached to her progeny, the reasons will probably be discovered when we become better acquainted with

the history of animals. The female whale is not less remarkable for this attachment than the quadruped mammalia: whether it extends to the other cetaceous animals, is not yet known. That the male possesses any regard for offspring, in the mammalia, is not yet proved: as, on the other hand, there are some, which, even when not predatory, willingly devour them.

Thus far the instinct is simple, except in a few animals, which, like the rabbit, prepare nests for their young: in this resembling the birds, or having an instinct of building, or preparation, superadded. But in this tribe, the instinct of anticipation and preparation, preceding the proper instinct to offspring, is as familiar as it is remarkable: while even that is but the first of at least three distinct ones, all tending to the same end. It is not within the objects of this chapter to enter on the details of a subject amply discussed in works on natural history. But the instinct of hatching is as distinct from the proper parental affection as is that of building; and if we have no proof that, in either of these preparations, the bird anticipates the result, neither do I well see on what grounds we can ever hope for one. But if there is such an anticipation at all, it should equally be dated from the pairing: a conclusion, I imagine, not likely to be admitted by those who refer the whole conduct of animals to instincts, nor, probably, even by those who allow them a limited range of reasoning powers.

Be this as it may, the intensity of the instinct of hatching is well known, since it diverts the animal from one of the strongest, the pursuit of food: while we see the wisdom of the provision, knowing that a steady and high temperature is necessary to bring the offspring to maturity. It is the second of a series of cares, all

tending to the same end ; while we cannot conceive any affection for the egg, nor, if there is no anticipation of a progeny, any motive, aught but pure force, the command that shall not be disobeyed. Yet here, as in the parental affection, there are variations and exceptions. The former are shown in the unequal perseverance of different species, under disturbance or otherwise : as, in the same species, it seems to depend on the personal character of the individual parent, familiarly differing in our domestic fowls, and perhaps merely unknown to us in the wild ones : thus showing that even this great instinct is not so absolute and simple as the advocates of pure instinct maintain. The exception familiar to us is the Cuckoo : and of this anomaly no solution has been offered ; since this bird remains with us long enough to have reared its own offspring. Yet even that exception has its interest under this general view ; as the mode adopted is equally efficacious for the designed end. Recent observations have taught us that the Ostrich is not the exception which it was once supposed, under an ancient authority : and if the marks of invasion lead the parents to destroy their eggs, it is possibly a fact to prove that they, and perhaps all birds therefore, have a knowledge of the result, and are therefore guided by more than a blind instinct, in the act of hatching.

Whatever may be judged on these difficult questions, the affection for the living offspring is dependent on the same provision as in quadrupeds. And here at least it does not arise from the personal communication of suckling, a theory offered to explain the attachments of these to their young ; nor from a desire in the mother to be relieved from uneasiness, as has been suggested by other speculative writers. And when it is said that

the licking of their offspring is the true cause of the maternal affection, or that this is but a modification of the instinct of eating, I quote a writer, Darwin, who would here have passed without censure, had not his writings been injurious, by promulgating the superficial views in which they abound.

But another important question arises on the subject of this instinct. As an instinct, it is compulsory; but of what nature is this compulsion? In the bird which tends its young with food, which sits patiently to keep them warm, as it sat before on the eggs, depriving itself of liberty, exercise, food, of all which seems to constitute the happiness of the inferior animals, we should conclude that all was labour and all was pain. But to judge thus would be to disclaim the admitted principle that the desire of pleasure is the universal stimulus to action: whence we must admit, that the exercise of affection to the progeny is the highest of pleasures; sufficient in itself to counterbalance all the labours and privations by which it is attained, or rendering all other pleasures of no account. And this inference is further safe, because we know it to be true of the human parent. Hence then, whatever the instinct, or the compulsion may be on the part of the Creator, the motive, as far as the animal is concerned, is the pursuit of pleasure in the exercise of affection, as in this also is the reward. And thus we deduce His goodness; who, in pursuing His wise ends through a compulsory command, has rendered that compulsion itself an act of free-will, a mode of the universal motive to every form of mind, the search and the attainment of happiness.

In the bird tribe, if not in quadrupeds, the male parent possesses this instinct as well as the female; though not to the same degree, and not uniformly or

universally. We do not know how this stands in all birds: where we do, we see that the labours of one parent would not have sufficed to find food for a race which consumes far more than any of the mammalia; as here also we find a provision of Wisdom, in a special law to meet a specific case. If some male birds partake in the labour of hatching, the conclusion is the same. And with regard to the mistake of some birds respecting the proper objects of their care, as in the case of the domestic fowl and its duckling brood, it proves the strength of a passion implanted for a useful purpose, since it is such as to deprive the animal of its usual powers of observation.

But the most interesting displays of the instinct or affections of birds on this subject, are seen in the last stage of their cares, the education of their offspring: while I am not aware that there is anything analogous in the quadrupeds, where indeed it was not needed, since the young, from their very birth nearly, move as they are to do during all their future lives. The transition between the repose of the nest, and flying, is very great: and even after their escape, the young, yet feeble, are not capable of finding sufficient food. Thus the parental cares are still exerted in teaching their offspring how to fly: and there are not many more interesting sights to watch, than this course of instruction, in the swallow and others which build high above the ground. He must also be a careless observer of nature, who has not witnessed the gradually diminishing dependence of the offspring, after this great change; in the beseechings and the caresses which solicit food, sometimes granted and at others refused, till the link is broken, and the passion implanted for this great purpose ceases to act; when the new animal at length takes its inde-

pendent place in the great society, to labour in no long time for a posterity, as it has been a cause of care and labour to its parents. And it is here, in the snow-white pigeon, that the painter will find that expression for the protecting and pitying care of angelic natures, which he may long vainly seek in his own imagination. Not less are all these cares of education to be seen in some of the aquatic fowl: and there are few sights of this kind more interesting than the laborious and long-continued instruction, the persuasions, caresses, examples, reproaches, through which the mother Guillemot teaches its simple infant the art of diving.

To point out some collateral circumstances connected with the security of offspring, its early maturity in all animals is very remarkable, when compared to the condition of man. But it is not true, as has been said, that the expansion of the mind and the body are necessarily connected, and that the remarkable difference in the bodily maturity of man and that of the other animals was designed to keep pace with those of their minds. A young quadruped or bird, mature in mind, has not attained that maturity of body which it will afterwards acquire. But it attains a certain degree of that quickly, because a longer dependence on the parents could not have been permitted, under the occurrence of a second progeny. Thus could not the colt have followed its mother, had not its legs been disproportioned; while a precocity of strength occurs in all. And if I terminate these remarks with the very singular provision made for the progeny of the Opossum tribe, or the marsupial animals, it is but to point out a variation for no other apparent purpose than the demonstration of variety and resource.

If we except the Cetacea, the whole race of fishes

seems to be without the parental instinct ; while it is an exception in proof of the utility of this law. Their young are produced in crowds which no care could have fed, or even noticed : though there seem to be some, among those laying the smallest number of eggs, which lead their progeny in their train, like some of the gregarious insects ; thus also perhaps conducting them, at least, to food. But the history of these races is so obscure, that we can determine nothing.

Still, there is an instinct implanted in fishes for the security of their races, and, as in insects, it is the depositing of their eggs in places fit for hatching. This, as far as we know, seems their great, if not their sole care on this subject : and here there is equally shown an apparent interest for a progeny which the parents are never to know, and respecting which they have, possibly, no conception. It seems to be simply an instinct to deposit eggs, according to certain rules, under which every kind is a compulsory agent : yet wherever we can trace it, the anxiety and the labour displayed are not less remarkable than those shown by other animals in the care of a living progeny. In the case of the salmon, the facts are especially familiar ; while the peculiar conduct of this animal evinces an instinct of extreme force ; the more remarkable, that we can see no reason why it should not have laid its eggs near the exit of a river as well as its almost inaccessible sources, when the same gravel, the same temperature, and, in spite of a recent idle hypothesis, water equally oxygenated, occur in both situations.

I may pass over the reptiles in all their tribes ; since, with the very singular exception of the *Rana pipa*, or Surinam toad, which carries its young in cells on its back, we know nothing respecting them to afford

grounds for any peculiar remark. But the insect races afford a field so wide, that to do it justice would be almost to give the history of this division of nature. Whatever anxiety about perpetuation we may trace in the quadrupeds and the birds, it is far exceeded by what these display. In the former, the attention which the progeny receives, constitutes a very temporary and slender care, compared to the whole life and occupations of the animal; and if, in birds, there is much more of labour and attention, the business of continuing, even their races, does not materially affect the total of their wants and actions. But in the insects almost every thing seems directed to this end alone: the labour is enormous, the anxiety incessant; it seems the occupation, in many cases, of the whole life, as if it were the sole end for which they were created. Nor is the variety of instincts, of contrivance, ingenuity, and toils, less remarkable; equalling the mechanical resources, the invention, and the diversity of form, displayed in this part of creation. Did we judge from these last, we should consider them the most important division of animal nature; and we should judge similarly from their mental powers, or peculiar instincts, exerted in modes which rival human ingenuity and invention. But we should conclude thus, still more, from the endless modes of care under which a system of perpetuation is provided for, in so many species. Many species in the larger animals have disappeared from the earth. We shall never indeed know whether this has not happened with insects also. But we cannot conceive such an event, when we see that their food is everywhere, and that it can scarcely fail in all places, when their enemies can scarcely anywhere entirely triumph over them, and when lastly we examine the wonderful mass of precau-

tions provided for their continuation. Though there were not another set of facts in all nature, if it were possible that sun, moon, and stars should cease to be, the mere cares bestowed on the perpetuation of the insect tribes, would suffice to prove the wisdom and the providence which form one portion of the present inquiries.

As before, I may consider the preparations for receiving the progeny, the treatment of the eggs, and the parental affection to the young, as so many distinct instincts; unless we believe that the bee, for example, in building its egg cell, has a perfect anticipation of the whole result, up to the full-grown progeny. But it is vain to conjecture of what we can never know: often as we may fancy that we can trace something done with such a prospective view; as in the feeding of particular larvæ, in the bee, for the purpose of producing supplementary queens.

This insect offers one of the most familiar and remarkable instances of preparation for the young: as in birds, it is the building of a nest for an egg not yet laid. The comb contains three kinds of cells, besides those appropriated to honey; namely, those for the eggs of the workers, somewhat larger ones for males, and lastly, a few, much larger, and considerably differing in structure, intended for females to become queens. In each of these, an appropriate egg is laid: though the instinct by which the queen, which alone lays, knows that she is about to lay male or female eggs, is one of the mysteries never likely to be solved. With the egg is deposited the well-known food, and the cell is then closed: the queens being produced from the imperfect female, or neuter, by placing a different food in the cells prepared for that purpose. If the selection and placing of

the food for the larvæ be considered a separate instinct, I need not here refine on those matters.

In some species of the bee, the egg cells are made of clay, built up, or excavated, and in others of moss; all under circumstances of peculiar ingenuity. In the wasp and hornet they are constructed from a paper, of different qualities, manufactured from the fibres of wood by themselves, and with not less ingenuity than the waxen works of the common bee. If those of our common wasp are familiar, there are many more, of various forms, not less remarkable. And as no honey is stored by these species, the whole labour, of the common mother and the entire society, is occupied about the offspring; in building, in collecting food, in closing the cells after the eggs and the food are deposited, and often further, in repairing or enlarging cells, and in assisting the pupa to extricate itself as a perfect insect. They give up their very food to each other, as they seem even to neglect themselves in favour of their offspring; as if this formed not the labour merely but the sole pleasure of their lives. And, whatever this be, it is not at least parental affection, since out of many thousands there is but one parent; even if we could conceive such affection directed to a mere egg.

The cares of the Termites are of the same nature, though the materials and the mode of building are different. The cells are constructed of clay; and a neutral race takes a similar charge of a coming offspring in which they would seem to possess no interest. In the proper ant, or Formica, some kinds construct nests for their eggs and young, from sawdust produced by their own exertions, or from dead leaves, or from clay; converted by themselves into cells communicating by galleries, and displaying an architecture not less effectual than

that of bees, if less symmetrical. The *Fuliginosa* gnaws cells of a similar nature in perished trees; and our more common ants erect or excavate works of the same kind; generally forming their cells and passages from bits of dry earth and fragments of sticks. And in all these cases, the end is the same: it is a provision for progeny; and upon the care of that until it has arrived at maturity, are all their labours lavished.

These are examples for preparations of progeny, executed by gregarious insects, or entire societies, where that progeny is the common property of the community. In the following cases, the preparations are made by a single animal, and as far as we know, always by the mother, for its own young or eggs. Naturalists at least have not ascertained that the male takes any share in these works, as happens in birds: and even in the social insects, it appears that the male does nothing, but that the whole labour of building, as well as all the subsequent care, is thrown on the neuters, as the office of laying eggs is restricted to one female.

Those singular productions termed galls, including that used for ink, the common oak apple, the hairy gall of the rose, the oval one of the willow, the downy one of *Veronica chamædrys*, and many more, are, in one sense, the productions of insects; nests for their eggs, and breeding-places for their larvæ. If the genus *Cynips* is one of the chief sources of these, other insects, such as *Curculio*, *Cimex*, *Tipula*, *Rhynchænus*, and more, produce similar nests. And this is one of the wonders of the vegetable physiology. The plant is punctured, and the egg is deposited; when, immediately, a new arrangement takes place in the vegetating process, and often within two or three days the new production is completed. Nor is the constancy of the

production the least remarkable circumstance: while it is plain that there is a provision made in the plant itself for the security and perpetuation of these several insects, waiting only for the equally provided stimulus, that it may form the intended nest. The design cannot be doubted, under such a perfect adaptation in two departments of creation, so differing. The cynips of the oak does not attempt to puncture any other tree, nor would the oak produce a gall from any other puncture. The history of the galls alone would suffice to answer an hypothesis of chance or accident. And if it is an insect architecture, it is one under which all the labour, such as that is, falls on the plant.

If, in these cases, the very slender toil of the insect produces a nest, and food for the future progeny, by one effort, and by the mere labour of laying its egg, it more commonly works hard for these purposes; while in these instances we find even more variety of design than in the proceedings of the social insects. Among many that dig holes in sand or earth, for the purpose of depositing their eggs and securing the larva and its food from depredation, the *Odynerus muraria* rolls the earth into balls, by means of a glutinous matter, and with these stops the orifices. Others which dig for the same purpose, are content with the earth alone: while in such cases, as in thousands more, we can discover no end but the display of variety. Thus, two other insects, the *Apis papaveris* and the *centuncularia*, have been directed to prepare their similar nests under a somewhat different manner; while each presents examples of that mechanical ingenuity, or instinct, which attracts our attention even more than the ultimate purpose. The former lines its cylindrical burrow with the petals of the poppy; and the latter forms a number of

consecutive cells from segments of rose leaves, each containing an egg and food, and their apertures being closed by two or three circular pieces, of mathematical accuracy.

In some other kinds, the excavations are formed in wood, as in the *Apis violacea*, extending to a foot or more in length, and being divided into cells by partitions constructed out of the agglutinated sawdust. Each of these is the place of an egg and of the provided food; while, to add to the ingenuity, there is an aperture at the further end of the tube, for the escape of the full-grown insect, because the egg first laid is that which first comes to maturity. Another wild bee, a *melitta*, digs holes in the earth, and forms the cells with a membranous silk; as another again finds an easily modified cell in the pith of a rose or a bramble. With more of architectural labour, the *Apis muraria* forms a cement of sand, by means of a glutinous matter of its own secretion; thus constructing cells in the angle of a wall, and covering the whole structure, finally, in such a manner as to resemble a stone. And lastly, the *Apis manicata*, forming cells within the cavities of trees, cements over them wool abstracted from the downy plants, so as to protect the egg, from the cold.

Such are a few examples of the preliminary toils of insects for securing their perpetuation in their progeny. In the following, no nest is prepared, yet the cares tend to the same object; consisting chiefly in placing the egg where it may find its own food when hatched, though a separate labour is sometimes employed in procuring that, and placing it within the reach of the future animal; sometimes under peculiar ingenuity as well as toil.

The simplest case is when the eggs are merely laid

on or in the plant which is to furnish food to the progeny; yet the instinct is very striking, because the parent does not feed on the same plant, as it will also never see the posterity for which it is providing; while the variety of those is also not less remarkable, when there is commonly a distinct plant, and but one, fitted for the food of each species. The winged mother, roving widely, and feeding on a thousand flowers, never lays an egg till it has discovered the very plant intended for its progeny. Knowledge like this belongs only to the botanist, whose systems, like his eyes, are even troubled sometimes to distinguish among species. Yet it is possessed by an animal whose range of vision is not many feet or inches, and which cannot be supposed capable of discriminating forms of this nature: given by Him who gives all knowledge, and for that never neglected end, the perpetuation of the races which He has appointed. We might almost suppose that there must be some purpose more than we can comprehend, when so much is done to prevent the loss of even the most insignificant of insects.

It is useless to enumerate many examples under a case so familiar. The yellow butterfly, wandering through a world of flowers, lays its eggs on the cabbage tribe alone. The tame butterfly, *Papilio cardui*, fixes on the thistle; the moth of the privet, on that plant, producing the well-known green caterpillar; and thus for every one of hundreds beyond the necessity of enumeration. And it is the same instinct, differently directed, that induces the thousands to which water is destruction, to drop their eggs in water only, because such is the primary destination of their progeny. Nothing but the Divine command could have effected this, when all their days are spent on the land; while

without that their races would have perished from the earth.

If cares like these are the most common, they are the least remarkable. In many, we find specific and differing instincts, or plans, for the security of their progeny, not less ingenious and varied than those of the insects which prepare nests or cells. That of the *Œstrus* is simple, yet is conducted under a knowledge, or discretion, which we must refer to the same High source. The destiny of the larvæ is to the stomach of the horse or ox: and thence the eggs are laid on those parts of the skin which the tongue can reach, and on those alone; while the accompanying puncture causes them to be licked and swallowed. Some moths cover their eggs by cementing on them hairs cut from their own bodies, apparently for the sake of warmth. If, in general, the eggs deposited on plants are simply glued on, yet very firmly, and often in a very beautiful and regular manner, there is a *Tenthredo* which saws a furrow for this purpose; while, though we cannot explain the necessity for the additional care in this case, we must still admire the machinery given for this purpose, with the labours of the artist toward the great object in view.

These instruments, so varied, and often so remarkable, provided for the sole purpose of depositing the eggs safely, are indeed among the strongest marks of the care displayed in the business of perpetuation: while, if we can scarcely perceive their necessity in such cases as the last, it is obvious in others, when knowing the destiny of the future larvæ. Thus there is an *ichneumon* directed to lay in the larvæ of those bees which deposit their eggs in deep holes, and, for this purpose, its egg-layer is two inches long: offering one of the

innumerable adaptations which pervade all nature, between inclinations and means, desires and powers. Thus also has the Cicada an auger for boring holes in wood, for the same purpose: though I need not here pursue what rather belongs to the anatomical history of insects.

I may also point out the very singular provision made for the progeny of the numerous race of Ichneumon, ordained to keep down, chiefly, the tribes of moths and butterflies; a contrivance among the marvels of the insect world, which seems, at first sight, to baffle our physiological knowledge.

The caterpillars are among our greatest enemies; while our only very obvious allies in keeping them in check, are the birds which we so often senselessly destroy; to pay dearly, in far deeper losses than we should suffer by them. No flying insect among us could have served to restrain animals so numerous, and often so large; nor could the carnivorous larvæ have done this, from the want of sufficient locomotive powers. But the great Contriver is never at a loss; and thus is their diminution committed to larvæ far inferior in size and strength to themselves. The ichneumon lays its eggs in the caterpillar; solitary at times, at others numerous, in a proportion which this invader seems to compute with perfect accuracy, so that none of its progeny shall die for want of food. And by an arrangement which constitutes the truly wonderful part of this contrivance, the caterpillar continues to feed and grow till it assumes the usual repose of the pupa; when that which should have produced a butterfly gives birth to an ichneumon: a surprise as great, until the facts were investigated, as if a sheep had brought forth an eagle. Nor is the instinct of the larva ichneumon less re-

markable than that of its parent ; since, feeding within the caterpillar, it destroys no part of it, consuming only the preparations for the future butterfly. And the accuracy of the computation respecting the terms of the two larvæ lives, is not less worthy of remark : since the ichneumon is full fed, and ready for its change, when the caterpillar has finished its career.

Without thus invading a larva, the Chrysis and others contrive that their own progeny should be nourished by that of another insect ; laying their eggs in the cells of bees, so that, when hatched, the most powerful worm obtains the mastery and its food together. Others make a more laborious provision for the forthcoming young, by storing up a larva food with the eggs, as in the cases formerly noticed where the insect stores as well as constructs. And here other kinds of knowledge, or instinct, are exerted, sometimes by choosing full-grown larvæ, since immature ones would die for want of food ; at others by stinging the larger ones in such a manner as to render them torpid, without destroying them, since their death would render them useless at the future hatching of the egg. The Necrophorus beetle, still more remarkably, contrives to bury large animals, such as moles and toads, for the same purpose : digging out the earth beneath them first, then forcing them into the grave thus made, when the eggs are laid and the whole is covered with earth.

The insects that dig holes without constructing cells within them, are numerous, and in all cases food is laid up with the eggs ; pollen and honey by many wild bees, as grubs are by the Sphex and others, and dung by the beetles. And the labour bestowed, even in these simplest constructions, if constructions they can be called, is often very great : since the Sphex and the burying

beetle will dig for three or four days, unceasingly, to effect their objects. But if I cannot afford to say more on a subject for which I can also better refer to works on natural history, let me conclude by repeating, that in these cases, including the greater proportion of the solitary insects, all this care and labour are exerted for a progeny which the parent is never to see, in blind obedience to the command of Him who has determined that none of all these shall perish.

But we approach by degrees to the instinct of parental affection, in that care which the gregarious insects bestow on a living progeny, though it is on a young which is not their own. Whether this is a merely blind instinct, like that which is directed to the care of eggs, is what we cannot decide: but there is much in the conduct and actions of those nurses, in the several gregarious tribes, seeming to indicate an actual affection towards a living being. And if there is truth in the remarks which I formerly made on birds, in this respect, I see not why we should deny it, even to those non-parental nurses, since the argument bears alike on all. It resembles a true parental affection more nearly, to find that in the genus *Sphex* and others, many insects pay frequent visits to the deposits of their larvæ, bringing them fresh supplies of food; though, of the well-known attention bestowed on the pupæ, as in the case of *Ants*, it may still be said that there can be no other feeling than that which is entertained for the eggs.

But where there is a living progeny resembling the mother, and tended by herself, there can no longer be any reason to doubt. It is the instinct, or feeling, of other animals to the same objects, and displays itself in the same manner. There are not many insects indeed in which this happens; nor could it well occur in any

but those races, such as the APTERA, where the offspring resembles the parent, undergoing very trivial changes compared to the enormous one through which a crawling maggot becomes a winged butterfly. And why such exceptions should exist, we can only explain on the general grounds of some utility; though it may also have been appointed as a display of variety, and in support of those analogies which pervade all creation.

As examples of this particular instinct, the *Cimex griseus* conducts her flock of young, like chickens, and even attempts to defend them when attacked; while the earwig sits, like a hen, over her numerous brood. Similar attachments are found among spiders, many of which carry their eggs about in silken bags, defending them with great energy; while others sit over their young, like birds on the nest, and the *Aranea saccata* carries them about on its person, to which they adhere, returning again, if driven away by an alarm.

I must yet extend the remarks on the appointments made for the perpetuation of the gregarious tribes, such as the bees and ants, and others; though I must refer to the naturalists, and chiefly to Huber, for what exceeds the purpose of this work. The reasons for a system which has imposed the business of production on a single female, and the care of her progeny on thousands which, in reality, are without sex, are very obscure; but as it is the law for all the gregarious insects, we must believe that the principle was necessary, or at least directed to that end. It might not be difficult to suggest plausible reasons for such a constitution of things: but I must now be content with pointing out the incessant cares bestowed on the coming offspring by the neuter workers, in building cells, storing food, in the transportation, warming, and clean-

ing of the pupæ, in opening the cocoons, and in feeding the larvæ. If, in the wasps, the real mother takes all this charge, of at least the first brood, for this and all other details I must refer to the authors on those subjects. In every thing, the care of progeny, the perpetuation of the race, is the object in view: and it suffices for the present purpose to have even thus slenderly pointed out the contrivance, in the multiplicity of instincts, the force and the accuracy of those, the provisions of machinery, and all else, through which the Creator has demonstrated His care on this subject. More could not add to the impression which I am desirous of making, and the thoughts of a writer cannot make him think who will not, nor form a substitute for that which, to have any effect, must spring up in his own mind and heart.

It remains finally to offer some remarks on that singular anomaly, or provision, under which many insects appear to possess, as they have been thought to enjoy a double existence, because its purpose belongs to the present subject. If naturalists have not produced a rational explanation, so have they mistaken the essential fact, which I have explained in the 25th chapter. It may be assumed that the flying insects were a needful part of Creation; or it is sufficient that such a tribe was intended. But an animal of this nature could not have reproduced its like, except under two other modes than that which has been adopted; though in thus deciding, we judge, of course, from what we know as already existing, and do not pretend to limit the Creator's power. It must have laid an immense egg, to have produced a posterity of a sufficient size for the mode of life which it follows and the purposes it serves: and thus would its progeny have been limited, to per-

haps a single representative, with the obvious consequence of a very different system from the present. Or else, as in the crabs, a minute progeny must have grown by renewing their skins, as a few actually do. But this would not have been easy under a summer existence, nor possible under an ephemeral one. Therefore does the insect lay a double egg, or produce a primary progeny, which, enjoying its own independent existence, is the real egg, or the nurse, of the secondary one; while this, growing with the growth of the second parent, is the true representative of the fly: a perfect animal, of full size, and mature at the minute of its birth. And if the false wonder thus disappears, on a rational investigation, we are more than compensated in discovering the ingenuity and beauty of a contrivance for perpetuation, which has surely no equal in the history of the animal races.

There is little left on this subject. It has pleased the Creator to construct animals which almost approach to plants in their simplicity; and that His work might be complete, a few have also been gifted with the property of reproducing by slips, either by forcible dismemberment, or by a spontaneous one; even in this, commanding that what He has chosen to create shall be perpetuated.

CHAPTER XIX.

ON THE PERPETUATION OF PLANTS.

THE care which the Creator has bestowed on the perpetuation of plants offers a somewhat wider field of inquiry than the preceding subject: for although, in the animal kingdom, the system of perpetuation is not rigidly limited to seeds or germs, the collateral means of propagation are far more numerous in the present one, and the results much more extensive and valuable.

The circumstance which is perhaps most striking in the mode of propagation by seeds, is the apparent anxiety for their production, in the means adopted. This is less sensible to common observation, where the magnitude, the duration, and the uses of the plant itself are conspicuous; but it becomes striking in the smaller and the more perishable ones, and is often very remarkable in the lowest parts of the scale. And this bears an analogy to a similar proceeding as to some of the inferior animals; where nothing so much arrests our attention, as the care taken for replacing the mortal parent, perhaps a hundred or a thousand fold; as if, in both cases, there had been no other object. Thus, in the oak, we pay little attention to the production of seeds; or, if noting it, we still know that there is before us a being, destined to a life of so many centuries, that we scarcely think of its death, or of the necessity of a system of perpetuation. Thus too in animals, we con-

template the lion and the elephant in their own actions and happiness, and if we ever think of those by which they are to be succeeded, it is with a far other feeling than in the insect, born to-day, and occupied, during a few short hours of life, in providing for the eggs which are to replace the existence that will terminate with the setting sun.

It is in the biennial and the annual plants that this anxiety for the continuation of the races is most obvious to common observation. Millions of individuals seem to be utterly worthless: and there are even species without end, for which we can discover no use, though desirous to find at least an insect attached to each. Amid the hundreds of lichens and mosses, a very few would, as far as we can see, have fulfilled the purpose which they appear solely to serve, in producing soils on naked surfaces. Yet in these, wherever we can find a seed, as in all the former, we trace the same care and the same anxiety. The annual seems to grow for no other purpose than to produce seeds; and that being accomplished, it dies; as if, in leaving a posterity, it had performed all its duties. For this it struggles against every difficulty: and under every check, every accident, every mutilation, it still labours for this end, as if it were a conscious agent. We cut off its flowers, or cut down itself, obstruct, impede it, in every manner, but it still resists, proceeding with an obstinacy of determination to effect this great object; while if, tired of opposing it, we cease, it recommences, and having at length gained its purpose, dies. We can often even prolong the annual life for another year, or more, by the same opposition; as if it was determined not to part with existence till it had obeyed its orders and fulfilled its destiny.

The production of seeds by some of the minute and perishable plants, is not less remarkable in other ways. The *Radiola millegrana*, the *Exacum filiforme*, and others which the botanist's memory will easily supply, are scarcely noticeable but for their seeds: in the former, and sometimes in the latter, they exceed the whole plant; which is but a stem, contrived to elevate the seed above the surrounding vegetation, with two leaves for nutrition; as if created for no purpose but to produce seeds, and perpetuate itself, without any ulterior object. Or, whatever that may be, there is no proportion between this case and that of the oak, where the care is not greater, and, compared to the result, much less. The *Rafflesia* is not even a plant, in the usual meaning of that word: and, if, in all cases, the flower is but the servant of the seeds, it offers an example of laborious anxiety, for no other purpose but to perpetuate those for ever. There may indeed be ends unknown to us in all these cases. The seeds themselves may possess a justificatory value, or the intention may be what to us it so often appears, the display of power and variety: yet in these cases and the following, we trace the anxiety for the perpetuation of species with peculiar distinctness, as if it was that law for all organized beings which should never be evaded. I allude to many of the fungi, and especially to such as the *Lycoperdon*, *Sphæria*, and *Tuber*, where the entire plant is often but a mere bag of seeds, and where we see neither use nor end but that which seems here to stand in place of all others, the dispersion of these countless myriads, that they may go on producing other seed-vessels, in succession and without end.

If this slender selection will convey a sufficient notion of the anxiety of the Creator (if I may so term it,) on

this subject, philosophical botany can produce its endless details respecting the production, protection, dispersion, and security of the seeds of plants, till the ultimate object is attained in the uprising of the posterity and representative. But while it is too extensive a subject to permit of more than a very slender selection from thousands of facts, so have some of those been elsewhere noticed for other purposes. The reader can refer where I need not repeat : and especially to the tenth chapter.

The first mark of care, if a remote one, is found in the contrivances for protecting the future flower through the winter, wherever such protection is necessary. In the buds, the beautiful packing, the investing scales, the down or hairs in some cases, and the varnish in others, are familiar : and, by these contrivances, aided by that vital power, the action of which in resisting cold has not been explained, the most complete protection is afforded. In the bulbous-rooted plants, the bud is not less effectually protected beneath the ground, partly by the depth of earth, and partly by the singular chemical properties of the coverings, aided by the same resisting vitality.

In other cases, the flower bud is not produced till the frosts are past : and our attention may now be directed to the provisions within it for the formation and ripening of the seeds. In a certain sense indeed, the flower is a superfluity, an example of gratuitous beauty, while it also contains provisions for the feeding of insects : yet with these are always combined some uses for the seed itself, as, in many cases, they are so numerous and remarkable that they cannot be overlooked. I need only remind the reader of the various ways in which they protect the essential parts of the fructification, the

stamina, and the pistils, on which the future seed depends; as I need also but allude, here, to the contrivances for bringing the pollen into contact with the latter.

The essential protection which the calyx affords, by enveloping everything while yet in a tender state, must not be forgotten; apt as we are to look on it as a superfluous part, from attending only to the expanded flower. It would be endless to point out the numerous forms and modes under which it guards the unopened flower, and, above all, from the access of water; being often examples of that ingenuity and variety so perpetually displayed in creation for the purpose of gaining an end that might have been attained in any one way. The calyx of the rose, so useless when expanded, is a familiar instance of protection afforded by a structure which, compared to the purpose, is very inartificial; and yet in this, and all similar forms, that protection is complete. In the *Cistus*, possessing a flower of unusual tenderness and delicacy, a varnish is superadded for the purpose of warding off the rains. The monophyllous calyces present a structure more apparently efficacious, yet the protection is not more complete. And if the scale calyces of the grasses offer a much simpler contrivance, the security which they afford is not less perfect.

But the student of nature must pursue this subject for himself, while I terminate the little that I can afford to say on this department of the protection of seeds, with pointing out one or two expedients for supplying the want of a calyx, or remedying defects in its structure: defects possibly intended for the purpose of displaying the remedy. The calyx of the poppy is lax, and not very firmly closed: but as a counterbalance to this, the flower bud is bent down by a curvature of the stem, and erects

itself only when the protection of this deciduous guard is no longer wanted. The obstinacy with which this bud refuses to flower till it can erect itself, belongs to a still more interesting circumstance in the physiology of plants : but under the present view, the inverted position enables the back of the calyx to ward off that water which might have penetrated the less perfect junction at the summit.

If I must be content with suggesting the various cases in which the involucrum of flowers assist in this office, I may point out that provision in the liliaceous ones, which, as a sheath, forms the substitute for the absent calyx, while the leaves also are sometimes arranged to perform this needful function. Under many different modes, the tulip, the genus *Allium*, the *Tradescantia*, the grasses, and far more, will afford examples of protection, given either to supply the want of a calyx, or to add to the security which that affords. And thus the seeds of the mosses are so embosomed in the plant, at first, as almost to elude the botanist; while they escape the chance of injury; to be elevated for dispersion, only when all hazard of failure is past.

It is under all this care and concealment, that the essential parts, destined to produce the perfect seed, are growing within; free from all hazard, till the expanding flower opens to the light that the work may be completed. And then do we begin to perceive the utility of many other preparations towards this great end, the purposes of which we might not have understood before, and which he who looks on this interesting part of creation with a common eye, never sees. The vanity of philosophy may smile, if it pleases, at what it may choose to term fanaticism, but it is he who seeks for the hand of the Creator in every one of His works, who has found

the true clue of investigation ; since the purpose is that clue, and, that to study the design and the Designer, are one. And if the care of a parent for its offspring, the anticipations, the preparations, the watchfulness of a mother, are objects of our admiration, shall we not at least investigate the contrivances, the thought, the anxiety, of the Great Parent of all, for the safety and the life of these, His beautiful, but His lowest children ; not inquire of His care for their perpetuity, that not one shall be lost ? Could more have been done ; and if He has not done it, by whom then was it effected ? Who is it that contrived, who is it that watches over the lilies of the field, that not one of them should perish from His land ? Who is it that guards to maturity, even the minutest moss, and ensures it a posterity, that it shall not fail from the multitude of His children, who, even in the vegetable world, look to Him for their food, their life, and their enjoyment ? Was it He : and is it He who cares not for man, provides not for him, governs him not, watches him not ? Be it so, if it can afford satisfaction to any one to think that so it is : but it will not be so to him who will open his eyes on the world around him, and who has learned, in everything, to look to the Cause, the Parent, of the universe. Would that I could persuade him who has hitherto walked through creation without eyes, without thought, without a heart, to take into his hand the first flower that shall present itself, and examine it as the work of some Being at least who intended, and wrought, and cared. If eloquence has long done its worst for this unfortunate cause, there must be one who can sit down with the next flower that meets him in his summer walk, and ask himself, whence came this, why is it here, why all this beauty, why all this care ? I have seen it rise from

a minute seed, I trace a series of cares and contrivances that seed shall spring from it again, I trace these under a thousand forms, I marvel at their ingenuity and their wisdom, I am astonished at an anxiety which has neglected nothing, I see that an end was intended, and I find that end attained. What more does man ever do to attain his objects, when does he labour with more care and more knowledge, and when does he succeed with more certainty? Does woman show more anxiety, more contrivance, for her offspring, than the parent of this little flower has displayed? And who can that careful, that affectionate parent be? No one! Even so was it no one that reared me from helplessness to maturity, I knew no parent's thought, no mother's care: there is no God. Can such a conclusion ever have entered the heart of man? We know not how to believe even him who has declared it.

I have elsewhere noticed the utility of the footstems in elevating the flowers above the ground, in advancing them to the light, and in the dispersion of their seeds. If I then also pointed out the use of their elongation, flexibility, and elasticity, in enabling the flowers to avert themselves from the wind, and thus to protect the essential parts, far more might be remarked on this subject, as it regards the protection of the flower. But, unable to enter on all that deserves notice, I will here point out only the frequent prolongation of this part between the period of the flower bud and that of the seed. The original shortness is a plan for protection, like the calyx; while it is a necessary construction, where there are involucrum, sheaths, or including leaves. Yet the notion of a necessary growth is so habitual, that we do not remark the contrivance by which the footstalk is thus managed to serve two distinct purposes, bearing, however, on the one great end.

Whatever I have elsewhere noticed in this part of creation, under the head of design, equally relates to the production of seeds, or the perpetuation of the plant. I need but remind the reader of the forms and movements and sensibilities of the corollæ of flowers. If there have been instincts and powers given to plants, by which they turn their flowers to the sun, or close the petals to protect the immediate sources of offspring from the rains and from the cold and dew of night, the security of the seed is still the object of this discernment and action ; which are as dependent on sensibility and life as those of animals, notwithstanding the wretched attempts at explanation, of a mechanical, and too often an atheistical philosophy. The various positions, numbers, and actions of the stamina and the pistils, noticed in the same place, the levity of the pollen, the movements of insects among these parts, and their travels through the world of flowers, accidental or undesigned as these may seem, are equally contrivances for the one great purpose : while we must not also fail to notice the simplicity and beauty of that arrangement, which, by placing the insect food deep within the flower, has compelled these animals to perform the duty imposed on them.

When, under all these cares, and more, varied in countless ways through the vegetable kingdom, the seed is completed, a new set begins, directed to the ultimate end, the production of a future plant ; the representative, perhaps a hundred or a thousand fold, of the parent : while, if filling its abandoned place in creation, serving also for the uses of animals, by presenting itself to unsuffering mutilation or death. Respecting many of the ingenious modes contrived for the dispersion of seeds, I formerly spoke ; as to that place I can refer : the protection of the seed till it shall become a plant

demands some remarks ; and a few must suffice, amid the variety which this portion of the history of plants, like all else, presents.

The protection bestowed on the formed but yet undispersed seeds, is visible in the lowest and minutest fungi, where the capsule does not open till they are ready for the winds, as in the *Sphæria* and the common puffball. The *Agarics* and the *Boleti* afford a security of another kind, in the sheiter which their roof forms against the rains, and in the beautiful gills and tubes which enclose their almost invisible seeds. But it is only a minute botanist who can appreciate the beauty and contrivance of the mechanism which, in the mosses, secures the opening of the capsules, so that the seeds shall not escape till they are ripe, and that, even then, they shall escape but gradually ; though an ordinary observer can see, in the disposition of the seeds of ferns beneath their leaves, a security against rain, if incapable of discovering the contrivances by which those are dispersed.

The disposition of the completed seeds of plants in general in their endless capsules and receptacles, the several kinds of security which these afford, the modes in which they open to disengage the seeds or permit their separation, form another of those wide subjects on which it is not possible here to enter, further than as I formerly pointed out a few examples of elastic and dispersing capsules. They must be examined by every one for himself ; and with the present clue before him, he cannot fail to find interest and discover truth. Let him examine every thing with the conviction that it was the work of a thoughtful Contriver, equally displaying His wisdom and His variety of resource ; let him examine it all with a view to the intended end, and

his own investigations will be of far more value to him than all that I could say, as they will assuredly furnish him much more pleasure, and interest him far more deeply.

But there is another law, even more remarkable than all the previous contrivances for the security of the future plant, through which it is ordained that seeds shall not even make an effort towards vegetation till they are in circumstances to ensure the great result: while he who has not yet been struck with the ingenious provisions for the perpetuation of plants, can scarcely fail to see in this, power, at least, before which he must bend, since it surpasses his comprehension.

Life, dormant life, exists in the dry seed. It is the miracle, equally, of physiology and of metaphysics: and it has been a miracle to the philosophy of all ages. It is the mystery of the egg; but it is almost an immortality, when compared to the animal germs. The chemical constitutions of the two differ indeed essentially: but we must not say that the Creator could not have made the animal egg as durable as the vegetable one, since the animal organization can be dried in the *Sphalangaria* and the *vibrio*, as the vegetable one is in the lichens and mosses, without losing its life, as there are also *Monoculi* whose dried eggs retain their vitality, like the seeds of plants.

If I have had occasion to speak on this subject for another purpose, in a future chapter, I must still examine it here, as a law for the great end under review, the perpetuation of plants; while it is a provision exceeding all that has preceded, as it could only have been the produce of boundless power. Life, produced from apparent death, starting suddenly into action from the sleep of a century, an atom, an unintelligible, an often

invisible organization, becoming in a few hours a living being, ready to reproduce and perpetuate the same lives and the same powers for ever, this is the miracle. Can He who does this, not effect all things? Where is death, where is mortality, if that atom which the microscope barely discovers, can sleep for years, centuries, and yet start up a living and an active being; and not even through a miraculous interposition of Providence, but through the simplest of means, moisture, warmth, light? No: there needs be no death to Him: He shows us His power, even in the seeds of the mustard; but we doubt it, when the very demonstration is before our eyes. There it lies; life, His life: but we cannot see it; of its presence we know nothing: it is attached (do we even know that it is attached?) to an unintelligible shape, to a particle which chemistry finds to be a common material pervading all nature, which, if it has a form, has no mark of what is to be. It is an atom, which, if continuously protected, as He has provided protection for it, is imperishable; for if it can exist through a century, why not then through thousands or millions of years? When shall it die, if it died not in the first century? Chemistry has no answer, and physiology has none. And that life, acting on that atom, produces an organization, a tree of the forest, living, and again multiplying life to millions. Is anything impossible to Him? No, nothing is impossible: but, here, His established laws prove to us, that even in consistency with those, and without deviation or miracle, He can do that, of which some of us have chosen to doubt.

It is not known to what length the lives of seeds can be protracted, and if it appears very different in different plants, no trials have yet been made by which these

facts could be ascertained. Yet it seems admitted that many have grown after a century of repose : while it was ascertained that maize found in the tombs of Peru was capable of germinating after a period of three centuries. The same has been said of seeds which had been found in Pompeii or Herculaneum. I know not if the authority be valid ; but it is at least a vulgar error, that the vegetable matters discovered in those subterraneous towns, including the much discussed papyri, had been acted on by fire. The subcarbonization of these substances has been effected by water : their present state is that of peat ; and I know not why the vitality of seeds should not have preserved them in this case, as it does in our own peat bogs.

The general fact of the sprouting of plants where their previous existence was unsuspected, is familiar ; but no one knows what the limits are, either as to the species, or the periods of dormancy ; if indeed there are any. Whatever our knowledge is, it is measured by our ignorance : the little that we believe ourselves to know respecting the possible vitality of seeds, is of no value. But we cannot turn a piece of ground, or bring up the buried soil, or apply an appropriate manure, without finding that plants soon spring up, unseen before, though their parents are far out of reach, and their seeds without the power of flight. The flowers of the long abandoned and forgotten parterre, the dormant records of years long past, surprise the new cultivator of the ancient feudal domain ; the mountain moor, producing but heath and rushes from the memory of the remotest generations, is covered with clover, by the application of lime, within the revolution of a single summer.

I have elsewhere said, that the dried lichen does not

die: we know not that it is not immortal. It is with less surprise therefore, that we find this true of the dry seed: it can no more act without water, than the dried lichen, or the salts of the chemist. But this brings it into action, or allows the vital principle to commence that train of chemical operations which is to proceed, through the life, even to the death of the plant. The investments are split by the expanding cotyledons, the germ enlarges, and thus, under so familiar a process, do we almost forget to notice the infinitely greater difficulties and mysteries that remain behind. Philosophy cannot explain them: if they are of the Creator's laws, they are, to us, as yet, but efforts of that Will which is the only cause of every thing, till we can discover the intermediate one between Him, who orders and that which obeys.

If the dry lichen is undying, the moistened one which is excluded from the light and the means of growing, dies: submitting to the chemical laws for all organized matter. But in the same circumstances, the seed preserves its apparently endless vitality: it is moistened, wetted, lying amid moisture for years, yet the same chemical proceedings do not occur. Nor will it germinate. Water has no effect: the cotyledons which ought to have expanded under the common laws of mechanics, refuse to expand: the seed will not split: it remains as dormant as if it had been placed in the extreme of dryness: torpid, yet not less vivacious, not less immortal. The laws of mechanics and chemistry are equally suspended: the facts are at war with all our philosophy. But if there is a proud philosophy which may be pained at feeling this, a sounder one is more than willing to acknowledge, that there is much yet beyond our powers: defying us, and compelling us

to bend to Him who orders all things, and who has perhaps intended that we should never ascertain the agents which He has interposed between Himself and us, lest we should in time neglect or deny Him, as we have already done but too much, and, in the pride which has analyzed His laws and discovered His agents, forget that those laws were of His ordering and those agents of His appointment.

The buried seed will neither die nor germinate. He has so commanded: but the final cause at least is clear, if we are ignorant of the efficient ones. Beyond a certain depth, the plant could never have reached the surface: it would have died; and the Creator's intention in its perpetuation would have failed. He would have been defeated by accidents; but against those accidents He has provided. Beneath the needful point for its future appearance to the day, the germ is as torpid, yet as immortal, as if it had been laid on a dry rock. Philosophy indeed has said that the seed must be within the reach of light, within the reach of oxygen; that one or both of these are the causes of its germination. Though either or both were true, we remain equally at a loss in accounting for their effects. Everything is easily said; but if conjectures are not knowledge, of still less value are terms; and these are little else. We know not how either of these substances should act on the seed; but we know not also why the action of oxygen should not extend to ten or twenty inches within the earth, as well as two; as we are also sure that the access of light is equally excluded in both cases. And as little can we conjecture why a few grains of lime should bring to life that which had been sleeping for years, and might have slept through centuries.

Yet though we could explain these things, there

remains the greater mystery, under which the cotyledons refuse to yield to the expansive force of water, and the still more wonderful one, through which the vital power prevents the usual laws of chemistry from destroying the organizations. In the animal living bodies, this is effected through an ever-active chemical force, whatever may be the fact in the egg : here, there is no controlling chemistry at work, but all sleeps together. God has so commanded it ; we have no other solution : and He has commanded it, because it was necessary to His plan, the perpetuation of vegetable life.

But if philosophy is discontented with this direct reference to the First Cause, it may not be equally displeased, should I say that the seed is gifted with an instinct or feeling by which it knows when it may put forth its germ with the security that this shall reach the light. It ought not, at least, to be dissatisfied, for it often makes use of the same solution for other purposes, while willing to forget, what I must not, that it has scarcely removed the hand of God by one step. But be this solution what it may, in any case, it is thus only that we can explain a further mystery in the conduct of seeds, not less necessary for the same great end. In whatever position they may be placed, the infant plant ascends, while the root takes the opposite direction. But for this inexplicable law, all the preparations for the security of the plant which I have already traced, must have failed in a large majority of cases : on a calculation of chances, in much more than the half, if, as would naturally be expected, the plant and the root had proceeded in the directions which they held in the seed. And so determined is this instinct, or so indefeasible this law, that these two parts turn again and again, if we reverse them in their progress ; persevering with the

most invincible obstinacy, till we give up the contest or weary them to death.

Philosophy indeed is ready, as usual, with its wordy and empty explanations. It is said to be a tendency to the light. What would this explain, though it were true; and what, equally, a tendency to the air or to oxygen? Modern philosophy is ashamed of the word attraction at least, however it may still be used in these cases: or, if not, it is time that it should. But what is a tendency to any thing, if not a desire; and a consequent progress, but an effort? To our knowledge, the plant wills and acts: it has been commanded, and it obeys. But even experiment shows that it does not tend to light or to air simply: it tends upwards, even to darkness. Therefore it must be termed an effort against gravity, a tendency to the perpendicular: which, translated into common language, is the fact that we knew before, and nothing else. The "occult causes" of the ancient philosophy explain as much, under greater brevity, and less pretence. The cause is indeed hidden from us: but there is one cause, of which at least we are sure; and that is, the Will of God. The instinct was indispensable, and it has been given: should we ever discover that there is an intermediate agency, the Eternal wisdom and the Eternal command will remain.

It remains to notice a few minor circumstances relating to the perpetuation of plants through seeds. I may refer to another chapter respecting the system of berries and fruits, where a material superfluous to the seed has been added for the food of animals; as the production of mere seeds, in an abundance far exceeding the purpose, or even the possibility of perpetuation, has been partly destined to the same end. In the drupaceous or stone fruits, the line between the two uses is

often so strongly drawn, that nothing but the ingenuity of man can break through it. In other cases, the seed is distasteful, or neglected, or it is protected against the digestive powers; so that its own proper uses are still attained, after the fruit has done its own office. And if there are animals, like the squirrel, which can conquer the best protected seeds, it is because there is a superfluity, intended for this very purpose.

In many cases, both in capsules and fruits, we must also admire that combination of contrivance, under which, while peculiar protection is afforded to the seed, it is ordered that this shall not become an obstacle to its great office. The seeds of the tropical plants present endless examples of this nature: but the cone of the fir offers a familiar one. The beauty and strength of the mechanism by which the seeds are here protected, must strike the most incurious observer: while, without experience, their escape would seem impossible. Yet this is effected with the utmost facility, by the retroflexion of the scales on drying; when the winged seed, protected a second time within a hard shell, takes its flight. In the stone fruits, as in our peach, the protection afforded by this shell is such that it requires no small force to destroy it; while in some of the tropical nuts this is still more remarkable. Ignorant of the fact, we should pronounce it impossible for the tender plant ever to make its way through such a prison. Yet nothing is more easy; but easy, only when the circumstances necessary for the germination of the seed are present. Mere moisture then suffices to overcome all this resistance: it penetrates the fissure which our tools cannot find, or cannot enter, and the expansion of the cotyledons, acting with irresistible force, does the rest. The prisoner is freed.

And what is this irresistible power of expansion which, in a feeble seed, suffices to split even the solid rock,—which in the tender root of a tree lifts weights that move only before our powerful wedges and screws,—which enables the radicle, small as a pin and soft as the human finger, to perforate the hardest ground and make its way wherever it wishes? Philosophy has not explained it: but it was necessary for the Creator's great purpose in the perpetuation of plants, and it must suffice, at present, to know that He has ordained it, with all else of the equally obscure which I have already pointed out. Of the mere seed, every one knows that no ordinary force can reach and destroy the germ, that this germ forms but a very minute part of the whole, that the cotyledon or cotyledons not only serve to protect it, but are provisions for its first nutrition, the lungs and stomach of the infant plant, as the body of the egg performs similar offices for the included chicken.

It remains to inquire of other provisions made for the perpetuation of plants, still further demonstrating the care which the Creator has bestowed on this subject. In the animal kingdom, the power of reproducing parts is very narrowly restricted; that of being perpetuated in this manner is so much more confined, as to stand in the light of an exception. But in vegetables, both exist, almost as a general law; though it is with the latter alone that I am here concerned.

If I commence by stating the exceptions, I can afford to do this but in the most general manner. The short-lived plants, for example, are limited in this respect: in the annual ones, it can scarcely be said to occur, though exceptions may be found, or can be made. But beyond this, we can scarcely find any general rules. In the fungi, among many species, not merely of an annual,

but of almost an ephemeral life, there are perennials of great duration, as in *Agaricus* and *Boletus*, propagating by extension or by offsets, as well as by seeds, as is true of even the common mushroom : and this is the case also very widely among the lichens. In the mosses, if there are perishable annuals, depending solely on their seeds for propagation, so are there many prolific ones : but it is not ascertained, I think, that the subaqueous plants in the cryptogamia can detach rooting offsets, or continue themselves in any other manner than by seeds.

Not however to enter further on this extensive subject, it must suffice that we everywhere find species that refuse to propagate except by seeds, as there are others that continue themselves through slips forcibly separated, or radical shoots, or tubers, and bulbs : while others again can perpetuate themselves by deflexed and rooting stems, by runners, by stem-borne bulbs, and even, like *Bryophyllum*, *Hoya*, and *Crassula*, by rooting leaves. I can but bestow a few words on each of these modes ; adding the apparent reasons, whenever these can be conjectured, as constituting the chief interest under the present inquiry.

That all is the result of design, of an additional plan for securing the perpetuation of vegetables, will appear in every case, though it may be more obvious in some than in others. If there is an appearance of chance rather than design in such instances as slipping, and laying, in the reproduction through deflexed branches, as in the *Banyan*, in that of the *Hoya* and others, through detached leaves, the design is still evident, because these provisions are limited to specific plants. In all other cases, the proceedings of the organization are as regular as in animals : roots are formed

only at one point ; and a fixed set of vessels and actions produces a certain succession of branches, leaves, and flowers, if not with the same symmetry as in animals, yet with unvarying constancy. But in the plants in question, whether destined to propagate in those and other collateral modes, naturally, or through artificial aid, it suffices that the appointed part touches the ground, when the whole course of action becomes immediately changed, and a new plant springs from new roots.

In the propagation of plants by suckers, or offsets from the roots, it is impossible to doubt the design ; while in this case it is also proved by the limitation ; though we may not always see why it was thus appointed and limited. The oak sends up an almost immortal progeny from its roots : the fallen fir is exterminated for ever. The roots of this tribe, destined to a short depth in the earth, are for ever reaching the surface, yet no consequence follows ; that of the elm, when by chance bared through the sliding of a bank, assumes leaves and becomes a tree. In the lily of the valley, the running root may be an expedient to supply the want of fertile seeds, though we know not why this plant should be thus deficient : but that reason does not apply to the oak. In the pine-apple, it seems to have been a provision of foresight, because this fruit was destined for the use of animals, under the chance or certainty of the destruction of the seeds : and thus perhaps also the additional and peculiar provision made in the crown, as it is termed. In the grasses, we may decide in the same manner, and on the same grounds ; for although Withering, and Paley after him, have said that cattle refuse to eat the seed stems of those, founding an argument for the wisdom of the Deity on that

which has no existence, this is not the fact, until the ripening and dispersion of the seeds have left that stem a woody and useless fibre. On the contrary, it is because of the assaults of animals on these plants, impeding their propagation by seed, that the Creator has conferred on them those remarkable powers of collateral propagation; ordaining that they should even grow most rapidly under the most continued injury from the feet of the animals appointed to feed on them, and equally conferring on their roots that surprising vitality, through which, in the arid plains of India, they are enabled to cover the ground with a green carpet, in a few days, after having been baked for months in a heat which no vegetable life could have been expected to resist.

The reader can easily apply this and similar reasonings to many more cases: I must pass to the system of propagation by superficial runners, familiar in our strawberry, and in many grasses, such as *Agrostis*, but perhaps most striking in the well-known Chinese saxifrage. There is a progeny of completed plants, sent out by the parent to find their own places: it is as viviparous as the quadrupeds themselves. We may not always see why such a double system of propagation should have been allotted to such plants: but, in the strawberry at least, it may be a substitute for the probable loss of the seeds, through the uses of the fruit to animals: as it is also the saving of time. If it has been attributed to a desire after a fresh soil, in a plant supposed to have exhausted that in which it is rooted, the facts do not justify this, when this parent continues to thrive, and when the seeds would equally have been dispersed; while the same wants must also exist in thousands of plants which possess no such means of an imaginary self-transference.

I need not here separate the cases of tubers and bulbs, differ as they may under botanical physiology: they constitute nearly one mode of propagation independent of seed; and whether the proceeding be conducted by nature alone, or modified by ourselves, the valuable results are familiar, in the various plants thus cultivated for pleasure or use, from the tulip and hyacinth to the potato. And it is here that we most strikingly experience the value of this mode of propagation, in the saving of time. Whatever other reasons there may be, this at least must have been an essential part of the intention. From the seed of the potato, we should not have had a useful plant in less than three years: from the tuber we possess it in a single summer.

And doubtless this saving of time, so precious, has constituted a chief part of the Creator's design, in every one of these collateral modes of propagation. The law which ordained that the seed should not produce a perfect plant but through the lapse of years, He might indeed have made otherwise: but where He has chosen to leave a defect, He has also provided the remedy, as in ten thousand cases all through Creation. The fallen oak gives us a dozen trees, while its seeds would have produced plants long struggling with the difficulties around them: we lay a branch, or dismember a willow, and within a few years we possess a tree which the seed would not have produced in twenty. Like the bulbs of the tulip, the tubers of the potato, and the offsets of the strawberry and the pine-apple, the reed and the banyan produce their respective forests, where the more usual efforts of nature, even under the aid of man, would long have been unavailing.

But, unable to pursue this subject further, and thinking it unnecessary, when the general reasonings must

ever be the same, I shall only further notice, among these more purely natural processes, the stem-borne bulbs of some lilies and alliaceous plants, as examples of variety of invention, together with the viviparous alpine grasses, producing and shedding ready-formed plants, where the fallen seed might never have reached maturity, and in this exceeding even the strawberry, which knows not how to detach its living progeny.

There remains however one collateral mode of propagation, which, though nature furnishes the means, she cannot effect without assistance. The possibility has been ordained by the Creator ; but He has left it to man, and to man alone, to render those provisions effective. I need not here distinguish the technical differences between three processes which agree in one physiological principle : but if there be any truth in those arguments for the beneficence of the Deity, which I have given in a future chapter on a similar subject (c. 46), we cannot doubt that He established this singular law for the same great end, the good of man : as we might almost believe that He had Himself taught the earlier races how to apply it, since it is far from easy to conjecture how it could have been discovered ; though we have been so long accustomed to a now simple process, that we forget to ask this obvious question. The practice of inarching might indeed have been adopted in imitation of some rare natural occurrences ; but scarcely even this could have taught man to insert a bud or a graff. The bud indeed has been called a viviparous production of the plant : but if the flower bud is but the preparation for the seed, the other is no more viviparous than the branch which it is to produce ; since it cannot detach itself into a new individual. It is even less independent than the full-grown branch, which may root itself : and the bulb,

with which it has been compared, is created with all the means of assuming a separate existence.

It may be true, that the process of grafting does not multiply absolute number in plants, as slipping or laying does; but for all the needful ends, it is the same; since it equally multiplies that of the desired plant, as it also possesses the same useful effect in the saving of time. But its especial value is as a subsidiary law, ordained to carry into full effect another, of which I spoke, though but slightly, in the chapter just named. Man has been empowered to influence the forms and qualities of plants, and of animals also, for his own uses: the question respecting the first, is that which here concerns us; and it will better take its place here, than under the future inquiry respecting fruits.

If ignorant of the laws through which we obtain these results, so, until lately, was the whole an absolute obscurity as to the means themselves; while even now, though we can add the mixture of pollens, to soils, manures, and to what is termed cultivation, we are still unable to explain how these act, or even to ensure any result by their use. We cannot therefore resolve this into a necessity: and he whose philosophical pride has not quenched his piety, will consent to receive it all as an immediate proceeding of the Divine beneficence, while he waits for a future explanation.

Every gardener knows that he is ignorant of the means of even changing the characters of a wild fruit or flower, of rendering the harsh wilding palatable, or doubling the single rose. The term cultivation has hitherto stood in lieu of all philosophy on this subject; and, like most other terms, explains nothing. We are not more ignorant of the physiological cause, than of the true process. In the fruit and the root, the organiza-

tion may be supposed to remain the same; but while the magnitude is increased, the chemical products are entirely changed. There are sugar, starch, mucilage, where neither was perceptible before, where all perhaps was wood. Or acid is replaced by sugar, the astringent principle disappears, and there is flavour where it was before unknown. And the further varieties are endless. There are hundreds of potatoes, and thousands of apples and pears, differing to a degree that is quite incomprehensible, in bulk, form, qualities, everything, and even in their durability and their periods of ripening. It is true that much of this may now depend on the mixtures of varieties through the pollen: but that cannot be the sole cause; else the first improved apple, for example, could never have sprung from a crab.

If, in flowers, the results are more obvious, the explanation is not less difficult. To say nothing of increase of magnitude, changes of colour, odour, form, duration, changes of the season of flowering, and even of the constitution as it regards climate, no botanical physiology can explain how a stamen, a pistil, or a calyx, becomes a petal; immense as are the differences of structure in those parts. Though we neglect it because it is familiar, the least reflection must show, that immense anatomical alterations must have taken place. What more extraordinary than the proliferous daisy, the involved nectaries of the columbine, or the calyx of a primrose converted into petals? Yet the most common event, the conversion of a stamen into a petal, is perhaps even more so, when we consider the very peculiar anatomical structure and the function of that part. Deformity is a word that explains exactly as much as cultivation does: nor do we know how to treat a wild flower, any more than a wild fruit, by any mode of cultivation, so as to

ensure, or even produce, any one of these results; while, even without cultivation, nature does it daily, in the double bramble and in many more. No horticulturist expects to produce a cauliflower from the seed of a cabbage, nor the garden carrot from the wild one, by any mode of cultivation: nor do we often even know when or where such varieties originated. To us, they are accidents; yet not produced without a cause. Nearly all that we do know is, that a plant will sometimes produce one seed out of many yielding a new variety, and that from this again we sometimes obtain others. And of this, our watchfulness takes advantage; labouring also, on some probable grounds, to do the same again, yet still indebted to accident, or to causes that we can seldom conjecture. And though it were proved that intermixture of pollen was the efficient cause in any case, we should scarcely be much nearer to an understanding of the proximate one.

Of this at least we are sure, that if the price is our labour, so is ours the reward. The variety may occur; but, without our care, it will not continue, and, without that, we shall not acquire new ones. For aught that we can see of the real connexion between the cause and the effect, we might as well use the term labour, or care, as cultivation; it is the immediately preceding act, of which alone we are quite sure; and it would not be more loose than much that has been written on causation, to say that human care was the cause of all these valuable changes. Metaphysics are scarcely more at a loss, when they would explain the communication of motion. Under ignorance so perfect, we can still at least conclude, that these arrangements were designed for our advantage. Science is ever making deductions as loose, if of a different nature; but they are not

equally questioned, for reasons that are sufficiently obvious, when it has been so often the purpose of science to seek after any cause but the First Cause, if not to reject this altogether. Nor do I desire that they should be unquestioned: since, neither here, or anywhere else, have I intended that this final conclusion should impede investigation: convinced, that however far philosophy may ascend, whatever boundary after boundary it may pass, there is one which it never will transcend, and that the line which shall finally limit human knowledge, is that which will at length compel us to recur to the great and terminal inference, the Will of God.

This is the primary law, to which I alluded, and to this the power of inserting one plant into another is subsidiary and secondary. Whatever we may effect in the plants which do not vary from their natural condition, by the sowing of seeds, in this rigidly following nature, or by the transplantation of tubers or bulbs, or by the separation of slips, or by layers, or by whatever else under which we imitate her proceedings, it is chiefly, if not solely, by engrafting, under its different modes, that we preserve and propagate the valuable produce, to which accident or unknown causes have given rise. And not only is the valuable variety thus secured, but it is also multiplied; while a tree of twenty years' growth is further created in two or three. A casual fruit or flower, valuable or esteemed, appearing, we know not how, is propagated even over the whole world, in a few years; effecting what centuries would not have done, had it not been for this provision, this law.

And if this be the demonstrated produce of human labour, and of nothing else, why will we not admit that

almost all the other means of propagating plants independently of their seeds, in as far as they cannot themselves effect this purpose in the same ways, were intended for man's use? For that of any other animals, independently of the utility those may serve to him, they could not well be, since only through his aid are they to be effected. But we cannot prove, in the rigid sense of that term. There is a coincidence between a presumed goodness in the Deity, and a good effected: and the inference must be left, rather to the moral reasonings, or perhaps the feelings, of the reader, than to the scientific ones by which he is much too often misled from the paths, equally, of piety and truth.

CHAPTER XX.

ON THE PROGRESSIVE IMPROVEMENT OF
THE EARTH.

IN using the term improvement, I must commence by saying that it refers to the animated creation, including, especially, man; or, that the point desired to be established is, a Design, and prospective view, on the part of the Deity, towards rendering the earth gradually, and, in a limited sense, perpetually, still better fitted for living beings: commencing in the remoteness of time, and pursued according to a consistent and a beneficent plan, through every change that it has undergone and every age that it has existed. If I have therefore introduced this great fact, hitherto unnoticed by natural history and theology, under the present attribute, as it might equally have stood under that of Goodness, I have but to repeat the apology more than once offered.

I have proved, in a work on this specific subject, Geology, that the living and animated creations extend much farther back in time than had formerly been supposed: commencing, in reality, from the very period at which the earth first became habitable, under the diminution of its heat. It is indifferent, for the present purpose, whether there were more of these early conditions than one, or whether we limit to one, the truly naked, empty, and uninhabited earth. The first form of the solid earth could have contained but granite, because

the first rocks were formed by cooling. No strata could have been produced but beneath water, nor could any stratified earth have surmounted the waters but by an act of elevation; a revolution. Until there was a second earth, there could not have been a land of sandstones and clays and limestones: be it granted, or not, that the latter are the sole produce of animal chemistry; as I trust I have proved. But I cannot here undertake to explain these particulars and views. I could not make them understood in a small space; and the details are not wanted for the present purpose. They who desire to know of this great branch of natural history, must resort to the book I have named; since there is no other to which I can refer them. It may show that the earth and its history are far other than they had imagined, from living on it, or from reading what has been hitherto written.

Suffice it here, that there is produced, at some period after the original form of the earth, a further one, in which there are strata, accompanied or followed by a creation of living beings. There are more; and each change is improvement: but it is sufficient, here, that I generalize these more remote and obscure events: the general proof of the Design in question is ample, without their aid. Much has been written to prove that these early creations were deficient in variety, in numbers and in perfection, compared to subsequent ones. It is probable: and we can see the reasons, in the successive improvements of the earth, through successive accumulations of strata, and successive subversions. This is the only ground of judgment; and it has remained unnoticed. Proofs have been sought in the facts; in the remains themselves: but these are worthless, because they are negative. It is the *argumentum*

ab ignoto. We may find what is ; but we can know nothing of what is not.

But on the *à priori* grounds, it is easy to admit a prime creation of animals, solely marine. It is equally easy to admit a period without vegetables ; since an earth of mere rock was unfitted for them : and it follows, that as the vegetable soils increased with successive emergences of new strata, so must vegetation have augmented. The final fact as to animals would lead us to infer, that terrestrial animals also would follow the increase of vegetable food : because that is the great final cause of vegetables. And the facts embracing fossil organized bodies, are sufficient to confirm these general assumptions : though they are not valid for the definite assertions and exclusions which have been made.

This is sufficient for the general view of the earth's progression, as bearing on the present point : it remains to ask in what the improvement actually consists. It is, principally, in the increased number and extent of rocks capable of forming soils ; in the increase of limestones from the accumulated spoils of successive creations of animals, destined for this end and others ; and in the production of coal : derived, similarly, from the spoils of vegetables. But as the reader is entitled to facts, and to proofs of this improvement, more specific, I will select them from the later changes of the earth. Geology must be left to extend them ; as well in advance as in retrocession. They are always essentially the same, as the Design is uniform ; but, for obvious reasons, the ratio of improvement in all that relates to the renovation of Earths through the production of new strata, and their subversion, or emergence, is accelerative, as well as progressive.

In one of the more advanced, or recent conditions of

the Earth, there has been a large creation of submarine animals, chiefly, it would appear, Corals: though it were indifferent for this purpose what they were. Beneath the sea, they formed coral reefs, and submarine beds of calcareous mud and shells: stores, which, in that place, could have served no apparent purpose beyond that which the original animals had derived from them during their lives. At this time, there was also, as there had always been before, a dry earth, as well as an ocean; and we might conclude that it was the seat of vegetation. It has proved so, by the examination of its ruins and relics: and, in parts also, of a vegetation disposed in a very peculiar manner, as the earth is concerned. The parallel store on the surface of the earth was therefore a store of peat. We have every evidence of this, from the facts as well as the inevitable necessities, and I trust I have proved it most amply in the work formerly referred to: it was then, as it is now, an accumulation of vegetable matter in strata. But it was not Coal. It seems to have required an enormous period of time to become this substance. It was therefore plunged beneath the ocean: as we are sure, because oceanic strata were formed above it.

In this place, the peat, even when it had become coal, was as useless as the limestone: to the submarine creation, it was nothing. It was not improvement: but it was the first step to improvement; the preparation for it. Another revolution and another subversion and elevation of the strata, occurred at the Divine command: and the improvement was effected. That chief tenant of the earth to whom it was to be useful, and for whom, simple good sense, not less than piety, is assured that it was all intended, was not to be created till after incalculable ages. But he came at length. He found

coal, that great engine of his civilized life, which, in Britain, equals the quintupling and more of his territory, ready for him : and he found many of the calcareous and argillaceous lands, of which Britain boasts, brought to the surface, from beneath the coal, and from above it, by one act of power, as of wisdom and goodness ; and not only brought, but so “subverted” that he had not even to seek, to find them. What more he found, I need not here say. I might continue to trace the continuity of the Design and the augmentation of improvement through after revolutions ; but, here, I cannot. The reader who may not be content with believing, will find the facts, as well as the proofs, in the same work.

Ignorance has asserted that there is here no progression ; whence also there can be no improvement. Who shall give eyes to the blind, or reason to him of no understanding ? ignorant, alike, of the works of God, and of God Himself. And wherefore, has it also been said, all this tedious and prospective preparation, when one word and one hour, one instant, would have effected all ? The ignorant man complains of the slowness of God’s proceedings on the earth. The Ephemeron wonders that the sun is so slow in rising, since its life will be half spent before the meridian day will bring to it its full enjoyments.

This is that improvement of the earth which it is ever undergoing through its successive changes and forms : and it proceeds in an accelerating ratio : for all the past stores are added into one heap to form the last one. It was late in this life, this planetary existence of our globe, that man was placed on it. It is probable that it was not sufficiently suitable to him before. Thus at least we may infer, from what we know of nature, and conclude of its Author. Briefly as I have sketched

all this, who shall dare to say that we do not here trace a Design, prospective, or providential, continuous, orderly, and systematic: for a good end, and therefore beneficent? If it is not seen here, I have written nothing to this purpose anywhere.

I might have demonstrated what I have asserted. I might have shown, that throughout the long, incalculably and almost incredibly long, existence of this Earth, and under all its perhaps yet uncounted revolutions, there was not one which was not an improvement, not any one that did not produce an earth better than the next anterior, and thus through the whole succession backwards. These events were ruin, indeed: but such is the ruin wrought by him who demolishes an imperfect building that he may replace it with a better: better; though the ignorant man may not discover its architecture and its uses. But it is enough. I will take up the Earth after its last revolution: that earth which was prepared for man.

From the hour of its first production, it began to improve: and we can investigate those improvements, not by inference, but by actual examination. They are visible to the senses: and they not only render the present earth better, at any successive period, than it was before, but they accumulate for a more distant and eventual improvement, analogous to the preceding. The general Design to improve continues: but the mode adopted is different. Modes, I should have said; for there is more than one.

Concluding that the earth in question was a terra-queous globe, we must also infer that the land consisted of rocks alone; covered, possibly, in a few places, with loose materials which had escaped consolidation. To omit some still obscure geological changes, as of no

moment to the general argument, such an earth must have presented a surface of naked rocky mountains, with some lower hills, and still flatter tracts of the same general character. Thus there were no alluvial plains terminating in the sea, nor were there any interior ones: every valley, or depression, being a cleft or a ravine, a rocky glen terminating in an angle, or a lake; originally filled with salt water, as being a portion of the sea, to be freshened afterwards, if freshened at all, by the transmission of a river.

The naked and rocky hill is still seen in every mountainous country: wherever there is soil, it is the produce of the waste of the rocks themselves, formed on the very spot, or else it is brought there by water: and where one of these things does not happen, they remain bare, and will remain so, till circumstances shall change, in the progress of time. With respect to lower elevations, it is the same: but the most lively exemplification of this general fact is found in lands elevated from the sea before our eyes. Such are the volcanic islands, produced by the same powers that raised the present earth itself above the waters; and such are the Coral islands, though the produce of far different causes. I may infer the same from a very extensive fact in physical geography. The sandy deserts consist of that saline sandstone which is a portion of the marine strata: they present no other loose matter than that which arises from their own waste, and it is therefore easy to infer a time when they were naked rock.

That an idea may now be obtained of the form and the extent of the original land, let the reader have recourse to the physical geography of the present, and perform an analysis more easy to be executed, than detailed in words. It is, on a competent map, to cover

with the excluding tint of water, every alluvial plain and deposit on the globe, wherever they can be made out. Thus, for example, he will blot from the habitable earth all Bengal, with large portions of the upper provinces of India, as far as Hardwar, to the foot of the mountains, all round; taking the geography of the Ganges and the Burhampooter as his guide. Thus also will he cut out enormous tracts in China, and in all the peninsulas of Eastern Asia. The Indus, the Euphrates, and the Tigris, will give him similar results; Egypt will almost vanish from the map; and, to pass over all else, let him, on this side of the globe, inquire what Italy was before the creation of the Po, what the countries which the Danube and the Rhine intersect, what, even, the valley of the Thames. And if he should still doubt, geology will inform him that under such tracts, even close to the mountains, and at depths corresponding to the present level of the sea, the remains of marine animals are found deposited in the materials of the original sea-shore. Thus may the earth be dissected, and replaced in the condition which it possessed when the present land emerged from the ocean, and the rivers began to flow; as to the operations of those rivers we trace the causes of this extension.

I cannot here undertake to follow minutely the mode of action or the particular effects: there is no more space here to teach geology, than chemistry or astronomy: a very little must suffice. The higher lands continually tend to seek a lower level, when free to move: they are freed by disintegration and decomposition; and the flow of water becomes the chief moving force. The first fragment is gradually reduced in size, till, at some stage of its progress, it is pulverized; when becoming thus capable of a more perfect suspension in

water, it is floated onwards to the lowest attainable level, and, in the extreme cases, to the sea. But whatever be the ultimate destiny, all the cavities between that and the mountain summit, are previously filled, along the course of these waters : and though the materials continue to be transferred by the same power, they are constantly renovated, and even augmented, from the original source of supply. The rocky and useless ravine becomes a glen, through the wear of its sides ; the materials, accumulating in the glen, produce an interior plain, or it becomes a flat valley : the lakes are filled up, replacing useless water by fertile tracts of land ; and, at the end of this progress, extensive maritime plains are formed, repelling the sea, and contracting the dimensions of an unprofitable ocean. And, in each place, the flotation of the pulverized materials causes them to occupy the surface, that they may become valuable for agriculture and vegetation ; while the greatest power of travelling, added to the most continued power of suspension, is the cause that the finest powder comes ultimately to occupy the places of the smallest declivity, or greatest retarding force, and above all, those plains which are formed on the margins of the sea. Thence the well-known and apparently inexhaustible fertility of these tracts of alluvial land.

Such is the beauty and perfection of this system ; a system, also, not less durable than perfect, since it can never end but with the destruction of all the higher lands. And through one simple contrivance, a single set of operations, which to the thoughtless appear unavoidable consequences, not designed causes, is the double improvement of the earth carried on : the surface is enlarged, and the fertility is augmented.

This species of improvement relates to the life of a

single form of an inhabited earth; as those first described belong to its planetary existence. But it is plain also, that every anterior form of that existence was undergoing corresponding improvements, from its commencement to its termination. The same causes must ever have produced the same effects: and, that they did so, we are sure, since we trace them in the facts that belong to the ancient strata. So consistent is the Design, from the creation of the globe onwards; and so perfect, yet so simple, the contrivance. And this temporary improvement also, is not limited in its utility to the single earth in which it occurs. Like the limestones of former earths, the alluvial matters of the present are an accumulating store, to reappear in future strata, for the enlarged uses of a subsequent one. That which is not a simile may often afford an illustrative metaphor. The insect of successive forms increases in vigour during any one form, and it improves also by every new transformation. Such is the life of the planetary earth.

I proceed to another of the Creator's Designs for the improvement of the present earth, which has, by a singular neglect, been overlooked by naturalists, too seldom contemplating nature under these higher views; and, of course, by theologians also. And most censurably neglected; since there is nothing in the whole circle of nature which equally indicates power and resource, in the apparent inadequacy of the means to the ends. I allude to the production of the Coral islands of the ocean.

The general nature of the Corals is familiar; they are stony substances, chiefly; growing, as if by a vegetation, and including many which emulate plants in their forms. But that apparent vegetation is the produce of an animal, conducted also by a combination of powers,

both physical and metaphysical, which continue extremely obscure. This little creature, the lowest in the scale of animal life, produces rocks, mountains, from the water of the sea: it converts that into earth, or extracts earth from it: and chemistry cannot, as yet, even conjecture how it should effect either the one or the other. But if the intelligence and will of the Creator form the instincts of animals, here surely, if anywhere, we see that intelligence acting, and that will exerted: through means also as complicated, and apparently marvellous, as the ends are wise and the results certain: acting also through the intervention of living beings, among which, if anywhere, we should conclude that there did not even exist faculties to receive an instinct: as is probably the fact. And yet thus does He execute His purposes, as if to show us that with Him nothing is difficult; if it is not indeed to teach us the higher lesson, that the power which plans, executes also: choosing from the most minute, and apparently powerless and senseless of animals, the agents which are now laying the foundations of continents; agents that have already built up mountains which cause the Apennines to shrink in the comparison.

On the Coral animal, little is necessary: to the naturalist nothing. Be the coral stony or flexible, the apparent, working animal, is not often larger than the pea, and it descends to less than the size of a pin's head. In common language, it is a polypus; a cylinder or a cone, with feelers for constructing its cell and for feeding, very distinct in some cases, not yet proved to be so in others. Each of these forms a cell, which it cannot quit: contiguous and successive cells are built by others; and generations in succession continue the work to the appointed form and limits of the whole structure.

But the metaphysical question is, here, that of the prime interest, as it is the chief difficulty. We have found the masons; but where is the architect? There can be no building without a supreme directing mind. If, for example, we take the fan coral, we find a regular structure, commenced in nothing, and terminated. The workmen increase in numbers as the structure grows, since none can leave his place: each lays but his own stone, ignorant of what his neighbour is doing: yet the produce is a York, and ever a York: it is not a Peterborough. In another community, it is a Peterborough or a Wells; and the design is not less sacredly preserved.

There is here no difficulty, as far as a single cell is concerned, or as to the point of dependence in the total structure to which it is attached: it was a necessity, the result of an instinct. But where is the instinct that conducted the design? constructed the fan coral, and not another? It is not the consultation of the workers, for they cannot consult: there is no individual polypus to claim the command: that which commenced the work has been dead long since; and what remains to be done at any one time, is as different from what had preceded, as is the portico of Peterborough from the original Norman structure. A collective, or a central instinct in the whole community, designing, in addition to the separate instincts of building, is incomprehensible; because we do not know where to place it. I ought not to be obliged to put this in a light of greater detail: but there are persons who will not analyze, and who continue therefore to adhere to some vague views, which are, to them, a theory. In the coral in question, as in many more, the new progeny must have an instinct different from that of the prede-

cessor, in addition to the fundamental one; as must all the other progenies have, in succession; yet, even in them, under endless variations, since each must take up a new and peculiar position, and work also in a new manner, or the pattern would fail. Neither theory will explain the result: it is not to be explained by any modification of communicated or implanted instincts. It is as far removed from even the case of the bee, as it is from that of man.

It is now, however, important to remark, that if I have hitherto considered the coral polypus as a being metaphysically separate, and as the member only of a political community, there is a physical, or anatomical connexion, which pervades the whole. Were the stony substance absent, the colony would resemble a plant: as the branching *Vorticella* is such an animal plant, without the stony basis or shell. It may be conceived as if it were a plant in which the flowers are the organs of the growth and nutrition, but formed of animal instead of vegetable matter. Yet, as far as is hitherto believed of plants, there is this essential difference; that the polypi, or flowers, exert volition and choice, since they feed themselves, and their plant also, through organs moved by will, selecting and rejecting. The original difficulty is therefore not removed. If the power of receiving an instinct is to be sought anywhere, it must be in that which can exert a will or obey one: for its exertion is an act of obedience to some will. And this is the more certain; since the polypus of a vorticella can detach itself, and become an independent will and life, with the power of reproducing a new colony, or colonial plant, of separate, though connected wills.

We have still then to seek the Architect, the mind, which not only planned the pattern, but causes all these

blind workmen to execute it, and every one also to perform his own peculiar and precise work, and no other; and this, in thousands of separate structures, and in tens of thousands of successive and similar ones, never varying from the pattern first established. There is One who is the Architect, and there can be none other. One mind unites the discordant and multifarious actions of each one out of millions of agents, into one design: One Intellect planned, and One Will executes. And this is the important question. An instinct may be, or is, deputed: the animal becomes the intellect; the designer and the workman both. It may then have been deputed from all eternity: God may take no further concern in the work: it is the result of a "pre-established law." Even thus has it been argued; of this, as of all else, by a modern peripatetic philosophy, yet, not like that of ancient Greece, a merely speculative and pardonable one. But that hypothesis will not avail in the present case. There is not a deputy to whom the design or the work could have been deputed: there is no receptacle for the instinct. He that planned must execute; for there is none other: and where in nature shall we seek a proof more complete of His perpetual and active government, and of its infinite minuteness and divisibility? Let the reader add it hereafter to the other innumerable proofs which I have given of His "working," of His present, active, universal, and perpetual Providence over the affairs of the universe.

The difficulty, and the solution, it may be said, are both produced, because I have represented the coral polypi as animals: call the whole a plant, and it vanishes. I have yet to learn, then, what an animal is, if volition, choice, locomotion united, do not constitute one; to omit all else: for the latter is true of the Vorti-

cella polypus at least, and the other resemblances are identity. But I will waive this. There is a pre-established law for the coral plant, and for each coral, as there is for a rose tree and each species of rose. It is so much the better for the general argument of a constructing as well as a designing Mind: I am pleased with the objection. All do not urge the "pre-established law:" it is the term of those who desire to appear philosophers. But all are so accustomed to see plants grow from seeds, and produce their forms and flowers, that custom, with them, is equivalent to law. How should it be otherwise? it is the usage, and it has ever been so. But the full-formed and full-blown rose tree is not included within the seed: I have proved this in a future chapter; (c. 56). The plant produces its parts and its flowers; makes itself; as the coral commencement makes the full-grown coral; while, in the original polypus of all, there was surely not present the germ, in stone, of the completed structure. The rose tree has not designed itself: that is already admitted; it has no will; it cannot will a branch or a flower, and it has not even the tentacula of the polypus, by which to construct one. How then is the work continuously performed? He who never thought, and he who does worse than if he never had, may answer. I see but one resource: the One resource.

If I have diverged from the immediate subject of this chapter, I have not trespassed on the object of the work: facts must take their place where they will make the greatest impression; for this is the main purpose. Many kinds, or colonies, of the coral animals inhabit together, and thus form extensive tracts of intermingled and different plants. That might be accidental; but their joint mode of proceeding cannot be

so. Though they build in the deep ocean, they select its eminences; indicating that purpose to reach the surface as soon as possible, which is ultimately attained; as it is their commanded duty. And though there can be no motive to such an end, where there are no motives but the search of food, and the construction of a cell, yet they all commence, in all the kinds, by agreeing to build up, first, vertically to the surface of the sea; thus facilitating the propagation and extension of others beneath their lee. Yet more, these walls are conducted in circular or curved directions, so as to enclose and produce a lee space, still increasing the facility of extension; while the result is a rock of corresponding shape, finally to become an island. Thousands of polypi originally united and agreed to form a plant of stone; millions, uncountable, of such thousands, and millions, myriads, through successive years and ages, have further agreed that they would unite to form an island: to execute what man himself could scarcely have planned, would never at least have dreamed of executing, and could not have executed, with the wealth and population of nations at his command. He exhausts his resources in erecting one dam in a shallow bay; which is an object for a microscope, compared to almost the least works of those insignificant animals; erected without money, without visible materials, without the mechanical powers, and even without hands. The Great Artist requires nothing of all this. And the Design which planned and executed the island is as distinct from that which constructed the single coral, as is the work of the stonehewer from the finished cathedral. There was no instinct, anywhere, to produce an island, at least; nor is there any pre-established law of organization by which islands grow:

it is not an organic production. If it be chance, the chances possess a singular consistency. There is but the One solution: why will not men see it; why did those who had so long and so often known these facts overlook it? If what I already said of the Workman, as well as the Designer of all this, was not before satisfactory, it is surely, now, unanswerable. He who will not understand must possess singular powers in blinding himself: he who will not admit that the Divine Mind directs everything, and also that the same will executes everything, has much yet to reflect on.

If it be asked why the Creator has adopted a plan so singular, and apparently so inadequate, for such an end, when He might, in a day or an hour, and by means also of which He does often make use, have erected such islands in the ocean, I know not that Natural Theology can give an adequate answer. To say that it was His will is the answer of piety, and, too often, of an indolent one. Yet we must rest there, when we have sought in vain for other reasons. "For like as a young child may not bring forth the things that belong to the aged, even so have I disposed the world which I created." The world is a progressive one, under that Will. That these additions may be graduated, so as to provide for a gradually increasing population, as does the extension of alluvial plains, may be one reason: it may offer others, that calcareous lands are thus produced, and that the general store of limestone for future earths is augmented: but we may not be wrong in thinking that the chief one was the intermediate exertion of His beneficence, as in the case of all the limestones, by the communication of life and happiness to the endless myriads of beings which He employs in those great works.

But the animals have performed their tasks; they have done all that they can, since they cannot exist beyond the level of the sea; the island is built, but not completed: it is uninhabitable and useless. Something more, indeed, they have done; for they have left a reservoir of water in the middle of it; so well has all been planned: but it is a lake of salt water. Had the great Artist not designed an inhabited island, He would not have proceeded to adopt other contrivances to finish His work; never ceasing until the Design is completed. Granting that contingencies or necessities had produced all the past, it would be very extraordinary indeed that other contingencies, entirely different in their natures, should have met and coincided in such a manner as to have perfected the plan in all its parts. It must not be said that it is a blind piety which thus concludes, as in much more of the works of Creation. It is a rigid philosophy; and the inferences are strictly philosophical. I must indeed continue to believe that sound piety and philosophy are but one thing. Both derive from reason; if there has been a self-assumed philosophy which has separated itself from piety, I fear that it will prove a spurious one.

It has been ordered that the stone of the coral shall be partially soluble in water. Through this, and by means of their fragments, are the separate ones consolidated into a firm rock: while, as the force of the waves, "obeying His will," breaks off the upper portions, they are piled up beyond the power of the sea, and there is at length an island surmounting the waters. The rains gradually convert the salt reservoir into a fresh lake, sea weeds and sea birds aid the coral sand in forming a soil, the floating seeds of trees and plants are directed to it through the ocean, and it becomes an

island fitted for the habitation of animals and man. Such are the multitudinous islands of the Pacific; yet an extensive nothing among the innumerable rocks which are every day springing up throughout its vast extent, and almost annually acquiring a vegetable surface, even to the eyes of the navigators of those seas. The great coral reef of New Holland alone, a thousand miles in length, and daily now beginning to assume its place in the vegetating earth, will not form a small addition to the useful territory of the world.

But neither yet is the full design completed, nor the resources of Creative power exhausted; while, in the further means used to accomplish these purposes, we see the greater mechanical and chemical forces which He employs: wielding and directing them, as easily and as unerringly as He governs the most minute and feeble: and presenting the most extreme contrast to those through which He laid the foundation of this new earth in the ocean. The coral islands, as first formed, are necessarily flat, as they are also but little elevated above the sea. Though they could command the rains, they can have neither springs nor rivers; and thus is their value to animals limited; thus even do many yet remain uninhabited. Had the Creator not possessed other resources, and had He not also intended more, He might have covered the southern ocean with a desert and useless continent.

Inconsiderate man has viewed the volcano and the earthquake as the instruments of His vengeance, and their effects as the demonstration of His wrath. Yet it is by those that His bountiful design is perfected. And the effort of an hour is brought to bear on the same point as the accumulated labour of ages. It is truly brought to bear on the same point: this is not mere

phraseology. Volcanoes do break forth in more parts of the ocean than these: St. Helena and Ascension are not the only examples. But the far greater number occur so as to act on and elevate the coral islands; and many have acted immediately beneath them. The intention is continued. It has been said that the animals choose the submarine summit of a future and prospective volcano. That would be intelligence indeed: but this is only one of many similar assertions. Yet, be it so, is it not the same intelligence which has directed all else? Why, man himself, knowing what the volcano could perform, would have proposed these very means to remedy a defect, or to perfect an inchoated work. Is he more wise than his Maker? Of the fact there is no doubt, even in those islands without volcanoes or volcanic rocks. If the numerous naturalists who have visited those islands could not explain the great elevation of corals above the ocean, knowing that the living animal could not pass its surface, it affords a proof, among many others, of the value of final causes, and of a regard to the Deity, in mere philosophy; as we cannot suppose such observers deficient in aught else. Why else the whole Design and its execution were not scanned before, I know not: while I trust it is now as plainly analyzed and demonstrated as it is in itself beautiful and perfect. I scarcely indeed know where to seek, in nature, its parallel in point of conviction; so unlike and remote are the several means employed, and so nicely do they all bear on a perfect result.

This then is the second great plan for increasing the fertile and habitable territory of the earth. And it seems as boundless as the preceding. It has been said, by the ignorant pious, who do not reflect how much more successfully they might defend "the ways of

Providence" did they first consider what those ways may be, that the apparently undue proportion of the sea to the land, was necessary: while they have also sought for reasons in the requisite production of rain, and in facility of communication. Bad reasoning can never aid the cause of Him who is perfect reason: and it is a worse ignorance which says that as the utility of the earth is to be calculated according to the number of its happy tenants, sea is, for this purpose, equivalent to land. The well-known divine who uses this argument, ought to have recollected that the numbers, of an immortal being at least, are of far other consequence than those of a fish; while it requires but a very slender portion of zoological information to know that the deep and wide ocean is, comparatively, thinly inhabited, and that there is perhaps a greater numerical sum of enjoyments contained in a single summer pond, than, with the exception of these coral animals, which he had not considered, there is in all the ocean which lies between New Holland and Cape Horn.

The contemplation of the past produce, and of the further means through the ever-increasing multiplication of labourers, points to a future day, when some enormous accession of land must be made to the present earth; as it is not less probable that this is a part of the general Design. And if there is an accelerating production of space, with fertility, it is still more probable that it bears a reference to the accelerating multiplication of man; though no more calculated to keep an even pace with that, than is the power of vegetable increase through added labour. It is further deserving of remark, that these foundations of new lands are almost confined to a zone of about sixty degrees in breadth, and in the best climate of the earth: as if indicating

still more the moral purpose of the Deity. I need not speculate on what may be the actual condition of the geographical world, and of mankind in it, should some thousands of years produce what they apparently will: I may leave to others what exceeds the bounds of my own inquiries.

There remains but one other mode, of which I know, for increasing the extent of absolute, and also of fertile territory, in the earth; as the same process may produce either effect, separately. And it is but that which has been adopted for the completion of the former process: the volcano. There are some differences in the application; that is all: but the design is apparent, and especially in the cases which approximate nearest to the former, because we cannot deny of the one, what we have admitted of the other.

The purely volcanic islands of the ocean, such as St. Helena, are the simplest cases. We cannot indeed be sure that this, or Ascension, or Amsterdam, is a production more recent than the general arrangement of our present earth. It is probable, however; because the volcanic mountains of the Coral islands are so: and though it were not the fact, it is of no moment to the present inquiry, since it is a plan that can be used at any future time, in this specific manner as well as in the other. And that power which produced such an extent of fertile surface as St. Helena contains, may produce any greater one. That which once elevated whole continents, can suffice again for less.

Numerous islands in the Indian seas, on the African coast, and in the West Indies, are cases less pure: but thus is the valuable result greater; while the design is even less questionable, if it could be questioned at all. Limestones formed beneath the sea, by corals and shell

fish conjointly, but which had not reached the surface, have been lifted above it by the volcanic power: the island is a volcanic mountain, or a group, covered, to a certain height at least, by limestones. It comprises the two greatest sources of fertility in its soils, and it is a new accession of territory. At what date in time the African and the West Indian islands have been produced, we do not indeed know; but there have been recent productions of this nature in the Indian seas: the principle belongs to the consistent proceedings of the Creator respecting the earth, and there is no reason why it should not continue to act in one mode as well as in another: in creating a new Madeira as well as a new Owhyhee.

But the action of this principle has not been confined to the production of islands only: as there is no apparent reason why it should be so. The rocky portion of Italy, as indicated by the course of the Apennines, has been elevated, at least twelve hundred feet, at some period since the general arrangements for the present earth were made; and, unquestionably, by volcanic power. For the appearances and the proofs I must again refer to the same book, and for the same reasons. The result, which, alone, concerns the present question, is, that the whole peninsula then experienced a considerable enlargement of its dimensions, the mode of estimating which is obvious, though the labour would be great; while the new land was also more valuable in its quality, or more capable of being rendered quickly useful, than the anciently elevated ones appear to have been; since much of it, at least, consisted of the unconsolidated bottom of the sea. It is a case analogous to many of the former ones, but on a larger scale; and it is continental, instead of insular. Whether the total effect was rapid or tedious, there is no evidence to show:

though at some points, such as Monte Bolea, the most visible effect, in the sudden entanglement and elevation of living fishes, proves that there, at least, and thus far, the action was immediate. But this merely indicates the volcanic cause : all experience, as well as reasoning, must lead us to conclude, that such elevations of land as this, not less than those of Madeira and Owhyhee, must have been the work of much time.

It cannot indeed be proved that this event occurred since the creation of man : it is beyond the records of history ; and there is no physical evidence. But this affects the present inquiry in no manner. The general fact suffices perfectly for the present argument, or it serves to prove that the earth has been extending since its last general arrangement, and that this is one of the provisions for its extension ; since it is of a date posterior to that arrangement. Every marine animal which that new land entangles, belongs to the present earth ; and nearly the whole are now inhabitants of the Mediterranean. Should living evidence be required for the actual occurrence of such events as this, and from these very causes, it will be found in Banda, which has long been gradually rising, and is under the same volcanic influences. And if I have given this case of Italy, it is but as an example in illustration of a fact, which, as I have elsewhere shown reason to believe, has had an extensive influence on the dimensions of Europe, and, I doubt not, on many other portions of the continents of the present Earth.

A slight mechanical attention to the forms and sections of land, will now serve to show, that the great practical result is, not the elevation of the central lands, but the extension of the lateral ones : the enlargement, especially, of the exterior alluvial plains, and the further

protrusion of the sea. Its boundary retires, as it had done before the alluvia of rivers; but from a very different cause. It is a cause also which seems to imply great force, and even violence: since we cannot hear the word volcano, without associating with it earthquake, revolution, destruction. But nothing of all this is necessary. The same extensions, and from the same cause, are occurring silently and slowly, in many parts of the world; far more widely, I doubt not, than we yet know of. Yet while few but the interested proprietors and observing residents note them, it has required the utmost acuteness of the rarer geologists, to prove that the cause is still the same, though giving none of the ordinary marks of its existence. In a philosophical light, I cannot call it another mode of the extension of the habitable earth: a popular view may consider it as such.

Out of many, two facts in proof will suffice. Italy is gaining lands in many places, by the retiring of the sea line, yet not by the new deposition of river alluvia: and the very nature of this country indicates the cause. Britain is also gaining, and has long been enlarging, on its eastern side at least, in the same manner. If I must again refer to the same book for the facts and the proofs, the general reader may here be told, that the occurrence of maritime remains, inland, and above the present level of the sea, in several places, depends on this cause; as do many of the peculiarities of Lincolnshire, for example, which ignorance had attributed to that which cannot be; a general diminution of the ocean. The rising of the land causes the sea line to retire: while to those who consider the earth as stable, the apparent effect is the subsidence of the water. But the chief fact which concerns the present inquiry is,

that those alluvia which had been so far transported as to have disappeared beneath the sea, are elevated, so as to be added to those which had at first succeeded in repelling it: the final effect being thus the same as if there had been no other source of this extension than the transportation of the higher lands by the rivers. Thus indeed has it often been ignorantly considered. The beauty and the simplicity of two arrangements, entirely different, yet again brought to bear on a single great object, the attainment of which is also compassed in so many other ways, ought to prove the Design; if the utility, the great final cause, did not.

As far as I know, this includes the whole of the Creator's plans towards the extension and improvement of the Earth, for the purposes of life, as far as they have been executed, and are still executing. More may have been done; but I cannot find the evidences. What other undisplayed resources He may possess, man can never conjecture in any thing. But the vast power of these is obvious, though they should never be applied in any other modes. And the only other application of volcanic power to the same great purpose which I can now suggest as remaining untried, is the one which I noticed in the 6th Chapter: since I cannot find that any evidence of such an event has yet been produced. It may not perhaps, however, have been inquired of. It demands other and higher views than Geology, or indeed natural history at large, has yet adopted, to be able to see what exists. The Creator may have reserved the sandy deserts of Asia and Africa, as He has reserved the ocean: that, at a future day, He might add them to the habitable and useful earth, through the simplest of all His agents, the volcanic power.

Views so new, necessarily demand unusual details

to be intelligible; and the inevitable length of these renders a brief summary convenient. A portion of the Divine Government, so important in its results, so consistently pursued, and as clearly demonstrated as it is simple, though multifarious, in its details, must not be passed over as if it were a collection of mere facts in natural history.

The original globe was unfitted for any form of life: but during the first periods of its existence, it became gradually more adapted to this purpose, by the partial destruction and motion of its materials, from the same causes which produce these effects now. Under a second form, the result of a revolution which elevated the submarine materials in the shape of rocks, it became still more fitted for this great end, through a greater variety of composition and structure. Under a third, a fourth, and many subsequent ones, there is a constantly increasing variety; since all the preceding productions become accumulated, in some form, on the last modification of the earth's existence: but the more remarkable, and among the most important accumulations, are those of limestone and coal, which never change their essential and useful forms, as the other strata do; while themselves are the accumulated remains of the several preceding creations of organic and living beings. And while these should also be accelerative in accumulation, inasmuch as successively better earths must maintain more numerous populations, so is it certain, that down to the present mode of the existence of our globe, be its number as high as I have supposed it in another work, namely, a fifteenth, or less, or more, something has ever been added from the last preceding, to render it a fitter and a better place, for animals at least, than the prior ones had been.

This is the improvement which the globe of the earth undergoes through successive modes of existence; many, if not all of which, are separated by great revolutions, or, by the conversion of the submarine earth into dry land, and those revolutions appointed for this very end. But each mode of that existence also has its own interior improvements; applied to the same great end then, and, finally, adding, under a new revolution, to the accumulative improvement. We infer it, chiefly, of what is past: but we see it, in that mode or period of the earth's existence to which we belong. The habitable surface is extended, by the transference of the higher lands, so as to exclude the sea, to fill up interior deposits of water and rocky cavities, and to cover unproductive with productive materials. It is extended also by actions of elevation, which produce new islands, and increase the dimensions of continents, and, further, bring back to the surface alluvia which had passed the maritime boundary during their progress; or also, convert the bottom of shallow seas, generally, into portions of the adjoining lands. And finally, among the shell-making animals which lay the basis of future limestones beneath the sea, there are some which build up their solid and living works to its surface: germs of islands, which further chemical and mechanical powers, and the actions also of the great elevating forces, convert into habitable lands during the actual existence of the same form of the earth; that, namely, on which man is the chief tenant. Lastly, to pursue all this as I have done the former, among these, the improvements belonging to one mode of the earth's existence, many productions which must now be obvious, become stores for future uses when their first appointed duties shall have terminated, and will re-appear in a future earth, still to be

a better one, should it be within the Creator's design to reproduce another from the materials of the present, in consistency with what He has already done.

If the proof of the progressive improvement of the present earth is especially ample, yet rather because it is obvious to our senses, so does it appear to have been designed essentially with reference to the race of man. The prior great system of improvement, commencing with the first solid earth, and regularly pursued through each successive change, refers similarly to a sentient and organic creation. We have not ascertained that this has gradually and successively improved with each new form of the earth; but we can have no doubt, when we compare very distant forms of its total existence. It would not be an unreasonable moral inference, that both progressions corresponded, inasmuch as the one was intended for the other. It is the only argument that I can offer: Geology has lately decided on the conclusion, and has not seen the only reasoning by which it can yet be supported. That any physical evidence will now be found, I more than doubt: the expectation is unreasonable. But where there is such a progressive law of improvement as to the earth itself, where there is also a living creation preceding that of man, far superior to some anterior ones, probably to all the prior, it seems a reasonable moral conclusion, that as all those improvements in the successive forms of the earth were designed to furnish a habitation for races of sentient beings under successively improving capacities and powers, so there was not one which had not some prospective bearing on a more distant earth intended for the habitation of man, in which, it having been at length fitted for him, he was placed. And as far as we have attained in knowledge, or as far as mere

man can attain, this was the end of all. That it is the final, terminal end, we cannot dare to pronounce. When our ignorance shall, Hereafter, be enlightened on that subject, it will form but a small portion indeed of what we shall then have learned of the government of God.

If there is any one still inclined to reject such a view, from the not unnatural repugnance to admit of a progression so tedious, I need not do more than refer him to some arguments already presented; as I must also refer the usual ignorance and its natural prejudices, to the facts in the history of our globe. “Knowest thou the counsels of God?” is not the answer in which a rational theology indulges; too well acquainted with its abuses, and with the pernicious indolence of mind which it tends to produce. But, in addition to what I have already said, the whole analogy of creation concurs with its tediousness, (as brief man feels it) in the progress of the designs of the Almighty. To the accumulation of the feeble labours of single men, through ages, He has committed the apparently impracticable charge of reducing a rude and almost uninhabitable earth to man’s own service; of converting a wilderness into the fair and rich world which we now inhabit. The great and good end is attained through intermediate good: it is the nearest analogy in point: it is almost an analogy to the specific plan comprised in the Coral islands. He who imagines this earth to have been at first, what it now is, has thought little: it is almost man’s own creation. And it is but the history also of his moral condition: I need not add, surely, of his intellectual one. Why need I say, that such also has been the conduct of God respecting that great, and, to our views, long delayed event, on which all our hopes

of a future existence are founded? In these things, indeed, we can as yet do nothing but acquiescently confess our ignorance of "the Counsels of God."

If the great plan which I have thus sketched, in a manner far more contracted than I would willingly have done, relates, ostensibly, only to the increasing extension of the race of man, we must not forget that even in this it is a beneficent one, since it implies a numerical increase, and therefore an extension of happiness. We must also hope that it will prove the extension of man under a higher average of character than he has displayed at prior periods; and thus also will the views of the Creator respecting him be better fulfilled. Arguments have abounded, indeed, against any progressive and consistent improvement of the moral earth, among those whom fantastical systems of perfectibility have provoked. But the reviews of man's history in which they seek confirmation, do not support all the ardour of those who refer to it. It may be true, that the moral progress of the world has been slow, that savage nations occupy three-fourths of it, that empires have fallen as they rose, that civilization and knowledge have given place to barbarism and ignorance, and that while Babylon is the desolation which was once predicted, the place of Nineveh is unknown. This is true, and much more. Society, civilization, knowledge, have been stationary, retrograde, intermitting, transferred. And yet, amid all that has fallen, knowledge has increased and remained; while a far wider world profits by its dispersion. Nor let it be forgotten, that all this is conformable to whatever else we discover of the Creator's plan. If His care embraces individuals, it is extended over generations, races; over the whole earth, over the universe, still more visibly. The leaves may fall, but the

tree lives : men die, but man survives : and that which He did not see fitting for one portion of time, is consummated in another.

But a view like the present has no reference to a system of Perfectibility, to that romance which, perpetually reproduced under some form, if never a new one, is as ancient as poetry itself. While man is the moral and physical being which he has been created, such a condition of things as warm or enthusiastic imaginations have conceived, can never occur. As far as the contemplated happiness is physical, it must proceed from wealth, which must therefore be universal. Universal wealth, which is not universal poverty, it would be hard to define. Wealth, without labour, demands miracles ; and wealth, capable of indefinite self-multiplication to meet the consequent multiplication of mankind, demands a perpetuity of new miracles. And he too who would abolish labour, must abolish Man ; for they are inseparable. Without it, he is a carcass : without it, his mind would be that of a beast of the field : for, by labour, are both his mind and his body formed. That education, like wealth, is to be attained without the evil of labour, is but another of the inconsistencies of a system, in which knowledge, is to be a prime source of happiness. But if universal knowledge is to be diffused through some miracle, another miracle must be exerted to find recipients for it : since the power of receiving and of using knowledge is, now, created by the labour of the acquisition. Under such a visionary system, it must be given, even to infants : it must be given equally to unequal intellects ; and it must be perfect, almost even as Omniscience is perfect. Less than this must hazard evil to gain good ; and the evil will not be wanting. Nothing less than this can prevent physical evils : not even this,

while deprived of Omnipotence. Less than both would not eradicate the human passions; which is, for man to cease to be. The system too is the happiness of all; and it forgets that the good of one is the evil of another. It is a system of universal benevolence, where none can be exerted; since no one can want it, when, under such an hypothesis, each suffices to his own happiness. It is the universal happiness in which all the social affections disappear; and the state of perfection is universal solitude, universal idleness, universal nothingness. If the waters of oblivion are the waters of death, the perfected happiness of this fantastical system is man's extinction.

But the radical error of every system of perfectibility in this world, is of more moment than all this folly. Such views are irreligious. They presume that the intentions of God as to man's happiness, are to be fulfilled here: whereas they can only be accomplished in a future and immortal life.

CHAPTER XXI.

ON THE MENTAL FACULTIES OF THE LOWER ANIMALS.

I FORMERLY demonstrated the contrivances in the construction of animal machines, and the peculiar adaptations of these to the purposes of their possessors. On the mere view of Design, it is obvious that some internal powers should have been invented to put this machinery into motion : it is the correlative portion of the total contrivance ; the source of those purposes. Under the same limited view also, these must have been various, that they might duly regulate this great variety of machinery, and under varying external circumstances. Such internal living powers constitute the animal mind : and thus an inquiry into the mind, or mental faculties, of animals, becomes a necessary part of the investigation of the Creator's Design. But it is obvious that I could not here enter on this question as it regards man. This is an inquiry, of itself, as extensive as it is important ; and a difficult one it has proved. As to the lower animals, it is necessary ; because their mental nature has been so perseveringly misunderstood : while that can only be examined under a comparison with the human mind ; obscure as that subject yet is.

This inquiry is not less needful, under a reference to the wisdom of the Creator : as I have selected this place for it. That wisdom is minute, as it is perfect.

There is not one species of mind for all the inferior animals, as there is another for man; but there is a separate one for each class, or group, or kind; as there is always a perfect harmony between this interior power and the capacities of the machine: the former always governing and directing the latter according to its powers of execution. A mere principle of vitality, the lowest conceivable degree of mind, might have enabled an animal to enjoy, under a few relations, and those, unvarying. But such an animal would not have exceeded a medusa or a plant: and it would have been useless to have possessed greater powers of machinery, without a corresponding set of internal faculties. And these have been given and varied accordingly.

The beneficence is obvious. The intention was happiness: but without internal powers, adapted to the external ones, and to all the variety of external circumstances, that could not have been attained. And although the chief happiness of animals consists in eating, there are other visible sources of this, in the exercise of affections and passions of various kinds; indicating certain moral, and also intellectual faculties; as it will be the business of this chapter to prove the existence of such minds in the inferior animals, or, to show that the Creator has given them minds, analogous to our own, suited to their constructions and powers, and designed for their happiness; as that happiness consists in the performance of what He has rendered them desirous of doing, and empowered them to do.

But it would here be impossible to pursue this inquiry through its details, or even under that broad and general view in which the organizations have been examined. Though our knowledge were more competent than it is, this would be both tedious and useless. It must suf-

fice, for the present purpose, to know that the animal minds differ, first, in a gradation proceeding from the more perfect, to those which approximate to mere vegetable life; next, according to classes, or groups; and lastly, with a relation to single species. Yet we can only see this gradation in a general manner; as also, we can only select particular species for examination, from each portion of it. And even such a view would exceed my limits. All that I can afford, is to inquire of the animal mind generally, in comparison with that of man, and without discrimination of its varieties: while the main object is to show, that it is constructed on the same principles, differing only in the quantity and the variety of its powers: and thus, that in the moral as in the physical world, in mind as in body, the Creator has gained His ends by varying the same general principles of design and construction.

That the question of immortality is totally excluded, it should be superfluous to say: yet I believe that the repugnance commonly felt as to the existence of a mind, or soul, in animals, has arisen from an unexamined association between the terms soul and immortality; as if the one implied the other. But the chief cause of this has been, that hypothesis which thought fit to consider the inferior animals as mere machines; influencing, through authority and habit, those who are so easily led by opinions and terms. The credit of this invention does not indeed lie with Buffon, whether it originally belongs to Descartes or not: yet the chief influence seems to have been produced by a man, the union of whose shallowness and fame is among the events with which we are ever surprised: and the more surprised in this case, when we see what was the produce of a whole life of application and industry. An infant in science

could answer what does not deserve the name of an hypothesis, since it is but an abuse of terms. A machine can perform but definite movements : there is not an animal action which is not an answer to it. A chemical machine, growing from nothing, by internal powers of its own, a willing machine, a choosing machine, a machine hating and loving ; the abuse of words is not so wonderful, as that such language should ever have gained a listener. The purpose, I need not say, was obvious : the step to the machine man was not distant. Yet the oversight is more extraordinary than the hypothesis : it required other metaphysics than those of this writer and his followers, to avoid setting the trap which was to entangle themselves. Every machine must have a moving force : and if the animal mind was not that force, it could have been no other than the mind of the Deity. Between the two, this philosophy has no choice : except indeed in an incomprehensible Epicurism. The “*vis abdita quædam*” must ever remain. But though I have elsewhere had occasion to remark on that philosophy which attributes mind to organization, I must note it here. It is connected with this theory, or is the same thing : since the philosophers of this school are never very intelligible, for the simple reason that they do not understand their own speculations ; as it is by means of this indistinctness, that they succeed in influencing those who naturally think that to be unanswerable, which they know not how to answer. And I am especially called on to do this ; because, in remarking that the organization and the mind are mutually adapted, all through creation, I have stated the fact whence this philosophy attempts to prove that it is the organization which produces, or rather is, the mind.

The general answer, dependent on the definitions of

matter and mind, I need not give again; as I may refer to many other parts of this work, for answers to this hypothesis. But as it is concerned with the immediate question before us, the answers are these. The addition of an imperfect mind to an organization so imperfect as that of a medusa or a hydra, is a mere matter of adaptation; consistent, not only with profound wisdom, but with common sense. Man, himself, were such things in his power, would not have given human desires, far less a human mind, to a plant, or even to an elephant. This therefore proves nothing. Setting aside all design, it would be discreditable reasoning, even in mere philosophy; since it is to mistake concomitants for causes: it belongs to the habitual causation of the most vulgar and ignorant of mankind, and is in daily use with them.

A fine, or a considerably perfect organization, is necessary for the existence and action of the several senses; and those senses are necessary to a mind of a certain perfection, because mind, incapable of receiving external impressions, and subsequently acting on them, is nothing: it is the eye unborn. But this no more proves that the nervous organization constitutes the mind, than that the senses do: it only follows, that they are both required for the purpose of external communication. Whatever more the internal organization may perform, nothing can be proved. But the more complete answer is, that on the very showing of the hypothesis itself, the facts do not conform to it: there is not a necessary relation between organizations and minds. In truth, all these hypotheses which have been founded on the material nature of the nervous system as the measure or test of mind, have equally failed. If the brain of man ranges from one twenty-second to one thirty-fifth

of his total bulk, being in youth one twenty-fifth, the proportion in the canary bird is one-fourteenth; so that the faculties are not to be estimated in this manner. And when this has been attempted by measuring its breadth to the beginning of the medulla oblongata, the conclusions are equally nullified by finding that this proportion is nearly double in the dolphin. But, still more, it is admitted that the nervous system, which is the very organization in question, is less perfect in the invertebrate than the vertebrate animals. The bee has no brain: it possesses only nervous ganglia: yet its mind contains geometrical knowledge, which even man has not acquired without much labour, and which is not now possessed by one in a thousand millions. I might extend this conclusion very largely, to the insect races; so noted for various knowledge and sagacity, and assuredly gifted with far greater powers of reasoning, as with much more strongly marked moral feelings, than many animals with brains: but it is unnecessary. How far this wide fact interferes with the hypothesis of the modern phrenologists, who seek for specific organs of faculties as special, in a brain, and in that only, it will be for those persons to consider; as it is their duty also to explain what they seem to have forgotten.

Another hypothesis of the animal mind has been sought in a system of appetencies; rejecting the term instinct. Some similar purpose appears to have been in view; though how it was to be attained, is not particularly clear; if quite as clear as the mind of this presumptuous writer seems to have been. It is a waste of words to examine such a mixture of puerilities and wretched metaphysics: if it were indeed possible to analyze what is unintelligible rather than indefinite. As far as it can be understood, it is, that the animal is

urged by the sensation of a want, or that its sole motive is self-gratification. It would be difficult to prove the bare fact, when we examine the painful toils of many animals, and of insects especially, to gain an end. But what though it were proved? nothing follows. There must be a mind to possess desires, and to discover and exert the means of attaining those.

But the great invention for explaining the nature of the animal mind and the conduct of animals, is the term Instinct: continuing, to this day, to be the solution offered for all their actions; such solution as it is. It is impossible therefore to proceed in the present inquiry, without examining into the meaning of this hypothesis: if indeed a term which is often without meaning, and is also applied under many meanings, can deserve such an appellation. Unfortunately too, it mixes itself up with the whole investigation; so pertinaciously and universally is it still applied to every fact that I must examine: thus inevitably giving a controversial air to what would otherwise have been a simple inquiry into facts.

We shall hereafter see more clearly, how human pride was united to ignorance, in desiring thus to solve the theory of the animal mind. In how many ways it has been connected with a materialist philosophy, it would be wearisome to inquire; so often has that subject come before us in this work. But we must not forget the age and the philosophy which produced this word: the pursuits and qualifications of those among whom it commenced its career, with such durable and pernicious success. It was the age of words, not of observation or reasoning: it was the philosophy of those, who, having ascertained nothing, determined not to appear ignorant of anything. That alone should form its

condemnation : but this is a philosophy which will hold its ground, as long as men shall be satisfied with the appearance of knowledge, and careless of the reality. It is not for me, here, to point out in how many things the philosophy of the age of the schools was inferior to that of the very sources whence it professed to draw : overlooking all that was valuable, while wasting its time on the paltry quiddities which it mistook for knowledge. It is a pitiable picture of the human mind : nor, boasting as we now do, have we yet shaken off the load which it bequeathed to us ; as I have often here had occasion to show. But he who reads the following passage in Cicero, will easily perceive that the philosophy of that age had formed a very different opinion of the animal mind from that which I am here discussing ; though, unfortunately, we can find no detailed examination of this subject :—“ Num existimas formicam anteponendam esse huic pulcherrimæ urbi, quod in urbe sensus sit nullus, in formica non modo sensus, sed etiam mens, ratio, memoria ?” But not all who read the Latin of Cicero possess the foundation that could read his philosophy also ; and still fewer minds can enter into the recesses of his thoughts, and there see what he has not written.

It is not just to be compelled to define a term which the inventors themselves have not defined. Paley calls it a relation : unfortunately, I do not understand what this means. The best way to find out the meaning of Instinct, is to examine its applications. That alone ought to show those who have adopted it, what kind of theory for the animal mind it furnishes. That mere naturalists should have committed such an oversight and persisted in such phraseology, is not wonderful : but it is somewhat surprising that metaphysicians, and dealers

in words, under the name of logic, should have forgotten to inquire of the meaning and application of words. And the metaphysics of the human mind have at least furnished phraseology, when they did no more : in this case, the fatal term instinct served for everything, as it performed the work before that was even attempted.

If this word is to have any meaning from its applications, it is a term of many and different ones, as it is without meaning unless it be associated with some other term of action : to use two grammatical words in an unusual sense, I might call it a plural and an adjective term : it is not a simple principle, constituting mind in an animal. It seems almost puerile to make such a remark : yet is the latter the sense in which it has been, and is used. And as an adjective term, it concerns the moral feelings and the intellectual faculties : and even more : while this most needful distinction seems, like all else, to have been forgotten. The complication of its uses is indeed scarcely credible : the very development is not easy.

Taking its moral applications first, it is a compulsion, not merely an impulse, to feel something : but it is, further, a compulsion to perform something. The animal must love, or hate, or fear : but it must also necessarily act in a certain and definite manner, in consequence of those feelings. And if opposing feelings were absolutely balanced, it could not act at all. Every one knows the familiar apologue of the schoolmen : and what the fact is. But granting that the animal mind is thus thoroughly enslaved, it is governed by many instincts ; so that the term must, at least, be made a plural one, even in this one of its applications. That, as thus used, it destroys all free-will, I need scarcely say : the animal becomes a species of machine.

Its application to the intellectual portion, or rather to the intellectual conduct of an animal, is similarly plural and multifarious: but here it is, that we see that result of human pride to which I just alluded; leading to the especially anxious and inveterate use of this magical term. Reason was to be the peculiar and exclusive gift to man: and therefore all animals were to be excluded from the very possibility of such a blessing. This is the brief answer we hear daily, when it is proposed to show that animals reason: and, as usual, from those who do not know what reasoning means, or in what reason consists. But it is a magical term, like Instinct: and that suffices: man, animal; reason, instinct: such is the sum of those metaphysics. The plural application is familiar. Do we wish to account for the mechanical exertions of a bee, the constructing efforts of a spider, and the thousand other analogous facts among animals? it is instinct: but it is through instinct also, that the bee and the spider and the bird, vary their exertions and works when opposed by unusual circumstances, or even under the foresight of what has not yet occurred. And as if that was not enough, the intellectual exertion and the moral feeling, or desire, are confounded together, as if there was but one instinct for both: the desire to build with the mode of building, nay, the very maternal affections with the intellectual contrivances and exertions by which these are to be gratified. Such confusion of mind as this, in any one pretending to think, not in a metaphysician merely, is scarcely credible: how the latter are to evade a very simple, and not very agreeable inference, I cannot foresee. And even this slender examination, which is, in reality, nothing more than an attempt to define their own term for them, ought to form an ample answer to

the abettors of Instinct. How the human mind can be enslaved and paralyzed by the sound of a word, has often been shown: but the word Liberty has scarcely effected more than this, if its operation has been more extensive.

Still I must notice another of the adjective applications of the term Instinct, since I just alluded to it. This is comparatively harmless; yet it has served to add to the general confusion. It is applied to those indefinite portions of particular kinds of knowledge, which have been given by the Creator to animals. The term is thus equally plural; as the phrase instinctive, or imparted, knowledge, distinguishes these cases from others, so as to avoid the usual confusion. The bee has received mathematical knowledge: it puts that into action through its intellectual faculties; and the purpose is the result of its moral feelings. The distinction is abundantly simple and easy. How many of these three may admit of the term Instinct, is the question which will appear hereafter.

Having thus far cleared the ground to be examined, I may proceed: without this, it would have been impossible. And the points to be shown are, that the Creator has given to animals moral faculties, and intellectual powers, in addition to imparted knowledge; thus, with the exception of this last, constructing their minds on the same principles as our own; as for that exception, the reasons will be apparent. And the arguments are, as usual, two-fold. The *à priori* one shows, that without this, the purposes of Creation could not have been fulfilled: and facts are afterwards adduced, to show that these faculties and feelings exist, and act; acting in animals, just as they do in ourselves, as far as the obvious differences permit. But the illustrations cannot admit of this metaphysical distinction:

it is the business of an intellectual faculty to regulate the moral feelings: reason is the controller of the passions and desires: and hence must the facts in evidence often involve both, as they must also be separated in a great measure from the general views to which they belong. But this would be equally inevitable in examining the human mind.

I need not repeat the *à priori* reasons for the imparting of moral feelings, sentiments, passions, or by whatever other name they are known, to the inferior animals. If not sufficiently stated in the introductory part of this chapter, the reader can easily supply them from a consideration of the human mind, since they are the same. But the human mind has been dissected and studied; and mind in general has not: the animal mind has been despised or neglected by metaphysicians, though the resemblances have been seen by the people, and pointed out by the poets. Had even man's moral portion been duly studied and arranged, the differences would have been found to consist only in number and degree, and in the superior power of volition, under the guidance of higher reasoning faculties and greater knowledge; including under this last, Religion, as an exclusive possession, or gift, or sentiment, or by whatever single term it can be distinguished.

Could I here investigate this subject as it demands, I should commence by an examination of the moral feelings and propensities of animals: but this would be to do what metaphysics have not yet effected as to the human mind. Nor does my space permit me to follow them as far as they seem to have been successful; as my limited purpose also does not require it. It must suffice to mark a few points: the desired inference will equally follow; as it must be left to a specific Essay to

do the rest : a task in which no difficulty will now remain. Had I done no more than shaken off the incumbrance of the term Instinct, all else would have become easy.

It is not disputed, that our own moral actions flow, essentially, from our very structure or constitution. They are the results of our passions, or feelings, or sentiments, (all our terms are loose,) and these form a part of our spiritual entity, however they may be developed, or modified, or controlled, through our intellectual portion. As far therefore as there is any meaning in the term Instinct, these are instinctive, inasmuch as they are implanted. We tend, without an effort of thought, to love or hate ; we desire property, as we desire food or heat ; we are actuated by hope or fear, anger, jealousy, or emulation, without reflection or reasoning : and so powerful are these instincts or impulses, that it often requires strong efforts of reason and volition to counteract or regulate them : these constituting the moral restraint, or the self-government of man. And the design of these is good : evil results are the consequences of excess or misdirection : and frequently, of the collision of wishes and pursuits, depending on the very nature of society.

Thus is our own moral constitution the type for that of other animals : or, similar inherent instincts and impulses occur in both. The parental affection of the bird for its young, is that of the mother for its child ; the adherence of the Eagle to its partner, is our own conjugal affection ; the emulation of the singing bird and the race-horse, is but our desire of superiority. He who longs with the longing of a lover to revisit the scenes of his infancy, may see his own picture in the swallow, and in far more. The desire of accumulation

is widely spread : but all this, and much more, has long formed the amusement of the people and the themes of poets, while they are facts in the science of mind, and ought to be the study of metaphysicians. They all prove, that the Creator has adopted a common principle in the construction of man and animals, on all points essential to their purposes and happiness ; though regulating that according to their several appointed ranks or places in the scale of His Creation ; as, ever adapting the structure of the mind to that of the machine through which it is to feel and act. If therefore the animal is a being of instinct, not less is man such, as far as the mere moral constitution is concerned : and because this was equally necessary for the purposes and happiness of all. If the members or the powers of these qualities, (to take a general term,) differ between man and all animals, so do they differ between animal and animal. But the fundamental facts remain ; while utility is always in view, and the end is always attained. Nothing that was necessary has been left to the capricious will of an animal, it is true ; but if this is to form a distinction, how is it with us ? The intellectual control is given, as this is our distinction and superiority : but I shall hereafter show that we are not the sole possessors of this valuable privilege.

To proceed to general illustrations and proofs, from well-known facts, it is familiar that fear, anger, love, and more of the marked passions and feelings, are universal in all the animals of higher organizations ; disappearing gradually, as far as we can perceive, just as the species pass towards the vegetable boundary. If we see the utility of fear and anger, it is also easy to see where they are no longer useful : they could serve no purpose to a medusa or a hydra. Those are adapta-

tions, as I formerly remarked : as this is in the lowest part of the scale of mind. Yet there is a wide distinction between these two tribes. The hydra mind is scarcely more than that of the plant ; whatever be the nature of that spiritual entity in the vegetable, which is, at least, sensible to impressions, and active under them. It is without social affections ; without love, as without any other intelligible passion. In the medusa, there must be some passion or sentiment of this nature, because it is gregarious. United to the instinct for food, this probably constitutes the whole of its mind. And if the hydra, and other analogous animals, are solitary, there is, in some of the Zoophyte tribe, and others, a vital and mechanical bond, which serves the purpose of the gregarious principle : leaving them in the uttermost part of the scale of mind, while attaining the necessary ends, from association, in a different manner. The Salpa, like some others, presents an intermediate case : it is compulsorily gregarious, but still possessed of the gregarious or social feeling ; of the passion of love, using that term to express social attachment of whatever nature.

Love, therefore, as far as it is possible to discover, seems to be the last moral feeling that disappears ; or it constitutes the sole moral mind, from the moment that the purely vegetable boundary is passed : while I need not say, that as we proceed upwards, it is as universal as its utility is apparent, whether under its mere individual action, or under the gregarious principle ; as it is especially remarkable in such cases as those of the ant and the bee, where there is a love equivalent to the parental, for that which is not offspring. It would be very desirable to trace, upwards, from this lowest point,

the gradual extension of the moral mind of animals, through the acquisition of other passions or sentiments: but, at present, this is impracticable; as I have already said. Something may be effected, though all cannot be hoped: but this will be, when naturalists shall have pursued their studies in another manner, and metaphysicians shall have changed their systems on this subject.

I must pass therefore, at once, to inquire of such moral qualities as we can discover in any animals, and without distinction of kinds. Excluding altogether the more definite sense of the term love, the cases of moral attachment, or friendship, between the sexes, in birds, are numerous and familiar. That of the small green parrot is perhaps the most striking: and it is well known, than in more birds than one, the surviving individual in the cage has often pined and died for the loss of its mate. If, in the whale, the affection to species is so strong, that it will sometimes allow itself to be killed rather than abandon the companions which have already suffered, such love, or friendship, is also common in many animals, without regard to sex, and even without regard to species. It is familiar, between horses and cats, or dogs, and also between the latter and birds; as between even the lion or the tiger, and the dog which is its prey. In reality, it seems universally producible, by mere association under confinement or domestication, among animals of the most discordant natures; even where one is the natural prey of the other: thus demonstrating the general existence of this moral principle. In such cases as this, all that is necessary to its development or action, seems to be to quell the paramount instinct of appetite by sufficient food, and to give

no opportunity to those habits of pursuit, or chase, which excite a stronger or domineering passion.

That it is the same refined moral feeling as in man, is also proved by our own power in producing it towards ourselves. It is produced and strengthened by kindness, not merely by an appeal to the coarse appetite, but by tenderness and attentions, which can operate only on the sentiments: while these attachments are producible, not in the common domesticated animals alone, but on every one on which the trial has been made; in toads, frogs, serpents, insects, down to the very spider: marking, in even animals so despised or rejected, a power of discriminating kindness, and the existence of this moral sentiment. To attribute this attachment to a pleasure in the odour of some individual, when it is confined or directed to one, is an evasion, as it is not a fact; since it is inapplicable in many of the preceding cases. And it is sufficiently easy to see, that where such selection is made independently of any peculiar kindness, the source of attraction is the look of benevolence; that moral physiognomy which is a natural language between man and animals, and probably also among themselves. Man is scarcely so quick as a dog in discovering the feelings which may concern himself: and the horse even knows his rider's state of mind by the slightest movement of his body.

The demonstrations of jealousy are not less familiar among the domesticated animals: so that this moral feeling, dependent on love or friendship, may also be added. And if emulation is connected with the same feeling, the examples of this, in the cases formerly alluded to, as in many others, are universally notorious. Of the existence of envy, we can only judge on the same grounds: it should be implied in emulation: but

the other usual sources of it among ourselves, cannot exist in animals ; as any other demonstrations of it, did it exist, are not very conceivable. Two things must never be forgotten ; that the study of these and other passions is not very easy, and that we have scarcely studied them at all ; from negligence as well as from hypothesis. In ourselves, there is much that we should scarcely know but for language. Of pride, or, rather, vanity, there seems abundant evidence in some well-known birds, as, apparently, much wider : in the mule, as is well known, it extends even to the article of dress : the animal learns to be as vain of its trappings as the peacock or the turkey of its train. If we discern these things, and more, best in the domesticated animals, it is partly because they are more easily observed, and partly because some are developed under our tuition : thus marking that capacity for moral education, on which I shall make some remarks hereafter.

It is here a fundamental difficulty, that we do not know how to arrange and divide these moral principles in ourselves ; so that the very basis is wanting. Few, I imagine, will consider the recent arrangements of phrenology as metaphysically justifiable : yet as far as mere demonstration of some quality of mind is concerned, we may borrow from even an erroneous arrangement ; since it is, here, only a question of comparisons. I do not know how to estimate the conduct of a dog respecting forbidden and reserved food, but by comparing it with conscientiousness : and whether natural or acquired, it is here indifferent : we are not sure, that in ourselves, there is more than a capacity for conscience. We do not know, metaphysically, what hatred is, or what revenge ; but be they what they may, they occur in animals ; even a long-treasured revenge being of notorious

occurrence in dogs and horses. Nor do we know more of the true nature of courage, so widely spread, and often so singularly called into action among timid animals, under maternal affections; as it similarly is in the human mother. I do not know in what light metaphysics will view a tendency to command, or tyranny, and a tendency to obedience: yet we find both, conspicuously, in the gregarious animals; and, the latter, entirely different from the truly instinctive or compulsory attachment of bees to the queen. Command is assumed by one, and may be forfeited to a higher assumption: and the allegiance is changed accordingly. The most absolute tyranny is often seen in the male bird, over its caged partner. The system to which I just alluded, has referred obstinacy to a radical principle of mind; but be that as it may, it is of the same partial and unequal occurrence in animals as in ourselves. Whatever contempt may consist in, it is known in dogs; as is that equally undefinable conduct, termed generosity or magnanimity; remarkable also in the domestic fowl, as I shall hereafter have occasion to show, for another purpose. I formerly alluded to the sense or knowledge of property, and the love of accumulation; which the same fanciful system of metaphysics has also termed an original part of the constitution of mind: and of this we have abundant evidence, under great refinement, in the case of dogs, and, without a possible purpose, in that of magpies. I need not seek further, for the sake of establishing the point in view: and if I have no room to quote the specific facts in evidence, they are to be found in numerous books, and are indeed generally known to most persons.

This must suffice to prove the entire analogy between the moral mind of man, and those of the inferior ani-

mals ; but there is an important question connected with the main one, to which I already alluded, and which I must now examine : since it is essentially connected with the vulgar doctrine of Instinct.

I have elsewhere had occasion to show, that the free-will of the inferior animals had been limited, and for purposes essential to their own well-being and the general order of Creation. Yet it is not destroyed, or entirely withheld. It was not needful that it should ; it would have been injurious if it had : and this would have been the case under absolute instincts ; since these are correlative terms. And I cannot help thinking, that if, on this, as on all else in Creation, inquirers had taken the Design, or purposes, of the Deity, as their point of departure, they would have found much less difficulty, and written far less uselessly and discreditably than they have done. The free-will of the inferior animals is not only limited, but peculiarly limited, under divisions and kinds ; while our own is extremely wide, appearing, to ourselves, absolute. But thus, doubtless, does every animal believe of its own. The conviction of liberty is perfect ; and it ought to be so : since without this, there could be no happiness, as animal nature is constituted. And we see that the love of liberty is universal, among the higher animals at least : the uneasiness under restraint, proves that the desire or feeling is the same in them as in ourselves : it is another of the universal sentiments. But the sense of absolute liberty can exist under restraints or limitations as absolute : since the boundary is fixed by the implanted desires and the existing or attainable knowledge. Thus is each animal perfectly free, because it can do whatever it has been permitted to wish : the actinia is as free as the albatross ; for its rock is the boundary of its know-

ledge and its desires. And man's free-will is no more : he cannot fly to the moon, nor regulate the stars : and, taught not to desire such things, he is at ease under the privation. Thus is every animal a voluntary agent, in every thing ; while under restrictions directed to a useful end, the harmony and happiness of Creation. There are instincts, even in the sense of compulsion, as used by the abettors of this term ; but all needful liberty has been united to them ; as I shall hereafter also show, that they are under both moral and intellectual regulation.

I shall therefore proceed to inquire of the intellectual mind of animals, commencing, as before, with the *à priori* reasoning ; while that will demand a little more detail, than in the case of the moral mind.

If certain implanted or instinctive kinds of knowledge have been given to some animals, for special useful purposes, it was necessary that there should be a power of varying the mode of action ; and also of abstaining, under moral and instinctive desires, or impulses : else would the object of the Creator have been defeated. In each case, some other faculty must be called into action, and therefore some other faculty must be given. This faculty should be reason : and the result, variation of intellectual conduct, and moral regulation. Had there been undeviating instincts, of either kind, all the surrounding circumstances should be equally fixed ; or the intended purposes could not have been attained. But those are ever changing. Heat, cold, the seasons, the winds, are inconstant, unequal, and uncertain. The forms of bodies are unsteady, and the sport of accidents : the very place, or plant, or animal, intended for the special food or nidification, may be wanting. The moral circumstances are no less subject to variations, especially among the social and gregarious

animals : these are the inevitable results of community and interference of pursuits and passions. It is plain, that none of the political communities, among the insects especially, could have been conducted without a large portion of intellect, or reason, and free-will. This is an especial case of accidents : the very necessity of mutual communication would demand intellect : and we know that information is given and received, even respecting things that never occurred before, and totally independent of the animal's ordained system of life. The social life, at least, must be widely under the guidance of observation and reasoning, though nothing else were. The facts will hereafter prove these assumptions.

I shall proceed to a sketch of the intellectual mind of animals, in the same brief manner : as far as a knowledge of it seems attainable. And the result will be to show, similarly, that it is analogous to our own ; and above all, that a sufficient portion of reason has been allotted, to render the instinctive knowledge available under changing circumstances.

If some of the points involved in this part of the inquiry are obscure, for want of sufficiently plain evidence, we may perhaps derive some aid from the consideration of utility, or a final cause. Thus, there is no apparent reason for allowing to animals the power of imagination, at least in the wide sense in which we generally understand that term. Yet if the sense of beauty and the sense of music are to be ranked under this head, as they have been, we cannot deny them a portion of this faculty. Our difficulties often lie in the definitions of terms, as well as in hypothesis : but if we set aside the Hartleian system, which I presume nobody now maintains, it is difficult to understand how volition can exist without imagination. Something is foreseen, or conceived, which is yet non-existent, or is not what it will be.

It should be an *à priori* conclusion, that powers of observation have been granted to animals, because, without those, they could not have conducted themselves; while, of this, the proofs are so familiar and abundant, that I need not quote them, as, to call such power an instinct, is a mere abuse of words. But as observation would be useless without memory, and as memory is nothing without the power of recollection, here also there ought to be no difference between the animal mind and the human one. And they are analogous; the proofs abound: while the difference consists in the application, not in the extent of the power; as the causes of that are obvious. The memory of a horse exceeds that of a man, both in accuracy and tenacity, in what concerns itself, or was an object of its observation: in the road, for example, which leads to its stable. That animals are governed by the same principles of association, is perfectly familiar.

But observation, especially if treasured in the memory, which is followed by action, implies an inference, as necessarily preceding volition. This is, already, the reasoning faculty: but that conclusion is perfect, where the observation implies comparison, and this is followed by choice; above all, when ideas stored in the memory are compared with others just presented. Facts of this nature are familiar; and I shall have occasion to note a few hereafter, among many other proofs of the existence of reason, which I am obliged to keep separate, from causes already assigned.

If it has been said that animals are without retrospect or foresight, and that they act only under immediate impulses, this is not only bad metaphysical reasoning, but is not true as fact. Without retrospect, there could be no experience: memory and recollection are retro-

spect ; and experience is proved by education. Foresight, or anticipation, is necessary to volition ; but the practical proofs of its existence are abounding. There is even a special gift of foresight, respecting weather, to many animals ; the very nature of which we cannot conjecture ; possessing nothing analogous. When it is said that they do not reflect, or think, what is the animal doing when it is watching its prey, or the dog when guarding its master's clothes, or the bee when it has been defeated in the construction of its cell, and is planning an expedient ? The operations of thought can be traced in the very countenance of a dog. And the dreaming of this animal is a proof of thought : the attempts to run and bark, are produced by reflection on ideas in the memory, during that imperfect sleep which constitutes dreaming : and such reflection is thought.

This should suffice. If the terms of metaphysics have any meaning, the intellectual constitution of animals is analogous to our own ; just as is their moral one. That aught so simple should have escaped metaphysicians, is sufficiently remarkable : that it should have been denied, is surprising : but it shows how little thought has been bestowed on this subject, though we allowed any power to the term Instinct. And it is superfluous to conclude, once more, that the Creator has constructed minds as He has bodies, on the same leading principles, but under varieties adapted to the structures of those, and for the purpose of gaining definite ends.

It remains yet to inquire respecting the susceptibility of education in animals, that I may approximate them to ourselves in another essential circumstance belonging to mind ; though education itself is but the application of certain faculties. This is needful also, as an answer

to the theory of Instinct ; since if there is anything that can be acquired, everything was not originally allotted. As far as the intellectual faculties are concerned, the term Instinct is here intelligible ; as I formerly defined it to mean imparted knowledge.

The human mind has not been endowed with knowledge : it acquires this, through means that I need not describe, constituting its education. But many, or most, animals have received certain portions of knowledge, in addition to their mental constitutions ; or are constructed in a state of education, as far as their wants are concerned. But this is not a difference of constitution in the mind : it is a mere question of acquired knowledge : the mode of obtaining possession being different, and no more. The peculiar utility is obvious : in the shortness of their lives often, and, always, in the necessity of early self-dependence ; as further, in the want of adequate means of instruction, for want of adequate language, and from their short dependence on parental care. And this is the knowledge which performs what observation and reasoning must otherwise have done : though not excluding the aid of those, when needed : while, if acting with peculiar perfection, it is because the knowledge in question is that of the Creator. It is He himself who builds the bees' nest ; and the animal is His tool.

But in addition to this, animals ought still to be capable of education, like man, because they possess the requisite faculties : though the extent of such education must be very limited, for the reasons just assigned. It suffices for the present purpose, if it exists at all. And that they are intellectually educated, there are abundant facts to show. As far as this is done by ourselves, these are familiar : as it arises from observation and reflection, or

from parental instruction, they cannot be less so. But the latter is that, in particular, on which our means of observation are most imperfect.

The details of education in animals, through our instructions, are so generally known, that it is unnecessary to quote them. As it depends on their own observation and reflection, I may note the well-known sagacity of old dogs, as of all old animals with which we are sufficiently conversant, whether domestic or not. The dog discovers that its master's property or his person is under its charge, that it must be found when lost, that it can gain admission, or the reverse, by scratching the door or using the knocker or the bolt, or turning the handle; as the cat does the same, and as a cow learns to unlatch a gate with its horns, and the ass with its teeth. Thus the dog learns that infants are to molest it with impunity, that beggars are unwelcome, who is the master in the house, and who is the acceptable stranger: learning also to estimate and to mark times and periods; to know Sunday, to recollect the hour for attending church, to be patient and orderly during the service, and far more of the same nature, or referable to the same principle. But respecting this animal, the facts are endless: all know what a shepherd's dog can learn, partly by instruction and partly by observation. Thus has Plutarch informed us of draught oxen which had learned to compute as far as a hundred, that being the number of loads which they refused to exceed, as having been their ordinary task: and although belief should be refused to this tale, it is certain that cats learn to count to a certain extent, by being fed with a definite number of morsels. But I cannot afford illustrations of this nature; as all can find them: the remark that concerns me is, that the intellectual education here, is often

of a very refined nature, since it consists in the nice comparison of many ideas, often sufficiently abstruse, and in inferences frequently as acute as those we make ourselves.

Of the instruction, or education, which animals can give and receive among each other, I have already said that we know little. Yet that is seen in the birds which teach their offspring to fly, and very strikingly in the auk, instructing its single infant how to dive. The alternation of example, reproaches, caresses, force, can leave no doubt that this is a process of education. It is not unlikely that something similar will be found in the gregarious insects, when their manners shall become better known.

But animals are also susceptible of moral education, whether through our efforts, or the exertion of their own volition controlling their passions and propensities. We are startled at the term : that is the real objection to this view ; partly because of the previous hypothesis, which allows them no minds, and partly because the mass, and more than the common mass of mankind, do not reason and do not analyze. Let the facts and views formerly stated be admitted to be what they are, to be proved, and the difficulty will cease. Let the facts in evidence be analyzed, according to the usual metaphysical reasoning, and they will leave no doubt. But these especial facts I cannot conveniently place here, without involving repetitions. They are mixed up with the other illustrations which I promised, and will immediately appear.

But thus does the parallel between the human and the animal mind become complete in every part. In everything, the difference consists in the quantity, not in the quality, and in the number and the extent of

the applications : while, in the descending scale of animal life, faculty after faculty, and power after power, gradually disappear, till we arrive at that point, where nothing more can be conceived to exist, than that simple consciousness of pleasing sensations, which I have elsewhere (c. li.) inferred to constitute the vegetable mind.

It does not, nevertheless, cease to be true, that these minds are definite, and perfect to all their intended ends, in each principal mode; and that they are, in this, and even in implanted knowledge, what they have been since the commencement of Creation. But those conditions are not absolute; although, from the differences of power and application, differences among them must always be greatly less sensible than in the human mind. It is notorious, that we discover very great differences of quality, of intellectual and moral faculties, both in different individuals of a single species, whether natural, or through education; and in all the animals sufficiently known to us. This still further tends to prove the analogy between their minds and our own; as it might also form another answer to the vulgar theory of Instincts. This, according to the very definition and hypothesis, must be invariable: it is a difference in the reasoning faculty, or the mental powers, which alone could produce the differences of intellectual character which we find; as the infinite variety of moral character among them equally bespeaks minds differently organized and differently susceptible.

I may proceed to the promised illustrations. They are selected from the most familiar cases, purposely; and I have also limited myself to the fewest possible. The object was not amusement, but illustration: and a single fact, justly reasoned on, is equal to hundreds.

But any one can add to them: from experience, and from histories of common notoriety. In this first portion of these illustrations, it will be seen that the passions or desires of animals are under the control of volition directed by reasoning, or that their instincts or impulses are thus capable of regulation. It will also be seen, that they can cause one feeling, or instinct, to check or regulate another, implying that there is a balancing power, which can only be reason. This is a case of comparison and inference, under contending motives or impulses, preparatory to willing: and thus are they moral agents, under the guidance of reason. It is scarcely needful therefore, to infer again, that they are not under the government of unerring instincts: but a confusion of mind can hardly be imagined, capable of torturing the term Instinct to explain the power which decides between two motives or impulses.

The appetite for food is the most indisputable and universal of instincts, as it is the least controllable. Next to that, perhaps, in force, stands the love of progeny. The hungry mother therefore who feeds her young ones in preference to herself, is under opposing motives; and she must have some power of deciding which she shall feed. She must choose: and that choice must be a moral control; since there is a desire, to be quelled. The case of the domestic cock is still more remarkable. The instinct to eat exists, because we can see that the appetite is not satisfied; but it is controlled by a feeling of a more refined nature than the last, which also is not a passion or a desire. The animal calls its hens to partake, and even selects a favoured individual for its bounty. There is a very delicate moral control: in man, it would be termed love, politeness, gallantry; more than simple benevolence.

If it is not such in the animal, let an explanation be produced: to call it an instinct, is to trifle with language.

We can trace the same balancings of passions and motives in numerous other cases. The hart stands aloof from the collected herd which the master deer guards from its approach; actuated by two of the strongest instincts, of which, one is fear. It is under the opposing motives to advance and to fly: and it finally determines. As moral conduct, this is prudence: if under the absolute government of instinct, it would either have advanced or fled the field. The animal thinks, and determines accordingly.

The instinct of a fish is to swallow the bait. But there is something to excite suspicion, and it continues balanced between the two instincts of hunger and fear. If the bait is rejected, here is an appetite counteracted by a passion: but the animal ought to fly, for such is the instinct of fear. There must be some other power, to decide at least. But it neither eats nor flies: it hesitates, which is the balancing of motives; prudence; a moral control, as before. But this is not all. It swims round the bait and examines; attempts to take it, and again repents; and finally determines. Here is doubt, suspicion, hesitation; and if it departs, to return no more, it is a temptation rejected on consideration, yet not without examination and conviction. The whole process of reasoning is sufficiently plain, and so is the source of the moral control. But there is yet more. This is not simply a decision between two motives or instincts, to which some fanciful solution, other than an act of reasoning, might be applied, but there is an instinct controlled by an intellectual operation. The fisherman himself, though he forgets to draw the obvious infer-

ence, admits that the fish had once felt the hook : and it is, therefore, reasoning from experience, or drawing an inference from observation and memory. This also, it is plain, is education. No possible idea attachable to the term Instinct, can explain such conduct. Under the knowledge of an infant in metaphysics, such an opinion could not have held its ground an hour : but the inventors of this phrase knew nothing of such a science, nor had even reflected on the operations of their own minds.

But this is a species in man, not easily convinced. The rat which enters a new trap, while it avoids a known one, is, like the fish, superadding experience, with consequent inference, to the contending motives of hunger and fear. It even remembers that such a machine once engaged its companions : and is restrained by prudence, founded on knowledge more remote than in the last case. There is not even the instinct of fear in this case : it is the fear of reason. The success of the first trap, proves that its appearance is no cause of fear. It is the conduct of a man who stands out of the line of a piece of ordnance about to fire. In the same observant animal, a companion has died after eating flour containing arsenic : it will never again touch flour under similar circumstances, but enters the flour cask without hesitation. And thus it will eat paste : yet never more, if a companion has died after eating paste. It is superfluous to draw the inferences again.

The same conduct may be observed in birds, as in most of the wild animals that are exposed to the cunning of man. If the scarecrow terrifies the sparrow at first, every one knows the cautious attempts through which it is at last discovered that this is not an object of fear. Had the instinct been the sole guide, this dis-

covery would never have been made: since its very essence, on the doctrine of instinct, is, that it should always act alike, and effectually, for the preservation of the animal. This is a case of experiment and observation, as it is a process of reasoning: man overcomes vain fears, only in the same manner. The bird also that enters within a net, to prey on the protected fruit, learns only by trial, that the cause of fear is not an inevitable danger. Had it not a command over the instinct of fear, it would not have ventured; and this is intellectual. And in this case, the animal is controlling, in succession, both the passions, hunger and fear. If there is any power which acts like reason, but is not reason, metaphysics must define what it is.

If the hungry rook quits its food at the sportsman's approach, we may conceive the instinct of fear overpowering that of appetite: but when the animal inquires first, whether it is a stick or a gun, and then acts accordingly, it is plain that this instinct is under the control of reason. The first impression is suspicion, with doubt as to the reality of the danger: a more accurate observation is made, with a reference to memory, or experience: and by the result of this sufficiently complicated process of mind, the animal is determined how to act. It remains or flies. How the instinct would have acted, had there been nothing else, we know by the conduct of man in a similar case; under the silly fiction of a painted image presenting a wooden gun. In an analogous manner, the dog which surveys the apparent powers of its antagonist, before it will attack, which measures with its eye the distance of a leap, which waits at the gap where it knows that the hare will pass, is reasoning; and, in the last case at least, is controlling, not only an instinct, but a very

powerful habit, since it has stopped in the full heat of the chase.

It would be abundantly easy to extend these illustrations; but I have adduced enough. I have taken those feelings, passions, or impulses, which, if there be aught of moral that is instinctive, are truly such. I have shown that they are controllable, and controlled; that there is a power of comparison and choice between the two, which shall sway, and that their actions are also modified, as well as restrained. I have further proved, that this control is sometimes derived from the intellectual powers, or from knowledge, the result of observation, or experience, and comparison, with inference. This is moral control from knowledge and reason. The advocates for instinct must say what sort of instinct this is; and the metaphysician must define what it is, if it be not reason. But whenever he shall do this, he must also explain what are the principles on which man acts, when he acts in the same manner.

I have separated, as well as I could, the facts which relate to a moral control as the produce of education, and may proceed to them. These serve to confirm what I have often already said, that the inferior animals are not the slaves of instinct; as they also confirm the entire analogy between their minds and our own. As no improvement should be possible, under the doctrine of instinct, so, especially, should it be impossible to produce absolute counteractions of implanted desires and passions, through education. We shall now see what answer to this the facts afford.

• The most powerful instinct is that of hunger; and the propensity to chase arises from it. Though the dog does often chase, without hunger, yet it is taught to bring the prey to its master, or to refrain from eating

what it has taken, when we know that it is under the impulse of that appetite, because it is ready to gratify its want as soon as permission is given, or a portion is allotted for it. It is true, that in some dogs, this restraint is the result of fear; present fear, or the recollection of former punishment: but all sportsmen know, that many dogs, or races, do the same without punishment. The dog has discovered, sometimes apparently through its own observation, that the chase is for the benefit of the master, and the produce, his property. This is an instinct controlled by an inference derived from education; in whatever manner that education has been obtained.

But this moral restraint through education, is even more remarkable in the case of food within the house; being one to which I alluded formerly: while, in the same manner, if it is sometimes effected through fear, it is often taught by very simple warnings, or is the animal's own discovery; made in the same manner in which it acquires the knowledge of the master's property generally. We know that the dog is hungry, or that the instinct is in full action: but it has learned that this must not be gratified; as whenever it has been tempted to break the laws, it is fully conscious of the misdemeanor. It is often not less easy to see, that there is an operation of balancing motives, or a process of reasoning, going on in the same animal's mind: the desire about to gain the victory, but repeatedly quelled by the considerations which belong to the moral and superinduced restraint. The hungry and virtuous pauper who will not take the loaf before him, because it is another's property, knows, in the same manner, and no other, that to gratify the instinct would be wrong, because it would be an infringement on the rights of

another man. In whatever way the pauper has learned this, the dog has acquired, through intimacy with us, a new moral motive, whence it draws a practical inference of the necessity of self-control.

The same fact is familiar respecting domestic cats, both as relates to food in the same circumstances, and to caged birds: while if less frequent and perfect, that is, perhaps, even a confirmation of the present views. The original minds indeed, probably differ, in these two animals: their destinations, not less than the facts, justify this supposition; but it is also true, that no trouble is bestowed on the education of the cat: there is even a vulgar prejudice against it, which checks the development of its faculties. Of other animals, we have no right to pronounce; because no attempts at such education are ever made by us, and as everything in their mode of life and treatment would prevent them from observing for themselves on such subjects. Yet the well-known case of a horse, giving notice to the driver to resume his work, might be quoted as an instance in point; since the instinct in this case, is to desire rest.

These illustrations, few as they are, will suffice to prove the statements with which I commenced, respecting the moral qualities, or moral portion of the mind of animals; and I may proceed to those which show that they possess intellectual faculties in aid of their implanted knowledge, and exert processes of reasoning whenever these are required to compass their purposes. And, as before, I have taken the most familiar cases, in preference, because they are those, of which every one can judge; while there is not a naturalist, especially in entomology, and perhaps scarcely a reader, who cannot add largely to them.

The bee is one of the best of instances, and in that

also which is most open to examination ; the structure of its comb. There are persons, even now, who, following Buffon, maintain that the form of the single cell is not the result of design, but of mutual pressure : thus far can ignorance and presumption influence corresponding ignorance. The triedral bottom would be an answer in itself ; as it ought to have been to him. But the answer is absolute, when it is known that the cell is founded as a hexagonal prism, by a single bee, and apparently a select one, out of many, possessed of this peculiar knowledge. Whether, however, there be this limitation or not, the foundation is partly excavated, and partly raised, from the wax plate which forms the basis of the whole collection ; so that there can be no mutual pressure at the design, while the whole erection is continued in conformity to it.

The purpose of the hypothesis is plain ; the whole was to be the result of accident, Chance : but it is not a very consistent one ; since, as the animal is a machine, it should have constructed its comb as any other machine would. Machinery and chance are opposed : but such have ever been the self-contradictions and blunders of what may truly, and without harshness, be called atheistical hypotheses, because the purpose is seldom concealed, and, more often, declared. The construction of a cell is the work of reason, and of profound geometrical knowledge : so profound, that it has required some of the deepest investigations of the algebraic analysis, to discover that the very peculiar form of the bottom is that which gives the greatest space with the least of labour and materials. But no one can imagine that the bee reasons to this end : this is implanted knowledge : in the only admissible sense of this term, it is Instinct.

Yet the animal is not tied down by a positive law. There is a point at which the use of reason becomes expedient, and, as I formerly remarked, at this point it is called into action. The surrounding circumstances vary; and the work must be varied accordingly, or the purpose would not be gained. It is accordingly varied, and in many ways: always also in conformity to the circumstances, or necessities. This is discretionary power: there can be no instinct of such a nature. There is observation, comparison, choice: the inference must be made by reason; and the success or utility of the result, further proves the action of an intellectual faculty. There is a new design for an end, and that end is gained.

These variations are seen in the dimensions and form of the entire comb; while there is a principle of utility kept in view, and under circumstances which are perpetually varying. There must be a certain space for passage, between the several surfaces, whether of the combs, or of those as they regard the hive; as no space also is to be wasted. Thus they are elongated, or curtailed, or even ramified; and, in different places, in different ways: the whole is a system of calculations and expedients, for the production of a definite effect under all circumstances. And this extends even to the magnitudes of the cells: they are often sacrificed, that this needful end may be gained. Thus are they sometimes fixed to a piece of wood, so that they have no waxen triedral bottom: thus are they sometimes made pentagonal instead of hexagonal, causing an entire deviation in the form of the bottom, at the same time; while they are often, also, otherwise irregular; especially about their orifices. And these, and other deviations, are similarly caused by varying circumstances, or premeditated disturbances on our part.

The last are especially remarkable changes ; because the animal is even daring to deviate from that peculiarly implanted knowledge, which, if there is anything compulsory, ought to be absolutely overruling. Such proceedings as this, are those of an artist, observing and calculating, or reasoning : not constructing a machine under an absolute command not to deviate, but doing that, of which he knows the purposes, and who could not do it unless he kept those in view ; as he could not modify his work, or remedy a defect by an expedient, unless he observed and reasoned. Is it because the bee is small in size that we refuse it reasoning powers ? Mind bears no relation to magnitude. It is not merely the effect of the unmeaning term Instinct : it is because we do not reason ourselves : often, not as well as the bee does.

This animal displays the same powers in many other cases ; in things which do not belong to its instinctive knowledge of construction, and which are often pure accidents, not within the range of its ordinary life. If a snail finds its way into the hive, the edge of the shell is secured to the floor by a cement : if it be a slug, the whole animal is cemented over. If threatened by their enemy the Sphinx, they build waxen traverses to exclude it : yet never making this addition, except when attacked or threatened by this depredator. I need not repeat the former conclusions : and the same reasonings can be applied by any one, to many other facts that relate to this insect, and to many more. Naturalists have often noted them ; as there are some who have ventured to say, that they could not be explained, except by the admission of a reasoning faculty. Yet they have seemed to make the conclusion unwillingly ; such is the power of habit and prejudice.

In another insect, not less familiar, we find the same mixture of instinct and reason: producing a structure upon a definite plan, yet left to a power of variation under expediency, even greater than that of the bee; because its work was still more subject to accidents and varying influences, against which nothing but reason could have guarded. I allude to the concentric web of the well-known spider. That the general construction is the produce of an instinct, there is no reason to doubt: yet the law of compulsion is especially lax. There are no two of those webs alike; but the intended purpose is always attained, and the variations are made, that they may not fail; as they are made through observation of the varying circumstances, with inferences, leading to the needful alterations and corrections.

Though the general plan is fixed, the main lines of the net vary, in length, in disposition, and in numbers, according to the nature of the supports. But still more observation is required for fixing the stays; while these are not only for ever different, even in the same web, but so ingeniously contrived and varied, that our own ingenuity could not do it better. This alone demands reasoning: but much more is observable in the case of injury. If the first attempt at repair is insufficient, a new stay is invented and applied; and thus successively, till the object is attained. The very failures show that this is a work of reasoning: there is a tentative or experimental process, founded on the best inferences that can be made: the absolute, or purely instinctive workman, would have seen and done what was right, at once. But further, like many other animals, this spider foresees the winds which are about to blow; and thus it is often seen hastening to carry out fresh stays, while, also, these are calculated to meet the expected force. To

this, at least, it would be difficult to give any other answer : such is the conduct of the seaman, tightening his own stays, and substituting a new rope for an old one, before an expected gale : and whatever it is in the one, it is the same in the other.

To limit myself to one more example, it is not true of birds, often as it has been asserted that they build their nests according to a definite and invariable pattern, or that this architecture is the result of a blind and unvarying instinct. But in this, as in all else, the metaphysicians have speculated before they observed ; as the naturalists have too generally forgotten to reason on what they saw, or even to see truly, because they had no general principles in view as their guides. If the diversities in the nests of a single species are not so remarkable as in the cases of the bee and the spider, they suffice to prove that the reasoning faculty is similarly exerted. The goldfinch's nest varies in external materials, and also in shape and fittings, according to its place, and so do those of many other birds : the martin will build in a cup, a shell, and in many other convenient objects ; yet, even then, adding to them its own clay fabric, should it deem that expedient, and under such various forms as its sense of convenience and security considers necessary.

These examples must suffice : since the purpose here is, not to investigate the mental history of the animal creation, but to establish the general principles of the structure, or nature, of the animal mind. But since the possession of reason has, above all, been denied, a few further remarks will not be misplaced. That there are cases where a reasoning faculty was useless, it is easy to believe, though it might not be so easy to produce proof of its non-existence. We might suppose

that the animals which approach nearest to the vegetable construction, are not less deficient in this respect than plants themselves are ; as we can also see that all their ends can be gained through definite and very limited instincts of mere sensation, or simple appetites. We must probably believe the same to be true, higher up in the scale, or in those parts where I have shown that the first moral feeling, that of personal attachment, begins to appear. But if this is the point whence our ignorance compels us to make a sudden step upwards, so we cannot conjecture where the first indications of the possession of a reasoning faculty are to be sought, or fixed. I have already shown that it has no connexion with our accepted scale of organizations : and the insects are an ample proof of this. For aught therefore that we can infer from this principle, the very general resort of naturalists, reason might be found in an earth worm. Under these difficulties, and when the proof from experience, or actual knowledge, must needs be distant, if not unattainable, I know of no ground of inference but the final cause. The power of reasoning should exist, wherever it was necessary for the good of the animal ; and it ought to be, similarly, extensive and accurate in proportion to its necessity. If we are not indeed incredibly ignorant of the character of the Creator, this conclusion will be hereafter justified by the facts, when animals shall be better known : and that we are not thus ignorant, I think the present work will have proved.

What the necessities are, I have already shown ; but so much darkness has been thrown on the subject of Instinct, even under its meaning of instinctive knowledge, that I must yet offer a few observations on that subject. If, as I formerly remarked, the Creator has

given to man the means of acquiring knowledge, He has adopted another principle for the inferior animals. He has imparted to them such definite portions of knowledge, of various kinds, as their wants demanded ; or they possess numerous and different instincts, or rules of intellectual conduct, with further impulses, or instinctive desires, to put these into action, for ends. It has been said that they do not know those ends : this is a remark from the same ignorant and prejudiced source : that which I have related of the bee, proves the reverse. The reasons for thus ordaining with respect to animals, in the necessity of early, and also of perfect, and, further, of definite action, I formerly gave. The principle of utility, or good, rules the whole. How special and numerous those instincts, or definite kinds of implanted knowledge, are, I need not say, as indeed I could not, here : they constitute the main part of the moral history of all creation. But the bee tribe serves as a convenient example. One species builds with wax, another with paper of its own manufacture, another excavates wood, and so on : while all those structures differ in form, and in other points on which I need not dwell. Thus it is with the several webs of the spiders ; thus with the very singular structures of many other insects ; thus with defences, stratagems, oviposition, and much more, well known to natural history.

The wisdom of the Creator is apparent through this general appointment, and through all the variations ; but it is not less apparent in the relaxations of the impulses that accompany those instincts, and in the means which have been given for varying from them, according to the variations of occasional circumstances. And those means consist in the further gift of reason ; of a competent portion of the reasoning faculty, superadded

to a power of observation. And the limitation is not less remarkable than the gift: both, equally, implying wisdom. There is a power of reasoning respecting the implanted knowledge, or, in aid of the instinct: but no further. It is never, even in this case, such as to defeat the prime law; and it does not extend beyond that. They who have objected to the existence of the reasoning faculty in animals, have objected, for want of reflecting on this simple matter also: for want, in reality, of inquiring what the meaning of reason was: as if, because a bee reasoned, it was to reason respecting human architecture or human governments. In every animal where it exists, as, under some limits, it probably exists in nearly all, it is ever an aid to the implanted knowledge, and to that only: it is a mere truism, so obvious that we must wonder how it could have been overlooked, to say that it never could be aught else, except as education may confer further knowledge; since reasoning is the comparison of ideas. The animal cannot reason about ideas which it has not the means of acquiring. And thus can its reasoning power never defeat that prime purpose in aid of which it was allotted. The extent of man's ideas and reasoning powers are the foundation of his practical free-will. He knows how, and what, to wish: and he disturbs the general order accordingly. This view brings us back again to the question of free-will, as it was formerly discussed.

On the individual utility of the whole, or double contrivance, I need say no more. But on that of the instincts, I may yet make a final remark; if it is one that must occur again in a future chapter for a more limited purpose. It is plain, that amid the multitude

and variety of animals in Creation, a set of laws for the action of each was indispensable, that order might be preserved : the very master of a complex manufactory governs in the same manner. In each case, the several individuals possess definite portions of knowledge : and in our own, some mode of force, or of inducement equally effectual, does what the Creator has arranged in the other, through instincts and impulses. Thus is order preserved, as order was intended : because order was happiness. Man has been permitted a far wider range : and there is much that he can disturb accordingly, if not all ; as the means have been given to him alone. Such is the source of all his wickedness and all his mischief : but this was his destiny : it was to be permitted under the Creator's plan. And that destiny he could scarcely have fulfilled, had there been, perhaps, but one other species in Creation endowed with powers like his own. Had the one hundredth part been such, the world could scarcely have proceeded for a year. Such was the purpose, and such are the great uses, of the definite instincts of animals.

I must end. I cannot but think, that when men shall overcome the prejudices arising from the several causes formerly stated, and shall apply their own reasoning to the facts of natural history, the view which I have here sketched, of the animal mind, will be found just. It will form the foundation of a system of animal metaphysics : of that, which, having been so universally denied, may now excite repugnance, or even ridicule. But unless we take a more liberal, as a more correct view, of the faculties of animals, we deprive ourselves of a great source of rational and philosophical pleasure,

and also of the power of forming just views of the conduct of the Deity in the arrangement of the universe. Through the whole of physical nature, we trace an uniformity of design: a system, in which there is a leading plan, including subordinate ones: while, wherever we fail to make this deduction, we must believe that it arises from the imperfection of our knowledge: being sensible, that as that has continued to increase, so has this consistency of design become more widely visible.

Does a similar plan hold in the moral world, or not? is it probable that when the physical analogies between man and the inferior animals are so remarkable, similar ones do not pervade their moral constitutions also? *A priori*, it should be so: the preceding facts and reasonings should prove that it is so: but this is, at least, a question deserving philosophical investigation; though nothing were proved. If the ancient hypothesis of Instinct is maintained, the very desire of investigation is cut off. The same conduct respecting the Ptolemaic system, would have now found us in the ignorance of Ptolemy. Such conduct in philosophy, is suicidal: arising from a prideful vanity to monopolize mind as a peculiar gift to man, it is infantile: flowing from unexamined prejudices, it is irrational; and, if the result of authority, it is timid and base. Among the varieties of moral courage, philosophical intrepidity is not the least useful. Had there been more, philosophy would not have tyrannized as it has done; nor would it now be that frequent subject of ridicule which it has so often and so justly been. The body of man was constructed for the sake of his mind: through all creation, equally, the machine is subservient; the mind was the

prime object. In the inferior animals, we have been ever labouring on the secondary, and forgetting, nay, denying, the primary: wondering at the machine, but neglecting the powers by which it was moved; and, while eternally anxious about the forms of matter, utterly negligent of the far higher interest that exists in the forms of Mind.

CHAPTER XXII.

ON THE LANGUAGE OF ANIMALS.

THE care exerted by the Creator in providing for the wants of the inferior animals, is so minute and universal, that if anything appears to have been neglected, we ought to conclude that our own ignorance is in fault. It is impossible to conceive how they can perform their duties, especially in the social and gregarious states, without some means of communication, or some kind of language; and therefore we ought to infer that He has provided them with it, under some form, as He has assuredly been the teacher of the human race in this respect.

The language of animals has indeed, at all times, been a favourite subject of speculation; but this has been limited to poetry and fiction. No rational inquiry has yet been made respecting the possibility of what appears incapable of proof: and this is what I feel bound to attempt in this work. And the mode of argument is simple. We have reason to expect it, on the grounds just stated: and we have no right to decide against it, if it can be shown that our faculties and observations are incompetent to discover what the fact is. Thus far the balance is, at the very least, in suspense: and it should turn decidedly in favour of such a conclusion; if we can find, in animals, actions which could not be conducted without language; still more,

if we can trace variety of sounds, and those accompanied by peculiar actions, though we should be unable to analyze them and give them their definite applications.

I must first remark, on the subject of hearing, as being fundamental on this question, that we are accustomed, not unnaturally, to give more credit to our own senses than they deserve. We decide on their perfection by an estimate drawn from themselves; which is as if the mole were to argue respecting a landscape, or he who is without ear for music should dispute the existence of refined harmonies. Even in the musical scale, which from the magnitude, the definite nature, and the repeated similar relations of the intervals, forms the most audible collection of discriminate sounds, there are tones at each extremity, which we cannot distinguish, as at length there are also notes that we do not hear. We know that they exist, from the visible vibrations and the measures of strings: but the ear has ceased to discern them. The snoring of a dormouse is so acute, that the note cannot, I believe, be assigned; as it is also on the very verge of inaudibility: in a string or an organ pipe, it is easy to produce indiscriminable, and even inaudible tones, at the opposite extremity of the scale.

If now we take sounds that are not in the diatonic and chromatic scale, the difficulty of distinguishing them augments rapidly as the ratios approach nearer to each other, till at length, to imperfect ears, dissimilar ones appear the same. This is the case, even if those sounds are single, or truly musical, belonging to fixed divisions of the scale: but if at all vacillating, as are the sounds of speech, there is no human ear that can

follow and distinguish them, however widely sundered they may be. Our ears are not calculated for such distinctions: in many persons, they cannot distinguish even among neighbouring enharmonic tones, except in the case of a chord, where there is a fixed and known note of reference, or in that of a false unison. Hence it is probable, whatever musicians may have thought, that however music may continue to improve under the increase of enharmonic chords, we shall never produce enharmonic melodies, because unintelligible to our organizations.

Yet I have elsewhere suggested that such melody is intelligible to the birds which produce it: since it is produced, definitely and intentionally, under finer organizations of the musical instrument and of the sense of hearing. Thence may it be inferred, that these, and other animals also, may both hear and discriminate those unsteady sounds produced by themselves which should constitute their own language, although we cannot: while to assume that they do not, is, plainly, to measure their faculties by our own defective ones: a proceeding inconsistent with philosophy and logic.

It is not less true, that we have been accustomed to decide against the sensibility of these animals on false grounds, and under an ignorance of the very nature of music. We dispute it, because they do not produce and enjoy that which we term music; a succession and consonance of intervals in the diatonic and chromatic scale. But while this is the produce of an arbitrary law of nature, rendering that class of sounds pleasing, as it is discriminable by us, it is evident that, instead of proving the high sensibility of our own ears, it is a proof of the exact reverse, though such a proposition may surprise musicians: since these pleasing

sounds demand little effort of discrimination, from the distances of their ratios. Hence should the sensibility to sounds, in the birds at least, far exceed our own : since their power, with their pleasure, consists in producing intervals more minute, and thence demanding finer senses, that they may delight in what was appointed for them, as our own less refined ones were for us. That they hear and understand what they produce, is evident, since otherwise it could not be executed. If musicians have reversed this most demonstrable proposition, it is plain, that if the sounds which require the highest sensibility to feel and enjoy are not musical to us, and that the pleasurable ones are those of widely differing ratios, our own music depends on our lower sensibility.

If the bearings of these views on the present question are obvious, there are abundant facts whence we may infer, in the animal races, a higher power in the nerves of the senses than we ourselves possess. I need but allude to the power of vision, in birds innumerable, depending on this, not on the optical machine ; and to the acuteness of the sense of smell in the dog and the deer, where we are sure that the power is in the nerve. The knowledge of impending changes of weather, remarkable even in insects, must depend on a similar cause : as we are assured of the unequal sensibilities of such nerves, even in ourselves, when there are persons who have seen that satellite of Jupiter which the great majority cannot perceive without a telescope of considerable power. And the application of this general fact to the case under consideration is completed by the known acuteness of hearing in the hare, the horse, and many other animals : while such a nerve ought also to be a finely discriminating one, since the two properties are but the same : as

the cases of seeing and smelling prove. The nerve of smelling in a dog, discriminates nicely, as it feels acutely: a fine sense of hearing cannot be different.

Hence the general conclusion as to the present question becomes obvious. In the nightingale and thrush, we distinguish a great number of sounds and articulations, because they belong, or approach, to that musical scale for which our sense of hearing is adapted. But we cannot doubt, that in these, and still more in birds whose tones are less musical and definite, there are sounds which we do not truly distinguish, and which we therefore neglect in favour of those to which we are most sensible. And there is no difficulty in believing that the song of a nightingale is better understood by itself than by us, or that it contains much more than we hear. If I were to suggest that it contains a definite set of phrases, with meaning, to the animal itself and its kind, there would be nothing absurd in the proposition; since it possesses, even to our ears, a greater variety of articulation than we can find in any human language with which we are unacquainted: while, in confirmation of this general view, all who have attended to such subjects must know, that where these birds abound, long debates are often carried on among them, in tones and articulations quite distinct from the ordinary songs. When we decide otherwise, we are deciding from a prejudice, or assuming that it is not a language, because we do not understand it. We should be equally justified in thus deciding as to the Arabic.

The nightingale offers a simple case, and at one extreme, where the inference is most easy. I may take one at the reverse, where the difficulty is greatest. The notes of a rook are, to our ears, among the most limited: but if a careless ear may distinguish but two

or three, a better and more attentive one will easily find more than twenty, as there are probably many more that no one can discriminate. In all animals indeed, equally deemed monotonous, similar attention will discover a great variety; as, in very many, the range of tone and articulation is equally remarkable and extensive. Observers have been deciding, as usual, before they had taken the trouble to examine. And if I have shown that our own ears discriminate very imperfectly, even in the case of musical and unvarying tones, when the ratios are near, and that we can scarcely distinguish at all in other cases, we have no right to decide that the rook, and all others equally, do not perceive, even in what appears to us a pure monotony, a great number of distinct sounds and articulations; especially knowing the great acuteness of the other senses in such animals. To decide otherwise, is, again, to argue from our own imperfections. It is a case of natural deafness, if I may use such an expression: and as well might the morbidly deaf decide on the non-existence of a sound, as he whose organ has not been constructed to hear a certain class of those.

But there is another circumstance relating to sound, which may concern this question, and which I must not therefore neglect. This is the quality, or timbre, on which I have made some remarks in a future chapter (c. 48.) We distinguish this readily, in the several musical instruments; and even in the different qualities of human voices, which depend on this mysterious property of sonorous bodies; mysterious, because it is independent of tone, of the number of vibrations made in a given time. It requires far nicer ears to perceive the minute differences in the qualities of two instruments of the same kind, which are still differences of timbre:

and if the ordinary ears which distinguish among singing-birds do this chiefly through the melodies, a finer one is fully sensible of the difference of timbre among many of them. And thus we may grant a still finer perception of this kind to animals of nicer sensibilities : of which indeed we have proof in the fact, that the wild birds and the domestic fowls recognise the voices of their own partners and offspring, and that even the sheep knows the bleat of its own lamb. Thus can we grant, again, that animals may possess means of discrimination for the purposes of language, where we can distinguish nothing.

I will conclude this *à priori* argument by now taking the case of human language. Such a language, to those unacquainted with it, presents nothing but noises, or sounds, which we can scarcely perceive to be articulate ones. If not rigidly true of the European languages derived from a common root, of which we are familiar with one branch, it is notorious in that of a Greenlander or a Hottentot, or in that of the Celtic dialects of our own country. Not to speak ludicrously on a grave subject, the objurgations of an assembled multitude of Welsh do not exceed, in articulate and discriminable sounds, the noise of a rookery. We happen to know that there is language ; but our ears do not give us that information : and had the speakers the forms of quadrupeds we should decide without hesitation that such noises were not speech.

The application of this part of the argument is as obvious as all that has preceded. When we have learned the meaning of those sounds, we can also discriminate them, but not till then : not even, easily, except under that slow and distinct articulation which allows us to study each. Thus, if animals have been

taught by the Creator such languages as are necessary for their wants, since more cannot be expected, it is plain that they may perfectly understand each other, or be expressing even numerous and definite ideas, where we perceive nothing but noise, and probably never shall.

This completes the *à priori* argument. There are valid reasons, in the necessities of the case, and in the general conduct of the Creator, why animals ought to possess language: I have shown that there is, or may be, language accompanying the means of language, for aught that we can decide to the contrary: so that the question remains suspended between a high probability, and an ignorance which has nothing to oppose. It remains therefore to inquire of the positive facts in evidence of this probability, while, if of any value, they ought to turn the scale. But I must be content with selecting a very few out of many: partly because this work cannot admit such details, and partly because the peculiarity of some of those might call up feelings of levity respecting a subject easily treated with ridicule.

I have said that communication is peculiarly necessary among the gregarious and social animals; and we accordingly see that many of those do act together under peculiar sounds. Let us not however be misled by the term language, since it is in terms that our difficulties often lie. The communications of animals are not the language of the fabulists. The range of their ideas is limited, and so must be their modes of expression. And, as a natural language, or a gift to those which are incapable of educating each other, it is probably fixed, or incapable of extension: though I shall presently show reasons for believing, that where educated by us, they increase its range. But if this inquiry is

limited to a language of sounds, it must not be forgotten that the social animals do understand each other, as some different kinds also probably do, by means of some physiognomic or pantomimic signs, equally taught by nature. We know this possibility in ourselves: and the physiognomical acuteness, not only of dogs, but of many more, seems to belong to this power.

Familiar examples of various and vocal language exist in the duck tribe, followed by correspondent actions, in marshalling their flights, and in much more. The sounds and articulations of the domestic duck and goose in particular, are so numerous and marked, that they are not equalled by any human language; while it is not difficult to learn the definite, if the general, meaning of many of them. It is not easy to see how else the decoy duck can perform its treacherous office. It is the same notably with the hog: while, if we see the effects in many of the proceedings of this animal in society, I need only note, that thus it will collect its companions to ravage a field, as the dog conducts its own to the chase, and as the rat and the mouse assemble and lead their tribes to a discovery of food. If we do not know that the beaver has similar means of communication, we cannot comprehend the possibility of its conduct in society without some language. In the endeavours of birds to persuade their progeny to fly and to dive, we can scarcely avoid believing that we hear a definite language, so unusual, and varied, and marked, are the articulations and the tones. The quarrels of sparrows are more articulate, and the noises more various, than those of a human contest. The sounds of the domestic fowl under the approach of a hawk, the intention to sit, the calling its young to feed, and much more, equally familiar, are not

less various and definite : but not to encumber these pages with facts which any one can supply, I need only add the equally noted cases of the cat and the rook. However disagreeable the sounds of the former may be to us, they abound in variety of expression : and in the latter, the comparison of actions and sounds, under a fact of familiar occurrence, renders it scarcely possible to avoid concluding that the latter constitute a language. The destruction of a rook's nest, occasionally proceeding to the slaughter of the animal, is preceded by a congregation of the society, and a great noise ; as all know that the work is executed by the deputation of two or three individuals out of this convention.

Not only the necessity, but the certainty of communication in the gregarious insects has been shown : especially in bees and ants. Huber, the deepest student of those communities, has thought that he could prove a language of signals, through the antennæ. This may be true ; but it does not seem to be a necessity. Some insects can produce sounds, independently of the vibration of their wings, by friction : as in the common sphinx and the grasshoppers, and the crawfish in the sea. If these are audible to us, there may also be similar inaudible ones, sufficient possibly for many purposes : while it is not impossible that one or more of their tracheæ may be provided with the means of sound. We have no knowledge by which to decide against that which might exist, without any extravagance of supposition : while should it be true, it is certain that such sounds must lie beyond the limits of our hearing.

If it is not unreasonable, but right, that natural history should pursue this subject, instead of rejecting it, I may now examine what occurs under education, since it seems to offer an additional argument. In the

cage singing-birds, there is often a language which is not found in the natural state; directed to ourselves, and proportioned to their domestication or our familiarity with them. They who are attentive and interested, will easily learn to distinguish those new sounds, in their applications: the morning salute or the welcome home, the demand for food, disapprobation under mistakes respecting this, remonstrance, or satisfaction, and much more. And when associated, in numbers, or with offspring, we hear and see what must be the expression of their ideas to each other, in various ways which cannot fail to be well known to persons attached to those animals, but would not be understood, and possibly not believed, by others. And if, universally, an educated bird uses many sounds which it does not possess in the natural state, the same is true of our dogs and cats, the only other animals in which it is easy to make these observations. The more familiar those are with us, the more does the variety of their sounds, or their language, increase; while we find that these are used for specific, and often, remarkable purposes. Were we unprejudiced, we should believe that they had invented new terms or phrases to express their new ideas, consistently with the general organization of their natural language, and, that in all such cases, there was that attempt at intercourse with us, which has become necessary to their new condition. It is the same in some measure with hogs; and would probably be found more widely, were we equally familiar with other animals. If any of the sounds of animals have a meaning, it is likely that the new ones express the new ideas, as the others do those belonging to the state of nature, or are attempts to converse with us; while we are at least sure that they do acquire new ideas through our education: as it may also confirm

this opinion to remark, that in any one kind, it is the individual which displays the most intelligence, or is the most ambitious of our intimacy, that possesses the most intonations, and makes the largest use of them. And if there be any truth in this, they not only possess a natural language, but are, like ourselves, partially empowered to be inventors, under restrictions easily understood.

If the facts in question admit of being explained in this manner, and in no other, while it is ignorance and prejudice, not knowledge, which refuse the solution, I may leave this argument to its own weight, and point out another, of some apparent force. If an animal can learn the meaning of a language which is not its own, it would be a very extraordinary conclusion that its natural sounds were without one. And if to act definitely through certain sounds, is not to connect ideas with sounds, or to understand language, there is no meaning in this term. Or, this acquisition implies an accurate ear: since the sounds in question are difficult, because they are not musical, and because not related to those used by the animal itself. And it would be to reason very inconsistently, to admit that a given animal discriminated and understood the language of another, and not its own. To do this further, without previously possessing the principles of language, would be as great a miracle as that a dog should speak in a human voice: while the possession of it is equivalent to a proof of the existence and use of a natural language.

The fact here alluded to is familiar in the case of dogs. They learn many of our words, and act upon them regularly and consistently. How much they can learn is well known, though it is not within my limits to quote cases of this nature, however well authenticated.

It is not by specific facts, which any one may choose to doubt, that I must seek to establish this point, but by the general train of reasoning. And if the case is the same with the horse, the mule, and many more, there are few persons of any reading respecting animals, and still fewer of any observation, who do not know enough for my purpose, as to those I am compelled to trust for what I cannot here adduce.

But I must add to the evidences in support of the last argument, the well-known case of parrots, by which, especially, the human language is spoken, and with much more appearance of intelligence than by the other birds which can acquire our words. And if that intelligence can be inferred, the same conclusion, which I need not now repeat, will be deducible.

A dog or a cat asks that the door may be opened, in some peculiar sound which it has invented; and it is confident of success. It has therefore the definite meaning in question, connected with the peculiar sound which it uses; and this is language. If a dog should ever chance to say this in our own terms, under the same expectation, we should scarcely deny that it understood the meaning of the words. Yet the parrot does the same daily, when it presents its head to our finger, under the appropriate phrase, or when, under the want of food, or drink, it asks, specifically, for those, or calls, separately, and under the equally appropriate names, or cries, the persons, or the domestic animals, with which it is associated. I do not quote such singular and certainly questionable cases as that reported by Locke; but there are endless other well-known ones to prove that these animals attach definite ideas to the words and phrases which they use, and, as far as can

be expected from the limitation of their faculties, what those mean. Yet it is denied that the parrot understands the meaning of its acquired language; it is said to be merely imitating sounds. It is in vain to argue against prejudices: but whoever admits the intelligence in this case, must equally admit it in that of the animals first named, using sounds of their own, instead of our language, and of which we know therefore only the general, not the precise meaning. In the parrot, there is an acquisition of new ideas, attended by the appropriate language which we happen to understand: had it made noises of its own, it would have been expressing what it now does, like the canary bird demanding food, or sugar; while they who admit its intelligence at present, might have denied it in the other case, as well as in the domesticated quadrupeds. The present conclusion must be, and as being such, must be equally true of all, that no animal could acquire a language did it not possess the principles of language, and that if we do understand, ourselves, more or less definitely, their acquired one, the result of their education among us, so are they using language in their communications with each other, when we conjecture the meaning but generally or imperfectly, or when we cannot discover it at all.

Such is the sum of the total arguments, from the *à priori* reasoning first, and from the facts in evidence afterwards. If I could have made the latter far more numerous, I know not that number could add to their logical value, whatever it might do towards the conviction of those who are more influenced by the mass of evidence than its quality. Yet while even the evidence is neglected, the subject is unfairly treated, by com-

mencing with the rooted prejudice respecting the absurdity or impossibility of such a fact as the existence of language in animals. If what I have thus said shall induce naturalists to study the conduct of animals with more care, I have little doubt that the conviction will extend; as we may acquire new and special facts, confirmatory of the present evidence, and exceeding it in weight. But the first step is to renounce prejudice: since never yet was anything believed, when it was predetermined that it could not or ought not to exist.

I must now state the difficulties of which I am well aware, though I need not here investigate this subject through all its cases. There are animals with very limited sounds, like the ox and the sheep, or with awkward ones, like the horse, as there are some which, like the rabbit, seldom use any. It is possible that in many of these cases, there are expressive intonations which we cannot distinguish; even in the horse, we know that there are such, as we also know of some in the sheep. It is equally possible that the dulness of the ox, social as it is, may render language little necessary, and that the rabbit and others can gain their limited ends by a pantomimic language. On nothing of this nature have we any right to decide, under our imperfect knowledge of the moral history of animals; and far less are we entitled to produce such cases in answer to the others. And if the whole subject demands that investigation which it has never yet received, let us not forget that it is our perpetual error to judge of every thing, even of the Almighty, by ourselves; as our vanity also knows not how to concede that any animal can approximate in faculties to man, or even that there is anything created but with reference to him, to his understanding and his enjoyments.

The case of fishes offers the greatest difficulty of all. They can have no voice, as far as we can conjecture, and their other powers in producing sounds are so limited, that I need not notice them. Yet a very obvious question immediately arises. If they are utterly dumb, why are they provided with organs or powers of hearing, and those of great acuteness, even in the shell fishes, as is well known to fishermen? We can scarcely conceive the purpose of such a provision, but for the sake of internal communication; since none have much connection with the sounds of the terrestrial world, and many can have none whatever. It would be that useless and operose superfluity, of which creation furnishes no parallel example. But there is also direct evidence to the same end, in the fact that a fish which has felt the hook and escaped, often renders the fisherman's further attempts useless, by warning its companions of a danger which can scarcely be described without some power of communication equivalent to language. Whether the very distant warnings which the alarmed whale gives to its fraternity, are effected by nothing more than the stroke of the tail, is not as yet proved. Thus must this subject remain for future examination. We ought to conclude, from the wisdom of the Deity, furnishing the means of hearing, and from His goodness, providing for the wants of all His creation, that the marine tribes do possess the means of communication through sounds; but what those can be, we are as yet unable to conjecture.

Universally, these attributes are implicated in the grant of language to animals, adapted to their wants, and of course, fitted to their several capacities, while limited by those. We have never yet found that He has neglected anything of which we could infer the

utility or the necessity; and I doubt not that we shall yet fully prove, that He has not neglected this, but that all the animals which He has appointed have been endowed with language, or means of communication, adequate to their uses and subservient to their happiness.

CHAPTER XXIII.

ON THE SYSTEM OF ADAPTATIONS AND CORRECTIONS
IN CREATION.

THE adaptations which have been quoted in some preceding chapters to prove wisdom and contrivance are obvious to the most common observer; but there is far more, of the same nature, discoverable only by careful comparisons and attentive reasoning, added to extensive knowledge of the mutual bearings and actions of the several parts of the universe. Such indeed are the greater number of those arrangements, that while utterly unknown to the multitude, they are too often overlooked by philosophers; as some have disputed them, or, if admitting the facts, have considered them as matters of necessity, not of design. Thus also does familiarity produce the same effects as ignorance: it is enough that it has been so from all time: “*nam assiduitate quotidiana et consuetudine oculorum assuescunt animi: neque admirantur neque requirunt rationes earum rerum quas semper vident: proinde quasi novitas nos magis quam magnitudo rerum debeat ad exquirendas causas excitare.*”

If I must here confine myself, as usual, to a slender selection, and to what is most easily stated under familiar language, I must make one preliminary remark, that I may avoid the necessity of similar explanations hereafter. It is said that if these arrangements had

been made by perfect wisdom for definite purposes, they ought always to answer those ends ; which they do not. Striking as this objection appears to be, the answer seems complete, while much more obvious than it has generally been thought. It is admitted that the Creator did not, in this earth, design a world of absolute perfection ; and while defects must thence exist, there is a broad and general system of adaptation, or a calculation for a standard medium, or average condition of actions and events, admitting of inequalities and irregularities, of casual excesses and defects. And if thus allowed, they are perhaps also commanded in many cases where we cannot discern the utility : while sometimes perceiving this, and relying on the Divine wisdom and goodness, piety is ready to draw the same inferences as in all other instances of evil.

But shunning an almost impracticable inquiry into details, this at least we can see, in general, respecting the uses derived from that uncertainty which the objector blames, or would adduce to prove a defective government, or a government of chance. As far as man is concerned, the defects in question, implying accidents, derangements, failures, evils, not only form the needful stimulus to our prudence, care, and vigilance, inciting to beneficial exertion, but thus constitute that source of education itself, without which the mind would never be formed ; produced as it is by the use or application of its implanted but dormant faculties. It is further apparent, that as the absolute order and certainty which the objector desires, would become equivalent to a necessary conduct on the part of the Deity, He would retain no power of making changes, or causing events, calculated to meet those which arise from the free-will which He has granted to man as his distinction and

essence, and would thus cease to be the moral governor of the universe. Under whatever lights systems of necessity have been stated, it is plain that a perfectly regulated and unvarying world is of this nature: as in these views are comprised the explanation and defence of what is termed chance.

As I cannot however here pursue such inquiries, I may proceed to state the illustrations selected for the general purpose of this chapter. If some of these have appeared in other parts of this book, as was unavoidable, they are here re-stated, or abridged, or expanded, as the object in view seemed best attainable. But the reader must recollect that they are only specimens, and that every subject treated in this work, with much more, might have been stated under the same views, since the whole of creation is a continuous and complicated system of adaptations and corrections.

It is a confined view which some writers have taken of this subject, when they limit their remarks to the obvious adaptation between the insensate physical universe and the organized sentient one, since it is fully understood that the former was created for the uses of life. If, selecting some details of more interest, I do not follow them through matters so obvious as the adaptation of the year and its seasons, or of the day and the night, to the instincts, desires, and constitutions of animals and plants, so must I avoid the trifling of those who praise the wisdom of the Deity for placing the sun in the centre of the planets, in contriving the earth "not too hard nor too soft," in causing it to be green, and the sky of a blue colour, in appointing that heat should render water fluid, with much more of the same nature. He intended to enlighten all the planets; He intended all else, and He designed in wisdom; but

while a due execution follows of course, there is nothing in these cases denoting peculiar contrivance, as there is no difficulty overcome: while to argue His wisdom in this manner, is to imply the possibility of its deficiency. Water was to be fluid, for certain ends: it is no peculiar proof of wisdom that it is not solid. Let the wisdom of these arrangements be sought in the adaptations and the corrections, as I am here about to do; for had He so chosen, a scarlet earth might have been as pleasing to the eye as a green one; while had He not done far more than place the source of light and heat in the centre of the system, the sun would have been of little value either to plants or animals.

If the mutual positions, distances, velocities, and magnitudes of the spheres in the planetary system offer the most splendid example of adaptation, the subject is unfitted for a popular statement; since no one but the mathematician, who does not require it, could appreciate the nature and value of this arrangement, respecting which I have also noticed, in a future chapter, all which a work of this nature permitted.

The quantity of light allotted to the earth, compared to the sensibility of the eye, is one of those adaptations which, striking as it ought to be, is rarely considered: but if we conceive ourselves to change places with Uranus or Mercury, we shall immediately become sensible of its existence and value. Feeling the inconveniences which occur now, amid the snows of the pole or the sands of the sunny desert, we can conjecture what we should suffer in Mercury or Venus; while, if I need not draw the opposed picture, His wisdom has guarded us from more than usual inconveniences from these causes, by a due adaptation of the susceptibility of the acting nerve, and by corrections which I need not here

repeat, provided for by the machinery of the eye. And could I here pursue this subject through all the animal races, this system of adaptation would be much more striking, in observing the manner in which both the sensibility and the structure are adapted to the various degrees of light which fall to the share of different animals, under their several dwelling-places, natures, and pursuits; the whole forming inferior sets of involved adaptations. But while a detail of this nature would here be too extensive, the reader can easily bring to bear on the present question the few varieties of structure noticed in the 9th Chapter.

It may safely be said, under a general view, that although many of the present animals, and plants also, might have inhabited the earth, had it possessed a different place in the system, and thus received a greater or less average heat from the sun, it could not have been tenanted by all the existing races as it now is; whence we may conclude, that in this case, as in that of light, there is an average adaptation between the allotted heat and the powers or sensibilities of the living creation. But while the range, the irregularities or casualties, and the inequalities of heat are far different from what occurs in the case of light, we must consider them as necessities involved in the Creator's plan: those of climate and season belonging to the established form and motion of the earth, and the rest being not less inevitable, as causes, or connections, or effects, involved with other requisite and appointed actions. Hence the necessity of compensations and corrections, or of adaptations, far different, and much more numerous, than those in the case of light; while, unable to give room to both, I have passed over these, that I may allow more space to the present, with the intention of showing the

reader how he may pursue, under the same views, any other department of creation with which he chances to be intimate. But since these corrections and adaptations consist in the position, motions, nature and disposition of the earth itself, and in those of its fluid and aëriform investments, in various chemical and mechanical processes, in the different constructions of plants and animals, especially of the latter, in their different sensibilities and affections, and in more than all this, the subject is so wide that I can but select a few points for notice: while if I need but allude to some matters treated of in other places, so must some repetition of that which belongs to the 35th Chapter and others be excused, as well as some misplacement of what science would have demanded there; since a work which must extract from all the sciences whatever is applicable to its views of the Deity, cannot confine itself to the order of any.

Passing over the very familiar compensation produced by the planetary motions and position of the earth, and following no order, I may first point out the ocean as the most striking of these contrivances: operating, directly, through its mean temperature and extent, and, more remotely, through those extensive currents which circulate between the equatorial and the polar regions. If a perpetual tendency to equalization is thus maintained between the heats of the tropical and polar seas, so does it become a cause of the same nature in another manner, by acting on the moveable atmosphere, and thus aiding to produce the sea and the land breezes elsewhere described.

Thus does the atmosphere produce other effects of compensation, by means of its motions, or winds, from whatever causes arising; acting further for the same

purpose, less directly, as the repository and the moving force of clouds, which, as screens, guard the earth from the sun's rays, and, as cold masses, reduce a higher temperature in the contiguous atmosphere, or, by generating winds, in that which is more distant. But if thus corrective of high temperatures, so do they produce the reverse effect, when, by being interposed between the warm earth and the colder ambient space, they check the radiation of its heat. And under this head I may include evaporation, as one of the great expedients for the reduction of temperature, and of much wider action than in the familiar case of the cooling of animal bodies. But while I cannot, in this bare sketch of a general system, pursue details so intricate and numerous, and involving, with so many facts, so much of the philosophy of heat, it must suffice, as a specimen of the complicated contrivance and action of these compensations, to point out, that where the reduction of heat in the earth by evaporation may be excessive and might be injurious, the formation of a fog, and even of an elevated and distant cloud, becomes the corrective, in the manner just stated.

In the 6th Chapter, I showed that the system of mountains formed an extensive and magnificent compensation of the same nature: while, the adaptation being double, contrivance and wisdom are the more strongly marked; since the desired effects could not have been attained but for that law through which the atmosphere is necessary for the production of heat from the sun's rays.

If, in the 35th Chapter, I have described the conducting and radiating powers, commonly termed the laws of heat, they are the means by which heat is communicated, or received by one body and discharged by another,

of different temperatures : while, through one or the other, provision is made for this communication at all distances, but under circumstances and variations far too numerous and intricate for a sketch like this. They are the essential contrivances on which all that is here enumerated depends; while so mysterious in their nature, that we can form no conception of them or of their modes of action. Like gravitation, we must refer them directly to Mind, and, implying motion for which we can conjecture no secondary causes, to that Divine energy, or will, where we must seek the source of all other action; all motion, and all power.

A volume might well be occupied in describing the actions of these two powers, under the present views of correction and compensation; and thence must I confine myself to some remarks on their application to the uses of animals, so that under the great range of the terrestrial heat, under the inequalities of climates, and under a thousand casualties of perpetual occurrence, there is nothing which essentially or permanently disturbs the existence or the felicity of those innumerable races, or interferes with the Creator's primary plan. And if we admire the result, in a perfect adaptation of the power of heat to the exigencies of the living world, so that a definite effect shall be produced under varying causes, thus also must we be struck by the contrivances through which this object is attained: while the selected example will be but a specimen of far more, equally intricate and effective, in many other departments of creation as well as in the present case.

It would have been a simple arrangement to have created an earth of an uniform and fixed temperature, with a population of animals adapted to that heat. But the first was impracticable, from being incongruous

with other portions of the Creator's plan; with the planetary arrangements for the earth, and with the chemical laws and actions necessary for certain purposes in creation. And whether certain fixed temperatures were necessary to the powers of the different classes of animals, or rather, as is the truth, that He appointed such arbitrary rules, here also we find certain necessities existing, and productive of collateral inconveniences, to which His wisdom applies the corrections in question, by new contrivances, so as to remedy the difficulties which His plan commenced by establishing; ordaining, not suffering.

Assuming, for the sake of simplicity, that the heat of the warm-blooded animals is 100° , it is plain that they might have existed, without producing heat, in a fixed temperature of this degree. But as such a state of things could not be, consistently with the rest of the plan, a remedy was to be found; while that is appointed in a chemical and vital power conferred on the animals themselves, producing heat, and what is more wonderful, not merely the exact temperature required, but a distinct, and still invariable degree for each of many different races. Nor is this all; since, as the variations of the external temperature must interfere with the generated quantity, there are other inventions by which an excess of the former is corrected by a diminution of the latter; as, reversely, its deficiency is counterbalanced by an increase of the productive animal power, exclusive of collateral protecting contrivances. Little as this extraordinary fact attracts attention, it is among the most surprising things in nature, that under differences of temperature ranging through much more than a hundred degrees, so small a body as is that of most animals, should remain at the same point, or be always

able, at least, to restore itself to its ordained degree of heat, under accidental influences affecting it; and this through an unconscious action: excepting, of course, those extreme cases, which, as sources of inconvenience or destruction, have been allowed or commanded to pervade all creation. That, in spite of certain vague or partial explanations, we do not know how all this is effected, serves, as usual, to add wonder to our admiration.

Passing from these general remarks, I may first notice the beauty of the compensation by which the cooling process consequent on the passage of an animal through a medium colder than itself, is counteracted, and by means of the very motion itself. That which produces the evil, or the hazard of evil, affords also the remedy. And this is, the heat produced by exercise: while as the motion, and thence the chance of injury, is augmented, so does the increased action of the muscles lead to that, whatever it be, which generates a proportional compensatory temperature. If animal heat had been produced regularly, or by equal increments in equal times, this correction, among many more, could not have existed. I speak here, of course, of the natural motions through the air: since there is no provision in nature for the artificial conduct of man. If he incurs this hazard through his own inventions, to his invention also is the remedy trusted.

If the nature of the cooling process in animals is still somewhat obscure, whatever may be attributed to evaporation, it is such as to afford a compensation for an excess in the production of heat through exercise, or motion, or through the presence of a hot medium instead of a cold one: while as far as the remedy consists in evaporation, it is self-acting, and proportioned to the

necessity, just as in the former case. And under both sets of circumstances, be the external temperatures or the muscular exertions what they may, there is no variation in the internal heat, or that of the essential organs, except under disease. All this, though ever overlooked, through ignorance or familiarity, is, in the common usage of that word, marvellous: it is that perfect system of compensation which a mechanic applies to a clock, in a parallel case, but under a far simpler difficulty: as, with him, even this little has been the result of much accumulation of thought, and many trials. If indeed the total mass of checks and counterchecks for the regulation of heat in animals, under all circumstances and casualties, be examined, we shall scarcely find it exceeded in contrivance by the balances of the planetary system, more conspicuous and imposing as these may be. I must mark such few cases of these variations of contrivance as I can afford.

It is obvious that the difficulty of producing and preserving a high degree of temperature in the inhabitants of the ocean must have been much greater than in those whose medium is the atmosphere; since, from causes too well known to require detail, the sea can never reach the same heat as the air, and an immersed body of a higher temperature is far more quickly cooled. If therefore it was to be inhabited, warm-blooded animals were less adapted to it; though the Creator has shown that He could surmount this difficulty, by the invention of the cetaceous fishes. But as there are reasons to believe that the respiration of air, or of oxygen, is necessary to the production of animal heat, there was an obvious inconvenience in compelling every marine species to breathe the atmosphere; while, independently of the great waste of time, this would have

excluded myriads, under numerous useful or needful modes of life.

But be this as it may, the Creator has appointed animals to breathe water while living in it; and thence, under what appear to be His own laws, incapable of producing the same heat as the atmospheric ones. Hence there was a new difficulty to be overcome, for which, human wisdom, knowing warm animals only, and finding heat necessary to sensibility and vital action, could have devised no remedy. With Him, it is a pure act of will, independent of any laws that we can comprehend, and acting in opposition to what had seemed indispensable. The necessity of an elevated temperature has been dispensed with, but the sensibility has been equally allotted, and the vital actions are performed as effectually as in the atmospheric animals. Here then is a balancing power as to heat and its variations, of an entirely different character from those formerly enumerated, and not less perfect than new: the consequence being an adaptation to compensate evil results, or to meet necessities arising out of the needful mechanical and chemical constitution of the globe. Thus further, knowing only the warm animals, or knowing the cold ones imperfectly, we should have decided that a much lower temperature than that under which they exist would have destroyed life. And if philosophy had thus determined, we now know that even freezing does not destroy all the cold-blooded animals: while, had it reasoned as it has seldom done respecting the Creator and His designs, it would not have made this rash assertion. It was foreseen that such animals would be thus exposed; and provision for their security has been accordingly made, by a further extension of this arbitrary law of the nervous system.

Whether the incapacity of producing much heat was a necessary consequence of the respiration of water, or not, the utility is evident: so that we might consider this a design instead of a necessity; while not indeed sure that it is not purely such, under our ignorance of the process by which animal heat is generated. It is obvious that the difficulty of finding a remedy for the cooling of immersed bodies, especially under rapid motion, was much greater in the case of water than in that of the atmosphere. Whether that difficulty might not have been surmounted in some other manner, we cannot conjecture; but the adopted one has been to equalize the heats of the medium and the resident animals, or to render the differences trifling; while the compensation has been effectual. But where, as I have just noticed, the Creator has thought fit to appoint warm-blooded animals to the ocean, as if to show us that there were no limits to his power, we find compensations, the partial nature of which is no less worthy of notice than the wider application of others. All the warm fishes are of large size, and many of enormous bulk, thus opposing the process of cooling: while the thick covering of fat, if it also aids their needful buoyancy, protects, by its non-conducting power, that which is essential, the heat of the vital organs.

In the flying insects, the smallness of the mass, with the rapidity of their motions through the air, would equally have rendered the preservation of a high animal temperature difficult; whence a similar proceeding has been adopted for them, while their dependence on the condition of the medium is greater than that of any other animals except certain reptiles and hybernant quadrupeds. In this tribe, I may also note another adaptation under this head, marking wisdom, if simple

when compared to many others. Their chief concern, both in food and in perpetuation, is with plants, and these are for the most part dependent on the higher temperatures. It was best therefore that both these tribes of beings should depend equally, or chiefly, on the external temperature, and it has been accordingly so ordained. The activity of the one would have been an evil instead of a good, when the other had ceased to act and to produce.

In the bird race, I may point out that remarkable difference in their appointed internal temperature, by which they are distinguished from even the quadrupeds which produce the highest degrees of heat. As I assumed a fixed quantity for the latter, so I may, for the present purpose, take the heat of birds, in a mass, at ten degrees more: a remarkable fact in itself, as the generating causes must be the same. The utility of this regulation is apparent, as far as the hatching of their eggs is concerned. This ought not to have happened under the atmospheric temperature, because the young might have come out in the absence of the parents, and failed: while it is probable also that the act of sitting preserves that continuous attachment necessary for rearing them, which such absence might have destroyed. And this evil might have occurred, had the heat of birds been no greater than our own, since this degree is not uncommon in hot climates: so that it has been wisely raised, as has the hatching temperature, beyond competition but from the most accidental occurrences of this nature. If this high heat is, as is thought, dependent on the greater quantity of air which birds respire, and if also, as is supposed, but not proved, their great muscular power depends on the same cause, then has the Creator, with that simplicity of procedure so

frequent in nature, gained many ends by one contrivance; since thus also, through the great capacity of the lungs, is the needful levity of the body ensured.

If this power of generating a high temperature is also a compensation for the cooling of birds under their rapid passages through the atmosphere, an additional one is found in their remarkably non-conducting clothing, still more conspicuous in the case of the sea birds: while it offers a remarkable contrast to that of fishes, where no such protection was wanted. Here also have the sensations been adapted to the implanted heat, reversing the law as to fishes in this case: as, even in comparison with ourselves, that which is enjoyment to birds would, to us, be a burning fever. But I need not pursue this subject through the other races of animals. The reader can bring to bear on this branch of adaptations, other details which he will find in this book, respecting the varieties and the changes of the clothing of animals, the diversities in their affections, or sensibilities as to heat or climate, their habitations, their hibernations, and their migrations: all these being balancing forces, of a partial nature, contrived by Divine wisdom, as corrective of properties and actions in the power of heat required for other purposes, or contingent on other uses, and which, without such compensations, would have been productive of evil.

If I already remarked that the constitutions, or the feelings and instincts, of plants had, not less than those of animals, been adapted to the arrangements, both as to light and heat, which depend on the constitution of the earth, the few facts which illustrate this are so familiar and obvious, that they deserve no more than a passing notice; as they are analogous to others in the

animal kingdom on which I have not thought it necessary to dwell. Such are, the astronomical year, to which are adapted the entire lives of the annual plants and the circles of action in the perennial ones, and such the different periods of summer in different parts of the globe, to which the instincts of the plants equally correspond, as we know when we change their climates without changing those, although some can alter their periods of action in conformity to those changes of place. Thus does the periodical sleep of plants conform, like that of animals, to the natural day; though in this case also they can alter their periods when the external circumstances are no longer the same. If, in a different way, their constitutions and affections are so ordered and varied that the one affects heat and the other cold, that some choose water and some the land, some prefer the sun and others the shade, that the sandy desert, the marsh, the dark forest, the bare rock, and endless places more, are the choice of others, all this belongs to one wide system of adaptation, planned at the creation, and executed with that wisdom which pervades the whole of the Creator's works. This subject too, like many more which I must pass by, would afford matter for an interesting examination: but I must trust it to the reader, who will find the needful materials in many parts of this book; as indeed the far greater number of the facts detailed in it can be brought to bear on the general views of the present chapter.

A far wider and much more intricate system of adaptations opens on us in turning our attention to those laws of matter which consist in tenacity, hardness, density, flexibility, elasticity, and gravitation. Established for useful purposes, they are also distributed in various proportions and combinations to the several

bodies of the universe, living and dead, so as to render them nicely adapted to their several uses : while if we consider the mysterious nature of those qualities, their inequality of distribution, separately taken, the endless combinations of proportions in which they exist, with the millions of substances and structures to which they are thus diversely allotted, so as to produce a variety of properties, which, while innumerable, are as constant as they are effective for the intended purposes, a system of adaptations is displayed, so complicated and profound as to bewilder the imagination. And if no time or thought could approach to the most remote conception of the ideas and intentions which must have previously existed in the Creator's mind, of the wisdom which laid down and executed these complicated designs, so is there, in the details, much that human knowledge cannot investigate ; while, of what we might trace, there is far more than a work like this can admit. Some detached remarks must therefore be substituted, as before : while, here again, the informed and reflecting reader, following the same path, can do for himself what the writer must omit.

Elasticity has been given to the atmosphere, as a property, for certain uses, but we can see no necessary reason why it should have been an exact counterforce to the gravitation of that mass or substance. It might have borne many different ratios : but the peculiar utility of the present law assures us that the adaptation was contemplated and executed by Divine wisdom. This gaseous fluid presses equally in all directions, while the useful results of this mode of action are too well known to require detail. When philosophy says that this is a consequence of its elasticity, it does not perceive that it is, perhaps unintentionally, dedu-

cing a necessity to set aside the contrivance and the designs of the Creator. Water is so slightly elastic that it has even been ranked among the non-elastic bodies, yet it possesses the same property. And when philosophy makes this a necessary consequence of a globular structure in this fluid, it ought to know that there is no evidence of such a constitution, and that if it existed, it would not explain the fact. But, without this property, water could not have formed the habitation of fishes; to note no more of its uses: it is an adaptation designed for the living creation.

The atmosphere might have possessed a less or a greater gravity. But, in either case, animals must have been differently constructed; as must plants, though not entirely for the same reasons. This is a case of adaptation, though I but indicate the general fact at present. Thus have the vaporability of water and the gravitation of the atmosphere been mutually adapted: while it would equally be to enter on too wide a field, were I here to note all that belongs to this extensive and complex subject. Similarly is there an adaptation between the gravity of this body and the velocity of the winds: while if I here confine myself to the supposition of a greater one, the extreme velocity of those must have been fixed at a lower limit, or else great additional weight and strength of structure must have been given to plants and animals, and, to the latter, additional muscular power, bringing on other consequences on which I need not enter. But, following the same plan as in the case of heat, I will here select that of plants as a specimen of details under this head, with the same intention of directing the reader's observations and reflections to the wider study of nature under the present views.

Though the uses of the winds have often been pointed out, I know not who has remarked on that beautiful balance of force and resistance by which the velocity of the atmosphere, or, uniting to this the appointed gravity of that body, its momentum, is kept within the bounds necessary to the safe existence of the vegetable world. It must not be said, as it has often been asserted of creation, that this limit of force was contingent on the constitution of the atmosphere and the moving powers, and is therefore a necessity, not the result of design. There are hurricanes, as permitted evils, or appointed variations for special ends ; and if they are among the usual exceptions to what we deem a perfect order of things, so do they prove that such forces might occur more frequently, or act perpetually, had it been ordained or permitted. But to have done this would have been to destroy the vegetable races, or else to demand the construction of stronger ones, endued with the necessary resisting power. And in this is seen the balance in question : it is an adaptation made in wisdom, not a chance ; while if we compare the apparent feebleness of structure so frequent in plants, with the extent of exposure and the enormous forces to which they are so often subjected without injury, we cannot fail to be interested in the facts, and in the means by which these compensations are effected.

Those facts are open to every one. There is no tree so large, no plant so humble and tender, as not to resist the strongest gales ; with exception of those rare excesses which form part of the appointed destructive powers of Creation. The tree is rarely broken, more rarely uprooted ; scarcely does it lose the tenderest branch, when bending for days to the blast : and even the leaf, attached by a slender stem, and destined to fall at no

distant day, defies the storm while its appointed office is required. The flexible and feeble rose-bush is tormented by the winds as if it would be dispersed in fragments, yet scarcely a petal is displaced till the time approaches when it would have fallen without a touch. It is intended that they should aid in scattering the seeds of plants: yet never perhaps was an unripe one detached by the utmost severity of the gale, tender as its attachment may be, tender as we know it to be in the case of the dandelion. No one, knowing the nature of these parts, in plants, and not knowing these facts, could have expected such resistance: it is only the experience of the cultivator which tells him, that neither will his cornstalk be broken nor its seed dislodged, by aught less than the hurricane or the whirlwind.

All this is effected with the utmost facility, not through strength but through weakness; by yielding, not by resistance. In lieu of that which could not be granted, the parts of plants have been endowed with flexibility and elasticity, in addition to such tenacity as was admissible: they are the corrective and compensating powers, and the result shows that the adaptation is perfect; while we cannot doubt the design, when we find that elasticity, one of the most beautiful and mysterious of the laws of matter, intended not only for evading force but for equalizing and continuing motion, is diffused through the vegetable world wherever it can serve this purpose, and nowhere else; effecting the ends in view, here as elsewhere, through the gradual instead of the sudden retardation of communicated motion. But, unable to bestow much space on illustrations, I must, as usual, confine myself to a few facts, so selected as to include many more, which any one can examine by using these for a guide.

Should a vane be fixed, it would be broken or bent by the storm: it is free to move, and in this motion it finds a shelter from violence. Thus also is a leaf empowered to place itself in a parallel to the stream of wind, and thence to defeat or elude its force; while the flexibility and elasticity of the footstalk enable it to conform to the most capricious and sudden changes; insomuch that there is scarcely an attachment so feeble as to be insufficient for security. To go through even a small part of the variations which occur in different plants, under this principle,—to show how, under different degrees of strength and of flexibility, and under differences in form and in the modes of resistance and escape, the desired end is always attained, would far exceed my limits: the student of nature may pursue this investigation through the whole range, down to *Nasturtium* (*tropœolum*), where the length and flexibility of the footstalk still form an effectual remedy, though the principle for the construction of a leaf and its stem are reversed.

If I have formerly shown how the shapes of flowers protect them and their essential parts from the force of the winds, the reader may examine how this protection is further dependent on the same principles applied to the footstalks, the branches, and even the stems in some cases; while a due research will discover many subsidiary contrivances for the same general end. If the herbaceous plant is low, that it may find shelter, or otherwise evade the winds, the tall tree is protected by some peculiar construction or qualities. The fir tribe is little flexible or elastic, because this would have interfered with the destined purposes of its wood for the uses of man; but, in compensation, its foliage is such that the winds can pervade it more easily than that of any other

trees. Under that of the oak it would have been destroyed: while this tree, reversely, opposing to the winds a solid mass of leaves, is strong both in material and form, although little yielding. The no less full ash bends to the blast through its flexibility, recovering by its elasticity, while its high tenacity constitutes the remainder of its protection. If the Cactus, Agave, and many similar plants, are neither tenacious, nor flexible, nor elastic, they are strong in form and in structure; the latter resembling that contrivance in bones, by which bulk is produced without weight, and strength without mass of materials. In the Vine, and in many more plants, in Bryony very remarkably, the tendril does not serve merely as a support; since in curling itself far more than is necessary for that purpose, it becomes a spiral spring, allowing the plant to yield to the winds, and restoring it to its place as their force passes away. It is almost superfluous to point out how the delicacy of the footstalks in the paniced grasses, added to the elastic flexibility of the whole stem, defends the flowers from any torments the storm can inflict: while interesting variations will be found in Aira, Agrostis, Briza, and others, with examples of elasticity in many more, not always exceeded by that of our metal springs. And if, in this tribe, the length and flexibility of the filaments afford singular protection to the anthers, independently of the more direct purpose which they serve in permitting their contact with the surrounding stigmas, so does the anther, almost everywhere, afford another example of contrivance subservient to this purpose, if to more, in that articulation which so far exceeds the ball and socket joint in freedom, that it almost seems as if no attachment existed. But while I must leave it to the reader to examine into many more special provi-

sions, destined to the same end, and depending on the nature, climate, place, or other circumstances of the particular plant, so can I but mention that one which, depending on the sensibility of the vegetable organization, is only called into action where it is wanted ; being displayed in the increased action of the tendrils, in the further spreading or growth of the roots, and in that general increase of strength which follows from exposure, very remarkably in the outer trees of a forest. It must suffice to have thus shown, that in this department of life the Divine wisdom has adapted the resisting powers to the injurious forces, through a great diversity of contrivances, and with a success as perfect as the general intention is unquestionable.

To proceed to another subject,—every one who has attended to the course of nature knows, that under irregularities which appear to us more capricious than anything else in the universe, and are the sources also of great occasional inconvenience, with much more alarm, the quantity of rain, in every part of the world, is, with a few peculiar exceptions, sufficient, and not more than sufficient, for the vegetation ; and also, under similar exceptions, that the average quantity in one place during one year, or perfected period of vegetation, is that of any other, or any number of those, notwithstanding our frequent expectations of the contrary, arising from irregularities in the quantities and the times. This very striking fact becomes much more remarkable when we consider the diverse modes in which rain is distributed to different countries or climates, both as to the quantities and the periods ; as in the case of the rains of India compared to those of our own country. And, under the present view of an adaptation between the wants and the mode of supply, the excep-

tions are even more remarkable ; as in the case of Egypt and that of the coast of Peru, where, in one case, the want of rain is compensated by inundation, and in the other by dews : as if, these being implicated consequences of the positions or circumstances, that more common supply of water which would have been injurious had been withheld.

Unable to enter on the details, these general facts must answer my present purpose. If we could say, of anything in nature, that it had been left to chance, we should say it of the rains, and far more decidedly than of the winds, since we find some of these at least to be under regular laws, and from assignable causes. Yet to suppose that they are not under government because they are not regulated like the sun, would be a bad conclusion in theology, as the facts in question prove it to be false in philosophy. Whatever be the modes adopted, or the secondary causes, an adaptation between the actions of the inanimate globe and the wants of its inhabitants is proved. On the necessity and uses of water to these, or on the mode in which it is produced from the ocean and distributed to them, I need not here speak ; but assured as we are that either excess, or defect, or great irregularity, would be pernicious or destructive, we can see that the wisdom of the Creator ought to have appointed some balance between the wants and the supply, as the result convinces us that He has done this.

In many cases, we can trace, to a certain extent at least, the contrivance ; the means by which corrections are made, and the details of a given adaptation. In the present, they are as yet concealed from us : but though piety united to ignorance might thence conclude that the Governor of the elements rules them to these

beneficial results by His own immediate will and agency, philosophy discerns enough at least of the train of actions to see that this great end cannot be gained without much arrangement; many checks, which it cannot discover, over laws which it recognises, and many unknown corrections of what it might deem the necessary course of nature. Thus may we ask why water evaporates, and through what agency, how it becomes air, wherefore it becomes mist, by what means that is converted into rain, why this conversion is not immediate and incessant, in what manner the evaporation is limited, and how it is confined to the production of definite average quantities of atmospheric water. Thus also, knowing the winds to be irregular, and even capricious to our experience, we must ask why and how they convey this water to the particular country or climate, in the needful proportions, and no more; and why, seeing the irregular distribution of the land compared to the ocean, with the similar irregularity of those mountains which aid at least in causing the descent of rain, that descent is so regulated for each country as the facts prove it to be. This, and more, may philosophy inquire of: while if its conclusion must be that which I have already drawn, so must it admit that the adaptation is good, if not absolutely perfect, where perfection was not intended; since seed-time and harvest have never yet ceased anywhere, and probably, as we have been assured of one land, never will.

If I designedly passed by that great example of adaptation which is found in the planetary system, I may here say that it might have been rendered equally effectual under a different balance of the several circumstances in which it consists, while I may put the easy case that the power of internal gravitation in the earth had been much

greater than it now is. But under those circumstances it would have attracted the loose bodies on it with a greater force, or their weights would have been greater than they are at present. If we suppose this power doubled, man, for example, could have carried but half the extreme weight which he now does, or supposing his muscular force to be the same, his own weight would have been an inconvenience to him, as he would, in many things, lose half his power, and also incur many accidents or injuries which he now escapes. If the same general results would have followed as to all animals, the consequences will be particularly striking in considering the elephant, created under the nearest approach to that limit of coincidence between strength and stress, which being past, the structure gives way from its own weight. What the numerous results would be in the inanimate bodies of nature and in works of art, it would be long to point out, as they are easily conceived; while it is equally obvious that in the case of the larger trees, the branches would have broken by their own weight, and while even a straw would not have supported the ripened ear, under a casual inclination.

Here there is a beautiful adaptation between the bulk, materials, and strength, both living and dead, of the inhabitants and the substances of the earth, and its own bulk and material, or the power of central gravitation allotted to its surface: while, little noted, it may perhaps be more striking if placed in another light. Could we visit distant planets at a wish, as romance has often dreamed, much more must be granted to render such wishes availing. He who could place his foot on the moon would no longer be what he had known himself: he might indeed carry greater loads, but, reduced to almost one-third in weight, a moderate gale might blow

him away : while, in Jupiter, he would feel himself oppressed by a burden considerably greater than the weight of his own body.

It is further obvious that, in animals, this adaptation is not limited to the materials and the mechanism, but includes that mysterious power which constitutes muscular force. We know that this force might have been far greater in the generality of animals, as it might have been less ; since it has been assigned to innumerable insects in a far greater degree than to the strongest of the quadrupeds. But while, in all, it is distributed in different degrees, according to their sizes, structures, and wants, so is it always adapted to the strength of the materials ; while these, as I have elsewhere shown, are endowed with a greater power of cohesion as the bulk of the structure diminishes, and while the force of the muscular fibre is also increased in proportion as the reduced size of the mechanism limits the quantity of this mysterious substance.

But it is not only in living beings that this adaptation has been made, since it pervades all substances ; while, could I here extend these views to the atmosphere and the waters, it would be easy to show how all their qualities and actions have been adapted to the weight or the attractions of the earth. But he who will meditate on that which I must omit as on that which will be found in this chapter, and who, as a mechanic or a mathematician, knows the difficulty of producing adjustments in the most common machine, will reflect to more purpose, for himself ; while he must not forget that never was a human machine produced without many trials and many failures ; whereas this universe, in all its endless complication, was perfect at its production, perfected in the ideas of its great Author, even from eternity.

To turn to some less abstruse subjects, we distinguish

between elastic and non-elastic fluids, yet assert that sound is propagated through air by means of its elasticity, forgetting that it is propagated even more readily through water. Reasoning on the present views, we ought to consider this as an attached property adapted to the organ of hearing in fishes. Thus has the respiration of atmospheric air been rendered a part of the chemical process for producing and maintaining the animal structure, and it is ordered that water shall absorb air. We can see no "necessity" in this case, and no other apparent purpose; while, in the animal, the corresponding part of the adaptation is found in the substitution of gills for lungs. The absence of colour, odour, and taste, from the atmosphere and from water, have been so often pointed out by writers on this subject, that I need not have noticed these facts except to remark, that in the former case at least, there is not a necessity, but a design for an adaptation; since the substances of which it consists form compounds possessing all these qualities in a high degree, as in the case of nitrous acid.

If I have already noticed, in a general manner, the balancing of forces in the case of the animal creation, none of the details is more remarkable than those which concern the structures of insects. Had they been constructed like quadrupeds, they could not have existed amid the world around them. They are therefore cased in armour, which, serving the purposes of bone as well as of skin, adds economy of materials and space to that strength which could not have been equally attained in any other manner: while, as I just remarked, the tenacity of these materials is increased, so as to be adapted to the indispensable augmentation of the muscular power. But where the several animal structures furnish the

most varied and abundant proofs of such a system, of the counteraction of external and internal forces by means of mechanical contrivance, tenacity, hardness, flexibility, and elasticity, I could not proceed far without repetitions which the reader's recollection of many other parts of this book ought to render unnecessary.

I formerly noticed the variations in the teeth of animals, with the uses of this knowledge in natural history; but the total adaptation demands some additional remarks in this place. If through their forms we discover the nature of the food, so is there a continuous adaptation in the general powers and structure and in the digestive organs, while the moral dispositions and the inclinations or instincts are also adapted to these. Yet in this has natural history, as usual, produced its false hypotheses; as I am bound to notice, since they oppose a leading principle in the Creator's plans. There is not that perfect chain of necessities which has been asserted. All carnivorous animals have not the same digestive organs, nor have all granivorous ones. The herbivorous are not necessarily hoofed, and all the hoofed ones have not similar teeth. The naturalist, whom I need not name, is forming a system of his own, not studying that of nature; and his attempt belongs to an ancient and false doctrine of necessities.

But the Creator, as I have often shown, gains the same ends in many different ways: variety is one of the modes in which He displays His power: and the naturalist who does not see this, has neither looked accurately into creation nor reasoned rightly respecting its Author.

There is a species of adaptation in the animal world which has often been pointed out by writers, and thence my notice of it may be brief. For different reasons, the

mouse tribe, the mole, the squirrels, and others, could not well have been larger animals : they are adapted in size to the surrounding circumstances and to their modes of life ; and if we examine the relations of climbing, burrowing, concealment, velocity, and much more, they will serve for a basis to investigations which I need not and cannot here pursue ; while the same will be found to hold good in the bird tribes, regard being had to their peculiar modes of motion and the different media in which these are performed. Thus also I need but point out the relative sizes of animals, with the ends thus attained, as in the often cited case of man and the horse ; while it must be left to others to examine into the crowd of mutual relations under which this great adaptation has been made, together with the uses which it serves in regulating the order and well-being of creation. While it is true, however, that our familiarity with facts like these and many more, causes us to view them as matters of no effort or contrivance, without wisdom as without plan, so does that familiarity tend to make us look, almost with contempt, on any endeavour to represent them as instances of profound calculation or design. A pernicious feeling, which an inquirer into creation is bound to correct, by pointing out what can safely be deduced, even on subjects the most apparently trifling, or by rendering them at least matters for his reflection.

Having already noticed some of the relations of plants to the arrangements of the earth, I might easily extend those remarks to the adaptations of their sizes, as in the case of animals, to the earth itself, to each other, to situation, climate, and much more, and further, to the relations of their products, in fruit, or seeds, to all these circumstances. But the scope is too wide : while if I

might also point out the peculiar adaptation of vegetables to animals in the case of food, I may refer the reader to what I have said elsewhere on the peculiar attachments of specific insects to plants as specific, on the joint powers and inclinations given to birds respecting their scattered and minute seeds, and to far more which I dare not there repeat; while the whole may merge in that great and wide adaptation which constitutes the system of feeding, discussed in another chapter.

This is, in reality, one of the most wonderful and perfect of the adaptations which the universe presents, and it is the more extraordinary the more it is studied; while assuredly the one, above all others, that could not have been neglected, when it is the indispensable foundation of all animal life and action. Nothing prevents me from going through it here, but that I have been compelled to treat of it in more than one place, for unavoidable purposes. Yet if I have, in one of these, put a problem of this nature in a parallel with the demands on the contrivance of a human guardian of animals, as I might have compared it with those on the commissary of an army, the whole system under which the world of animals is fed is a subject for the consideration of the philosopher in political economy. He must, however, study it well and deeply: and when he has done this, he at least will not be the man to doubt that it was all contrived and arranged by an intellect before which the thought and study of his life shrink into nothing. It is a magnificent problem, solved in a manner which, even where we best see it, is nearly incomprehensible; so perfectly solved in all its intricacies, and solved or ever, that we as little doubt of the future as the present though far too generally forgetting that there was any difficulty, any problem to be solved.

But if it should be objected that no such arrangement or adaptation exists, if it is said, as it has been, that food was produced in one mass and animals in another, the latter being suffered to act as they pleased, and to feed themselves as they thought fit, or could agree, while also breeding as they found food, and ceasing to do so when they did not, so as to produce a gross compulsory balance or adaptation, the objection is that of ignorance. It may indeed be that of what is sometimes called political economy, but it is not the answer of an informed and a philosophical economist,—of him, the one among hundreds, who deserves this name. The mutual adaptations of the means or powers of animals, of their inclinations, and of the food produced, form an absolute reply. The system is minute, and minutely perfect; while the multiplicity of its parts is beyond investigation, or even enumeration. It is he who, with the most extensive and intimate knowledge of natural history, combines the habit of economical investigation and reflection, if such a combination there be, who will think most correctly on this subject: and he who can thus contrive to see what this adaptation is, will require no other evidence of the wisdom of the Deity.

The inclinations of different animals to particular sorts of food, and the mental exertions, be these instinctive or rational, through which they contrive to obtain the desired objects, form but a small portion of the total adaptation between the moral and intellectual faculties of the animated world, and the inanimate objects and powers by which it is surrounded. Deserving a place under the present views as this does, I must pass it by, because it demands far more space than I could here allot to it. As it concerns man alone, that

which it might occupy would be a treatise rather than a chapter. With respect to the inferior animals, this book contains much that a reflecting reader can easily bring to bear on this question, but which I could not collect for that purpose without far more repetition than is admissible : and if I name the chapter on the limitations of animals as one of these portions, he will easily see how much more of what is here written may be contemplated under the same light. Thus also, in numerous detached remarks, elsewhere made, on the conformity of the desires and the will in animals to their allotted powers, will he find the materials of what he may arrange and expand into a system of designed adaptation between the passions, the will, and the intellect, while I have taken occasion to note the adaptations, with the wisdom and goodness by which they have been made, wherever these subjects have occurred.

In reality, there is but little of what this work contains which might not have been viewed in the present light, and thus have taken its place, if not in this chapter, yet in a treatise with a similar title. The whole of creation is a system of adaptations ; and the ultimate adaptation of all the substances and powers in nature is to the existence and the well-being of the animated and sentient world, as I have already remarked. This then should be understood, without being specifically urged, of much that has preceded and of much more that follows this chapter. The supply of water, and that of soil to plants, involve two very complicated trains of the most ingenious adaptations : the chemical round of respiration between plants and animals implies another, as does that of food and decomposition, of life and of death : while the different chapters on uses and pleasures scarcely require the addition of the

term adaptation to render them demonstrative of the same general design. And thus of far more ; while under the original limitation of this work, I have confined these views to the physical world and its arrangements, and to the more striking bearings which these have on the sentient or moral creation. The moral world beyond this, is the mind of man : but the field which it opens is too vast to form a portion of a work so multifarious as the present, as it has been excluded by the very plan. That in this also there is a definite design, with a system of adaptations, perhaps even more profound than what we have already seen, we must conclude from the character of God and the importance of the object ; while, obscure as it yet is, we see enough to confirm this *à priori* belief, and to assure us equally of the beneficence and wisdom with which everything has been ordained. But whatever may have been hoped or attempted, we trace but fragments : nor, let the vanity of hypothesis and the self-confidence of system think as they may, can a rational philosopher expect aught but a repetition of assertions, obscurities, and disputes, while the true anatomy and physiology of mind remain unknown.

If this chapter has drawn on materials that have been used elsewhere, the witness who has proved one fact may be examined to prove another ; and while I could not dispense with the present view, I must even regret the shortness and slenderness of that which serves to display the thought, the consideration, and the wisdom by which opposing properties, powers, and actions have been so arranged and balanced as to produce a good result, by which the incalculable complications of the universe of materials and motions, of matter and of mind, have been so mutually adapted as to produce the desired results, and those results good.

But while this leads to the great conclusion which I need not for ever repeat, it calls for a remark which, if elsewhere made when treating of varieties of form in creation, should be even more convincing here, under a view of the arrangement of actions in the universe. It refers to the hypothetical assumption of simplicity, so often asserted of the proceedings of the Creator, though contradicted at every step by the plainest facts. And when held up by writers as a cause for admiration, it is not simply censurable because it is untrue, but because, by encouraging indolence of inquiry and resting on ignorance, it impedes a just estimate of universal power and wisdom.

A very slender consideration of the preceding facts respecting heat, for example, will show that so far is the needful balance preserved in a simple manner, that it implies a collection of checks and counterchecks, corrective of each other, and not unfrequently placed in actual opposition. This is indeed beauty, as it is wisdom; but it is not the beauty of simplicity. That the Creator's wisdom is often shown by simplicity of contrivance, is unquestionable: but to base it on that alone, is to take a very narrow view of this attribute, as it is, demonstrably, to take a false one. And if I have selected but a single instance as an example, there are other cases, almost beyond numbering, where it is equally displayed by multiplicity of contrivance, by compensation and correction; of which the present chapter and many more will afford ample proofs. Had it not indeed been so, there are many chapters besides the present which could never have been written: and it will more than suffice, though I should but allude to the plans for the dispersion of seeds and for clothing the naked earth with vegetation, to the process

contrived for ultimate nutrition in animals, to the different modes of motion assigned to them, to the various inventions for their self-defence, and to the complicated multiplicity of organs in a *Beroe* or an *Asterias* compared to a *Medusa*: while he who can continue to maintain the hypothesis of simplicity, must be strangely forgetful of the complicated actions of chemistry, or, if ignorant of them, ignorant also of the tedious and intricate process through which the globe of the earth has been rendered what it is,—through which even coal has been made and stored up for the uses of man.

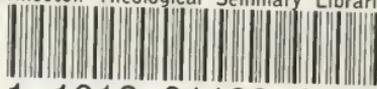
To conclude this division of the present work, in concluding this chapter: if I would rather not believe that there are atheists, there are, at least, philosophers who do not think of a designing and wise Creator, who never concern themselves respecting such a Being or Cause. Yet that tacit acknowledgment which they do not or will not make in words, is for ever forced on them. Their sagacity is perpetually exerted in tracing design and wisdom, and their pride is to have discovered what they had been seeking; they search, and when they have found, they produce the discovery as a proof of their own wisdom. They labour in the investigation of a design, and they are proud when they can detail that which they neither planned nor executed; as if, to have found it, was to have been capable of the invention and the execution. They seek for ends and uses; and they boast of having seen the means and the end, as much as if they had intended the end and invented the means. They do right; for it is an honour to human intellect to have succeeded in all this: wisdom and sagacity alone can discover what it required wisdom to plan. Yet he who boasts should not forget that there was a Wisdom which anticipated his own,—that had there not been a

Sagacity which planned, his own sagacity in tracing the execution would never have appeared. They have ably analyzed and criticised the work of a great Author: but, like the critics of human works, they forget that but for Him and His talents they could never have found the means of boasting of their own; nay, that it is He, the criticised, who has taught them what they know and how to think; who, in giving them His works to study, has also given them the power of observation; and who, in permitting them to trace His wisdom, has conferred on them that emanation from His own which was necessary for its investigation. Let them never cease to remember, that whatever is, was executed by Him, and that what He has performed, He planned; that they are but students; and that, in their pride of assigning the wisdom and the design, they ought not to overlook Him, the Designer and the Wise, their own designer, and the great Being who gave them the power of knowing Himself, their God.

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