Metaphysical inquiry into the method, objects and result of ancient and modern philosophy / By Isaac Preston Cory.

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INTO THE METHOD OBJECTS AND RESULT OF ANCIENT AND MODERN PHILOSOPHY

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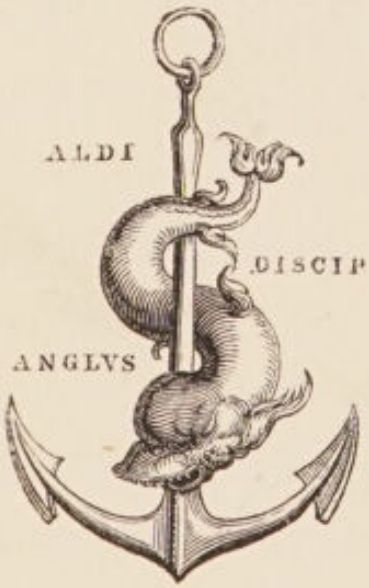

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METAPHYSICAL INQUIRY.

THE revival of literature in modern times was slowly followed by the introduction of a better system of philosophy. In some branches of literature we have not surpassed the ancients, and in their philosophy perhaps there are some points, which, even at the present day, may not be altogether unworthy of attention.

To Lord Bacon the philosophic world justly looks up as the father and founder of modern science. Yet we have, in many respects, unconsciously departed from his instructions, and have arrived at conclusions directly the reverse of his. The differences which occur are not such, as, in the infancy of science, might have es-

caped his notice ; but they arise on points, which had been ably discussed before his time, which he had himself examined and scrutinized with the deepest attention, and which he at length admitted from the philosophy of the ancients as principles satisfactorily established.

In the following Inquiry into the Method, Objects, and Result, of the Ancient and Modern systems of Philosophy, I have no intention, nor would I presume to set them in array against each other : but have endeavoured patiently to examine the foundations upon which they rest, and to draw from the great storehouse of antiquity some speculations, which have been too generally slighted or overlooked by the Metaphysician and Philosopher, but which seem to be of such practical utility, that they may tend to the advancement of science, even amid the brilliant discoveries of modern times.

If we were to ask, what was conceived

to be the great engine of invention and discovery among the ancients, it is highly probable we should be answered that it was Syllogism. And if we were to ask the same question relative to modern science, we should be unhesitatingly assured that it was Induction: and, possibly, at the same time we might be told, that the method of the ancients was something worse than useless. Yet, when we consider, that human nature is the same, and that such admirable productions have been the result of human effort both in ancient and modern times, we shall find reason to suspect that the methods of discovery, or the tools really used in all ages, have been much alike, though their names may have been misapplied, or they may have had no distinct appellations assigned them.

By the INDUCTIVE METHOD we are supposed to go about to collect, by experiment and observation, all the facts

and circumstances within our reach, relative to the subject in hand. We must examine them in every light, compare their similarities, and mark their differences; we must reject the particulars that are irrelative or negative; and conclude upon the affirmatives that are left. By these means, from the individuals we rise to some general proposition, and we rest assured of its truth as proved by Induction.

To take a common instance: a child that has been burnt by a flame, is afraid of the *same* result from the *same* cause; and such fear or expectation is said to arise from experience: and in the expectation of the *same* result from *similar* causes, he is said to reason by a species of Induction, though not founded on an enlarged experience. But by trying experiments upon all objects which have the appearance of flame, he learns to distinguish such as are hurtful from such as are otherwise, and excluding

those that are harmless, he arrives at the conclusion, that all such objects of a particular kind are hurtful.

Now, in this statement of the process, it appears to me that two very different instruments are used: the first of which seems to be Analogy, ἀναλογία, a *reasoning upwards* from the known to the unknown, the great instrument of Invention and Generalization, which provides, as it were, subjects for the exercise of Induction; which Induction, ἐπαγωγὴ, seems to be rather the collection and examination of experiments, and the drawing a conclusion from them; and as this conclusion cannot be extended beyond what is warranted by the experiments, the Induction is an Instrument of Proof and Limitation. A person, that has been burnt by a flame, feels certain that he will be burnt again, if he try it; he argues only from *same* to *same*, and is said to be sure of it by *experience;* and it is upon this constant expectation that all physical

science is *founded*. By *analogy* he argues that all flames will burn him, he argues from *like* to *like*, he generalizes and draws an *inference;* and I conceive it is by this analogical reasoning that all science is *advanced*. The inference which he thus draws *a priori*, is merely an *hypothesis*, ὑπόθεσις, a *supposition*, probable indeed, but far from satisfactory. But when he brings it to the test of induction, and collects experiments, he either confutes or proves this hypothesis, or limits it to something not quite so general.

This analogical reasoning, when it is extended only from individual to individual of the same species, is commonly called *experience*, and not *analogy;* and from the perfect uniformity of nature, perhaps not improperly: thus, we say, we know by *experience* that all stones gravitate to the earth. But when we extend it from species to species of the same genus, it is *analogy*, properly so called. If from the gravitation of all stones we reason to

that of earths, we reason by analogy, from like to like : we obtain a probable *inference*, not satisfactory till experiment be directed successively to individuals of the different species of earths, and thereby the *inference* converted into a *conclusion*. Having thus included earths as well as stones, we may proceed from one species to another by the same process of analogy and proof, till all bodies upon the surface of the earth be included under the general law of gravitation, whence we may rise to more general propositions. I am inclined to think that such has been the common process of discovery in all ages of the world.

When Sir Isaac Newton, from the fall of an apple, was led to the consideration of the moon's gravity, he is said to have made the discovery by Induction ; which is true as far as the proof of it went. But, it is manifest, that, at first, he merely formed a probable hypothesis by Analogy, and then laboriously brought it to the

test of observation; and it is highly probable that the hypothesis he formed was, that the moon gravitated to the earth with a constant force, instead of a force varying inversely as the square of the distance; which was the result of another hypothesis, suggested by the elliptic orbits of the planets, and the force necessary to confine the motion of a *projectile* in such an orbit.

When Harvey observed the valves in the veins, he is commonly said to have made the discovery of the circulation of the blood by reasoning from *final causes*, or by asking of nature for what purpose such valves could be intended: but, perhaps he might have asked the question for ever, unless the resemblance between the valve of a vein and that of a pump had suggested a plausible hypothesis, in which he was confirmed by repeated experiments and observations directed to the point.

Analogy, so much slighted and over-

looked, and to which such an inferior part in the advancement of science has been assigned, and that too with so much suspicious caution, appears to me to be the great instrument of generalization and invention, by which hypotheses are supplied, which are most commonly the subjects that call for the exercise of Induction. By Induction, as usually understood, we make it a rule to exclude all hypotheses: first of all, we collect the experiments, and, having obtained these, we are next to examine them and compare them; we then reject the irrelative and negative, and conclude upon the affirmatives that are left. By this means, says Lord Bacon, we question nature, and conclude upon her answers: yet I would venture to suggest, that, ninety-nine times out of a hundred, the Analogy or comparison precedes the collection of the experiments: some resemblance is observed, some hypothesis is started, which is the subject that is brought to

the test of Induction. By this the hypothesis is either proved, or confuted, or more commonly limited to something less general.

I would not be understood to assert that the common inductive method is barren; for, no doubt, discoveries might be so made; but I really question whether a discovery was ever made according to its rules, which the discoverer had not, in his own mind, anticipated by Analogy as an hypothesis long before he had completed his investigation, and indeed guided his investigation by it. But, however that may be, it must be admitted, that thousands and thousands of discoveries are made and inventions brought into play, the result merely of analogy and a few experiments, or very commonly of a single experimentum crucis. By the common method proposed we take too wide a range, we embrace the whole subject at once, and require the completion of its natural history; but by

the proper use of analogy as a guide, we step cautiously but from one species to the next.

Induction has two instruments of operation; EXPERIMENT for all things within our reach, and OBSERVATION for such as are beyond us. And of these Observation is less efficient than Experiment; for in all Experiments Observation is involved: but in many investigations Experiment is not attainable, and we are reduced to Observation only, because we cannot use Experiment. Now by Induction *without* Analogy we first ask innumerable irrelative and impertinent questions of nature, and then make use of Observation upon the experiments in hand; but by Induction *with* Analogy we try experiments or observe for a specific purpose, and obtain specific answers to the point.

Having thus obtained a general law or fact, or cause, for an entire *genus*, we may proceed in the same manner from

this genus to the next, till the whole *order* be included under the same or some more extensive generality: thus at length we may arrive at certain most general laws, or phenomena, or causes; beyond which it may not be within our power to proceed. To arrive inductively at a generality it is of course requisite to have in hand a most extensive collection of the facts or particulars, which must be all included under it: and Aristotle, no less specially than Bacon, insists upon this preliminary. The only question is, whether in reality we do not ascend to an extensive generality by a series of particular conclusions, by successively reducing each fact or individual under some general law, conceived *a priori* by Analogy from some single instance, instead of deciding at once by a formal and comprehensive survey of the whole.

The progress of science in the ascending scale consists in rising from Individuals to Generals and Universals.

Having established these generals and universals, from them we may extend discovery in what may be termed the DESCENDING SCALE: and here Syllogism, in its common acceptation, has its use. And, as an instrument of invention, Syllogism may in this case supply corollaries; as in the former, Induction might yield discoveries without the help of analogy. Yet a very slight consideration will show, that here also Analogy is the great engine of invention, by which hypotheses or suppositions are supplied; and that in the descending scale Syllogistic Demonstration, as Induction in the ascending, is the grand instrument for confuting, proving, or limiting those hypotheses.

But it is said, that, among the ancients, SYLLOGISM was the great engine of discovery. If we examine this matter, we are informed by Aristotle, that Syllogism is a *discourse* or reasoning, in which, certain things being admitted or supposed,

something different from these admitted principles or propositions, necessarily follows, in consequence of their existence.* He tells us, likewise, that Demonstration is a species of Syllogism.† Now it is really of no consequence whether a syllogism is composed of two, three, four, or any number of steps; and, indeed, every mathematical demonstration by synthesis is no other than a chain of Syllogism. If we inquire further of him, how the first principles of all philosophy, and every art and science are to be obtained, from which such demonstrations may depend; he expressly informs us by *Induction*,‡ by collecting together all the in-

* Συλλογισμὸς δέ ἐστι λόγος ἐν ᾧ τεθέντων τινῶν, ἕτερόν τι τῶν κειμένων, ἐξ ἀνάγκης συμβαίνει τῷ ταῦτα εἶναι. I. Pr. Anal. 1—Edit. Casaub. 1590. N.B. there is a great variation in the numbering of the chapters in the different editions of Aristotle.

† I. Pr. Anal. 1.

‡ I. Pr. Anal. 30—II. Pr. Anal. 1. 23—I. Post. Anal. 1. 10. 14. 18—I. Top. 7—VIII. Top. 1—VIII. Phys. 4—IV. Meteor. 1.

dividuals, and drawing the conclusion from them. His logical treatises, indeed, being entirely directed against the sophists of that day, relate solely to syllogistic demonstration. Of course, therefore, he does not investigate the method of obtaining the universals themselves: but he speaks repeatedly of it, that is, of Induction, as the well known and familiar method of obtaining them, through the *senses*, by *experience*.* He clearly explains to us the progress of science, both in the ascending and in the descending scale.† We learn, says he, only by Induction or Demonstration; by Demonstration from universals to particulars, i. e. in the descending scale; by Induction from particulars to universals, or in the ascending scale. Hence a person, who is defective in any of his senses, cannot use Induction, and therefore can-

* I. Pr. Anal. 30—I. Post Anal. 10. 15. 27—II. Post. Anal. 18.

† I. Top. 10—VIII. Top. 1.

not theorize to universals, or by abstraction obtain general propositions: hence, also, his progress in the scale of demonstration must be equally defective with his data.*

If we turn to Plato, he throws a new light upon the method of investigation, by requiring some previous hypothesis† or idea for examination; and, in the beginning of the Parmenides, lays down the Eleatic or Dialectic method of examining it. The method is this—Either, I., The subject *is*, as it is supposed; or II., it *is not*. On the first supposition that *it is* so, we must examine *what happens*—1st. To *it* with respect to *itself:* 2d. To *it* with respect to all *other things:* 3rd. To all *other things* with respect to *it:* 4th. To all *other things* with respect to

* I. Post. Anal. 15. See also the preceding references.

† Aristotle uses the word thesis for hypothesis in this sense. His dialectic also differs from that of Plato

themselves. Four similar cases will result when we examine what *does not happen;* and, according to the exposition of Proclus, four more, when we examine what *does, and at the same time does not, happen.* Upon the supposition, therefore, *that it is so,* we must investigate its relations in all their bearings; and we must pursue the same method of investigation upon the second supposition, that *it is not so.* And if, in so doing, we were guided according to certain categories, a more thorough investigation could not possibly be devised: and the method is equally applicable to Experimental philosophy as to Intellectual science.*

The ancients, then, professed, in the ascending scale, to work by Hypothesis and Induction; and, in the descending scale, by Syllogistic Demonstration or Deduction from first principles or propo-

* For a method of starting ideas for examination, see a curious description of Socrates, with his hopeful pupil, in the Clouds of Aristophanes.

sitions, inductively determined by *experience* upon the evidence of the *senses*. If, then, as it is commonly asserted, the Syllogistic method was held to be their only method of discovery, though I am not aware that such was indeed the case, and the method was a process of reasoning from known to unknown, I conceive that, in this respect, the terms must have a more comprehensive signification than is generally allowed.* I can find nothing, however, to warrant the supposition, that they accurately divided their method into Analogy and Induction in the ascending scale, and into Analogy and Demonstration in the descending scale. They seem to have imagined that by their method they went precisely to the point, and no further, instead of often going

* Some papers, entitled Vindiciæ Antiquæ, in the Classical Journal, throw some light upon these subjects, though I cannot concur with the author of them in his opinions of the perfection of ancient science, much less in his abuse of modern philosophers.

something beyond it by too extensive a generalization, as we are led by analogy, and then retreating to the point determined by the proof; which is a mistake that has equally prevailed in modern times.

LOGIC or FIRST PHILOSOPHY is the science, to which these subjects belong.

In the CATEGORIES, which the ancients used, they endeavoured to comprise the relations of all things to themselves and to one another. The categories of Aristotle are deficient. Those of Kant are more comprehensive indeed, but are much less applicable to ordinary physical investigations: they are likewise imperfect, and in some respects redundant, and even repetitions of one another. Yet, if due attention were paid to the subject, I believe the categories might without much difficulty be supplied.

DEMONSTRATION is the *concatenation*, the *chain of reasoning* by which a pro-

position is connected with its principles or data. And not only in the descending, but in the ascending scale, we are frequently under the necessity of calling in logical assistance for bringing our hypotheses to the proof.

MATHEMATICS are a branch of logic, more particularly applicable to the philosophy of matter, inasmuch as Number, Quantity, and Measure, both in Time and Space, are the peculiar subjects of that science. And many physical hypotheses are started, which cannot be examined without a most accurate admeasurement and an extensive knowledge of mathematical science: and the proof or disproof of them can thus only be exhibited. But mathematics are not the only kind of logic employed in philosophical, or even in physical research: and I conceive that Playfair's idea of the subject, in supposing such to be the case, is but partial, and wants something of the generality of the ancients. The connect-

ing chain, for instance, among the propositions of moral and metaphysical phenomena, is a different species of this same logic; but, number, quantity, and measure, having little to do with those sciences, mathematics must, from their very nature, be almost wholly inapplicable. An undue regard to mathematics has often been productive of very serious inconvenience, and of grievous mischief, when brought to bear upon those sciences: and, sometimes, even in physical pursuits much misconception has resulted. A mathematician can rise no higher than his data; and, eminently useful as his science is, not only in the descending scale, but in the examination of hypotheses, it is not within its compass to prove any *simple* physical proposition or first principle. All the mathematical proofs of the parallelogram of forces, for instance, are vicious, and merely arguments in a circle. Like all other sciences, Mathematic must depend upon

its own first principles: and its axioms are only general propositions raised upon individual, by induction. We know that things equal to the same are equal to one another. It is no innate scrap of knowledge; nor need we have recourse, with Plato, to a pre-existing state in which we learnt it. We know it only inductively from observation of the particulars, and it is absurd to suppose, that, in the demonstration of any proposition, we admit the *particular* by virtue of the *axiom*.

The origin of THE UNIVERSAL AND NEVER-FAILING EXPECTATION, that the same or similar causes will always be attended with the same or similar effects, an expectation upon which all physical science is founded, has been a subject of the ablest controversy. Hume denies it to be the result either of Experience or of Reason. 'It is not the result of Experience,' says he, 'for Experience is only of the *past*, and cannot pos-

sibly extend to the *future*. If it be the result of Reasoning, produce the chain of Reasoning, which connects the two following propositions with one another; *I have found that such an object has always been attended with such an effect*; —(therefore) *I foresee that other objects, which are in appearance similar, will be attended with similar effects*. If there be any chain of reasoning between them, it is evidently not of the *demonstrative* kind; because the converse is equally conceivable. It is therefore of the *probable* or *moral* kind. Now all probable reasoning relates only to *matter of fact* or *real existences*. And all arguments concerning existence are founded on the relation of *Cause and Effect*. Our knowledge of that relation is derived entirely from *Experience*. And all Experimental conclusions proceed on the supposition, that the future will be conformable to the past. To endeavour therefore the proof of this last supposition by pro-

bable arguments, or arguments regarding existence, must be evidently going in a circle, and taking that for granted, which is the very point in question.'

Such is the difficulty, respecting the very foundations of our knowledge, which is proposed by Hume. He attempts to solve it by attributing the Expectation to mere *Custom* or *Habit*, which he conceives may be ultimately referred to some instinct, or *mechanical* tendency. Reid, as usual, has recourse to an innate sense, instinct, or principle of our nature: and Brown appears to acquiesce in the same solution.

The principles of connexion among our ideas, according to Hume, are *Resemblance*, *Contiguity* in time and place, and *Cause and Effect*. They have been more justly stated as *Resemblance*, *Contiguity* in time and place, under which the relation of Cause and Effect may be reduced, and *Contrast*. The ideas of men flow in trains of thought, connected by

some one or other of these three primary principles. Now, in the argument of Hume, a fallacy seems to lurk under the proposition, that 'all *probable* or *moral* reasoning relates only to matter of fact, or real existence, and is therefore founded upon experience.' The first time a triangle, suppose an equilateral triangle, was presented to us, we had no conception of its properties. By attentive consideration we might *demonstratively* acquire the knowledge, that the sum of its angles is equal to two right angles. Now if another triangle, nearly similar, suppose an isosceles triangle, were presented to us; if we took it into consideration, I conceive, that, from our knowledge of the properties of the other, we should *a priori* suppose or infer, as an hypothesis, of this triangle also, that the sum of its angles was equal to two right angles: and such an inference would have nothing whatever to do with Cause and Effect, and the truth, from which it is

inferred, was not obtained by *Experience*,* but by *Demonstration*. In like manner, if a Circle were first presented to us, and then an Ellipse, we should, probably, before we paid much attention to the peculiarities of the ellipse, infer that its properties were the same with, or similar to, the properties of the circle: or, if our genius were of that turn, which is more taken with Contrast than with Resemblance, we might infer the contrary: and in either case an hypothesis would be inferred, and probable reasoning introduced. With respect to the triangle, our inference or hypothesis would be correct, and might be proved by *demonstration*. With respect to the ellipse,

* We might, perhaps, say, 'Knowing the properties of the equilateral triangle by *experience*, we infer, &c.' But it is only the ambiguity in the word experience, that requires to be exposed. The truth was not obtained by Experience, neither is the inference drawn by Experience, in the sense in which Hume uses that word.

our inference would be incorrect, and might be refuted by *demonstration*. These arguments *a priori* are analogical, and only probable, and by them the hypothesis is inferred directly, without need of any other intermediate chain of reasoning. They have no reference to matters of fact, or real existences; nor are they founded upon the relation of cause and effect, nor do they depend upon experience. It is not true, then, that all probable or moral reasoning depends upon experience.

Again, if a cause should be presented to our notice as about to operate, with which, hitherto, we had been utterly unacquainted; it is universally admitted, that we should not have the slightest conception of what would be its effect. And, if all the possible effects were set before us, we should be equally at a loss to guess which of them would result. But if the same cause were a second time presented to our notice as about to operate; and if,

having observed its result in the former instance, we were again to consider what its effect would probably be, this second time; we should lie under the same complete ignorance as before, with one exception, that is to say, the effect which was its former result: and with this exception, we could have as little hope of guessing* as we had at first. The only well founded expectation, then, that could possibly arise, that is, the only plausible

* The doctrine of Chances applied to Moral, and Metaphysical, and even to Physical reasoning, has been driven to such a length by some of the ablest Mathematicians, and so thoroughly abused, that I am afraid it needs some apology for introducing it; especially as it commonly involves within itself a glaring fallacy, and is, as Euler observes of the *Sufficient Reason* of Leibnitz, only a very ingenious method of setting up our ignorance as an instrument to ascertain, and a standard to judge of truth. In the above argument, however, I *hope* I have drawn the true conclusion; yet upon the doctrine of Chances only, I scarcely see any *sufficient reason* why the *chance* is not infinite to one against the same result following the same cause twice alike.

hypothesis we *could* frame, would be 'that the same cause would be attended with the same effect.' So far it would only be an hypothesis for examination: every successive trial would confirm us in our belief; and when upon an induction coextensive with our knowledge, we met with no single exception, we should justly *learn* to regard it as a general law; liable nevertheless to be limited by any future exception, which might thereafter be produced. I see no necessity to produce a chain of reasoning to account for the primary supposition, or for any supposition whatsoever. As, in *demonstration*, we *intuitively* perceive the relation of equality, so, in *probable reasoning*, we *intuitively* perceive the relation of resemblance. And if, in establishing the first principles of demonstrative reasoning, we infer that the properties of things equal, are equal or the very same; so in probable reasoning we infer that the properties of things similar are similar.

And, in both cases, these inferences are established or refuted by Induction. The first step in each proceeding is an hypothesis, inferred by analogy from a preceding truth or fact. In the first set of examples, I have taken, it is confirmed by Demonstration, from principles admitted or gathered inductively by intuitive *Observation:* and in the second, it is gradually strengthened by *Experience.* What is common in the foundations of the two different cases, is not the relation of *Cause and Effect*, which is confined solely to the last, but it is *Resemblance.* The general law, whose foundations are disputed by Hume, seems to be established precisely in the same manner as is every piece of knowledge we acquire.

The error of Hume, then, appears to me to spring from a contracted view of the subject; in supposing that all probable or moral reasoning is founded upon one single relation, that is to say, upon Cause and Effect, which, so far from being

of a general nature, is itself, in this respect, comprehended as a species of *Contiguity:* whereas he should have extended his view, so as to have embraced all the three primary principles which, as it were, connect and regulate our trains of thought: upon the relations of every one of which, I conceive, that, probable reasonings and analogical* arguments are continually based.

ANALOGY can hardly be called Resemblance or any species of Resemblance as it is ranked by Brown; but it is a kind of argument, a probable argument founded chiefly upon that relation. And it is also manifest, that the very

* As the word Analogy is not necessarily, though it is commonly and even anciently, connected with Resemblance alone, I see no reason why a probable argument, founded upon either of the other relations of Contiguity and Contrast, should not be termed *Analogical*, especially as all the three principles are probably reducible to one and the same, viz. that of Contiguity.

common restriction of the word *hypothesis*, to imaginary *causes* only, is incorrect, and springs from the same error which would confine probable or moral reasoning to the relations of Causation.

The great ABUSE OF ANALOGY is resting in its hypotheses, without bringing them to the test, building systems upon such hypotheses, and bending the facts to their support. Of this, the Timæus of Plato exhibits a curious example. He professes in that discourse to philosophize by λόγοι εἰκότες, which may be translated analogical reasonings, alone: and this dialogue, no less than many of the physical treatises of Aristotle, is a proof how little the ancients were in the habit of attending to the excellent rules of investigation, which they had themselves laid down.

An ascertained fact, or law, or cause, is like a centre or a stem, from which many hypotheses branch forth on all

sides, varying according to the different resemblances, which the different objects or genera bear to one another. One only of these hypotheses can be the truth: but each of them, if assumed, becomes another centre or stem, from which as many more hypotheses proceed: and such is the case ad infinitum. The chances of error, therefore, increase in a very high geometrical proportion, whose ratio of course must be indefinitely variable, so as to include all the possibilities. A single hypothetical step into the regions of discovery we may, *probably*, make aright, but it is not to be depended upon, till it is proved: and the chances are very much against it. Nevertheless, we may, *possibly*, even make a second step into these unknown regions without proving the first: but the chances against it are prodigiously multiplied. And any attempt at a second step, before the first is proved, is a false method of proceeding. It is like false heraldry,

laying colour upon colour. The colour can only be blazoned on a metal, nor ought an hypothesis to be laid but upon the sterling basis of a truth. When we make a step into these regions of imagination, a new field is opened to us, presenting us with explanations of phenomena and objects of attention, which we had never before conceived, each inviting us to make another step; and so delighted are we with the wide and fair prospects before us, that we are apt to forget that we are but in the fields of imagination, and that it signifies but little, which hypothesis we had assumed, which path we followed, as all of them open to us prospects as delightful, as they are visionary. It is a fault and an abuse, almost equally to be imputed to modern as to ancient philosophers.

Another abuse of Analogy is arguing from individuals to genera, or from *gĕnus* to *genus*, when these genera are too remote; which is skipping to *generalities*

instead of cautiously proceeding from *species* to *species:* not that it is of very material consequence, save only, that, the difficulty of the proof being increased, an hypothesis, so obtained, is apt to be received upon insufficient grounds.

But the most dangerous abuse of all is arguing from Matter to Mind, of which, as well as of the kind of similarity that exists between them, I shall have occasion presently to speak more at large.

I would observe, also, the great laxity in the significations of the word THEORY. It is sometimes used for a general law or principle obtained by Induction, and as something almost synonymous with hypothesis: in this view it might be looked upon as a proved hypothesis. In its other and more general signification it implies the whole system or chain of reasoning from general laws and principles, and sometimes the result of such

a chain. Its real signification seems to be the Survey itself.* In the descending scale the result of the survey is termed a Theorem, θεώρημα: and in the ascending scale the general law obtained, the result of the survey, might perhaps likewise be termed a Theorem: whilst the Theory, θεωρία, the Survey itself, may be taken for the whole system or chain, which, as it proceeds, every now and then, as it were, deposits these theorems.

An HYPOTHETICAL SYSTEM differs from a Theory, as does an hypothesis from a general law or fact; and is dependant upon Hypotheses instead of Facts; and its productions are of the same description. But it must be remarked, that the productions of such systems, that is to say, *Hypotheses deduced*, are, of all other hypotheses, the most susceptible of error; inasmuch as they embody all the hypothetical un-

* See an excellent paper upon the subject in Blackwood's Magazine, August, 1830.

certainty of the data in one single conclusion, independently of the chances of error in their deduction.

The more extensively a legitimate Theory is unfolded, the greater is its approximation to the truth. The more extensively an Hypothetic System is deduced, the greater are its deviations. And one of the easiest and most forcible methods of proving the accuracy of a system, is, unflinchingly to drive it home.

From one or more general laws or data we deduce certain results or theorems, such as the different expressions for the range, velocity, &c. of a shot, in the theory of Projectiles; and each of these expressions would be *practically*, as well as *theoretically* true, but for the innumerable other circumstances to be taken into consideration. It is therefore only an approximation to practical truth. From a certain other set of general laws we deduce a theory of Resistances; and,

by a combination of these two Theories, we approximate still nearer to practical truth in all the theorems which they contain. And by adding theory to theory, relative to the powder, form, texture, elasticity, &c. of the shot, climate, and a variety of other circumstances, we might still nearer approximate. And all these Theories taken together might be termed the Theory of Gunnery ; and by uniting these approximations with practical experience, a sufficient degree of certainty is attained.

But it is utterly impossible, upon the surface of this earth, by Theory, to arrive at practical results, even in the most simple and advanced of all practical sciences, Mechanics ; particularly, as it sometimes happens, when the results of each Theory, instead of being Theorems, are themselves merely approximations. Of this the ancients were perfectly aware ; for, both in ascending and descending, they excluded the individuals,

as objects of sense and not of science. And all men of experience seem to be equally aware of it. For, however accu rately contrived, and well considered, any proposed combination may have been, they never expect it to be carried into execution off hand. Every *new* step must be *actually tried*, before the engineer can be confident of success. Something or other, either in the theory itself, in the materials employed, in the workmen, in the weather, and a variety of other circumstances, is sure to arise at almost every turn, which has been overlooked, or unprovided for. And such unexpected obstacles very often prove insuperable; and would do so more frequently, but for the talent and patient perseverance, which is enabled by new applications, experiments, and inventions, successively to overcome such repeated disappointments. I have myself so frequently witnessed this, in attempts to reduce to practice some of the

most admirable combinations for the advancement of the arts, that in every general estimate I should be inclined to allow no inconsiderable sum at each new introduction for unforeseen contingencies, and to calculate upon the failure and readjustment of at least one half the combination before it can be reduced to practice.

Much less, then, is it possible to reduce Theory to practice in Politics, or any other moral or intellectual science; where not only so few general laws, universals, or data, are ascertained, but the springs of action are so manifold and various, independently of the free-will and perversity of the individuals, that human intellect can scarcely hope to form even a likely approximation to the details. The speculative philosopher, as is justly observed by Stewart, possesses a fund of knowledge, invaluable in all untried cases, which will guide him a certain way in approximation to

the truth. But if he attempt to reduce such theoretical principles *immediately* to practice, of course he fails in every instance, and produces nothing but confusion and mischief; of which the state of this kingdom, at this moment, is a most lamentable proof: and the probable result of persevering in such a course cannot be contemplated without the utmost alarm, the more anxiously, as many of the systems, still acted upon, are built upon false principles, and are merely hypothetic systems.

It is common in all philosophical treatises, to say something upon a general abandonment of PREJUDICES; and to assert that we should begin our researches, unswayed by any of the Idols, which have unquestionably retarded the advancement of science But what are Prejudices? Prejudices are presumed to be deeply rooted *opinions*, taken up on trust without sufficient proof. In-

numerable are the *opinions*, which we must necessarily and for ever hold without any proof at all, and upon very slight analogies. And what are Inferences drawn a priori by Analogy but unproved opinions? And if such Inferences or Hypotheses are, as I have endeavoured to point out, the first steps to knowledge, it appears to me to be a false conclusion, that because they have been *abused*, they ought therefore without examination, to be *abandoned*. Prejudices differ from such inferences and opinions, only in *degree*, the degree of strength.* If, then, slight opinions and inferences, founded but on a single analogy, are to be examined, and not abandoned, it appears to follow *a fortiori* that such deep-rooted

* Prejudices are often confounded with the evil passions by which they are accompanied and fostered. In such instances it is the passion that should be eradicated; and the mere opinion, if it has no other support than the passion, will quickly vanish.

opinions, as prejudices are commonly represented to be, so far from being flippantly laid aside, are worthy of an investigation, still more attentive and minute.

Prejudices, which have obtained a general ascendancy, must either have been originally founded upon some strong analogical reasonings; or have been the conception of some master-spirit of a by-gone age, so brilliant, as, at the time, to have commanded universal assent; or, having been struck out in the ordinary course of analogical inquiry, they must have been corrected by succeeding hands, till they obtained a place among the standard opinions of the world. Very often, from the increase of knowledge, we find upon examination that these prejudices are mistakes: but the very mistakes of a man of genius are valuable, and deserve all due consideration. But for the paradoxical errors of Hume, we should possibly not even yet have thought

of investigating the phenomena of causation. The attempts of Reid to refute these paradoxes, or rather to evade their conclusions, conferred a lasting benefit on science, not so much by the success of his attempt, as by his erroneous multiplication of the senses, faculties, and powers, of the human mind. And, however mistaken in his views upon the subject, they have been the occasion of far more accurate investigations and analyses.

The attempt to make the mind a mere *tabula rasa*, must surely be as injudicious as it is impracticable. If it were in our power to shake off our opinions, and we attempted to supply their places by our own individual research, it would take us almost the labour of a life to master the far from contemptible acquirements of a naked Indian. If we had recourse to men or books, with the first information we received, we should receive another set of opinions, if not for belief,

at least for examination: and we might busy ourselves in examining the mere opinions of some single philosopher, instead of the standard opinions of the world; having abandoned, in the mean time, all practical principles of conduct. Three times at least in four, a philosopher is wrong in any novel speculation, even where he flatters himself he is proceeding upon the strictest induction: and his suggestions only become practicable and useful, by being corrected or continued by the repeated improvements of his successors: after which, if they be of such a nature as to be incapable of proof, they are received among the professed opinions and prejudices of the world, to be examined thereafter, by any succeeding philosopher, and sifted to his heart's content, to be improved, established, or overthrown, as the case may happen, but not to be wilfully abandoned. "Instead of casting away all our old prejudices," says one of the ablest,

and the most prophetic of politicians, that ever instructed mankind, "we cherish them to a very considerable degree; and, to take more shame to ourselves, we cherish them because they are prejudices; and the longer they have lasted, and the more generally they have prevailed, the more we cherish them. We are afraid to put men to live and trade, each on his own private stock of reason; because we suspect, that this stock in each man is small, and that the individuals would do better to avail themselves of the general bank and capital of nations and of ages."* Though the foregoing extract may be a little in the extreme, yet every practical politician must be sensible how much more productive of human happiness is a steady adherence to ancient prejudice than a general adoption of new-fangled theories. The first are practicable, if they are false; they produce

* Burke's Reflections, p. 129.

no irremediable mischiefs; and when their falsehood is detected, they are gradually mended and superseded; but the latter are very generally impracticable, if they are true. And the statesman, that should attempt to reduce to practice, the novel speculations of a single brain or school, would prove himself a man, but very partially acquainted with the springs of human action, and of such contracted views, as we have not been in the habit of expecting from the statesmen of this enlightened age.

Men, who pride themselves upon a superiority to all prejudices, are generally found shallow in their acquirements, sceptical to demonstrated truth, and in a remarkable degree credulous, and apt to take upon trust some favourite novelty or other, that intrinsically is scarcely worth a moment's consideration. Nevertheless all have their use: and the flippant sophist often renders service to science, by drawing the attention of men,

more able than himself, to the examination of established prejudices, and the result most commonly is, as Burke justly observes, that they are reestablished upon a firmer basis, their ancient foundations, which had been concealed, are openly tried, and their soundness publicly declared. When, however, the reverse is the result, a service even more valuable is rendered to truth by their exposure. But, unfortunately, it too frequently happens, that the whole is for a time discarded, its truths rejected with its errors, till future examination partially recalls the opinion, and reestablishes its truths alone. In the philosophical world of the present day it is a strong and deep-rooted prejudice, that all prejudices ought to be abandoned. But if this prejudice were itself abandoned with examination, we might rush into the opposite extreme, and incalculable might be the mischiefs that would result. As a nearer approximation to the truth,

than was the system, which was in use before the time of Bacon, this prejudice has rendered essential service to science, and to mankind. But from the time of Burke to the present its errors have been more acted upon than its truths; and it has become mischievous. With respect to prejudices, then, it appears that they are not to be abandoned without examination; but rather to be retained till they are overthrown; that they are to be subjected to the strictest scrutiny and investigation, and that *cæteris paribus* the leaning should be decidedly in their favour and support.

Lord Bacon has made the general abandonment of prejudices the active principle of curiosity in his method of investigation, and the exclusion of hypotheses the clog and safeguard. It might be recommended to consideration, whether a process, directly the reverse of this, could not be acted upon, not only

more naturally, but with greater facility and greater safety; whether the ardour of inventive genius, instead of being at once damped by the rejection of its speculations without examination as wild hypotheses, should not be encouraged to pour forth the brilliancy of its conceptions;* and whether a sterner and a safer check might not be placed upon its flights, by Prejudice, rigidly insisting upon proof of every novelty proposed. The former method is evidently a strain

* It was amusing, upon a late occasion, to hear the reverse of this proposition driven home by a demonstration, "that Genius was rather detrimental than otherwise."—Some men are more apt to discover, invent, and generalize, their minds being of that kind, which is more taken with Resemblance; and such men are geniuses of the highest order. Others, being more observant of Differences than Resemblances, are better able to examine any subject or hypothesis proposed. Both are equally wanted for the prosecution of science; but the present system almost amounts to an exclusion of the former.—See, in many of the dialogues of Plato, his curious speculations upon *The Same* and *The Different*, *The Similar* and *The Dissimilar*.

and a task upon the mind, both with respect to the check and the incitement; but the latter falls in with the natural inclinations of all men.

Thus far I have spoken of the *Method* of proceeding. It is a method universally applicable to every inquiry; inasmuch as it is perfectly independent of every science, and is merely an exposition of the Laws, or manner, in which the mind pursues the objects of its inquiry. And I have used the terms Laws, Facts, Universals, and the rest, in their common acceptation. But these terms are so confounded with each other, and with Causes and Effects, Power, Agent, and the like, that we scarcely know what we are in search of; and some of the most able views of Bacon's Novum Organum have become as much lost to the world, as have some of the very finest speculations of the ancients. In examining the proper *Objects* or *Aim* of science,

I would endeavour to point out, as they arise, the distinctions, which, for the sake of perspicuity, so necessary to the cultivation of science, ought ever to be maintained among them.

Our knowledge, both of the mental and of the material worlds, relates to the *Substances* which compose those worlds, either in respect of their *Qualities* as they *coexist*, or of their *successive Changes*.

The *Qualities* of matter *coexist* in *Space;* and all its *Changes* are but the *successive motions* which occur in *Time*. But the coexisting and complex phenomena of mind, and the successive changes, of which it is the subject, notwithstanding these strong analogies are wholly independent of *Space*, and *Motion*, and probably of *Time*.*

* That they are wholly independent of Space and Motion, few but the Materialists dispute: that they are independent of Time is not so universally allowed. Such an opinion, however, is most ably maintained.

Now if we could become acquainted with every *Object* as it exists in *Space;* and if we could intimately perceive its conformation, and the circumstances on which its qualities depend; and if we arranged them all into classes, according to the *Resemblances*, which they exhibit, and then described them, giving names both to the individuals and to the classes, we should have completed one great branch of *Natural History*. And this single branch is not unfrequently regarded as the whole of that science. But there is another great branch, equally the object of classification and description, that is, the *Changes* which occur in *Time*. And the forces, actions, passions, and accidents of bodies, the phenomena of Attraction, Galvanism, &c., so far as they are the subject of classification and description only, are no less to be ranked as the objects of Natural History, than are the Qualities and the Individuals themselves.

Natural History then is the classification and description of the *substances*, of their *coexisting qualities*, and of their *successive changes*.

Struck with the resemblances to each other, which the Individuals exhibit, we have arranged them naturally into Species. By a comparison of the species Genera are formed: and again Orders, Classes, and Kingdoms in the ascending scale. Or if we pursue the classification in the descending scale, an order becomes divided into genera, by observing the *Resemblances*, which prevail among the various groups, and the *specific Differences* by which they are distinguished. Thus, Trees may be divided into Oaks, Elms, Ash, &c. resembling each other in their general features, but distinguished by certain differences. Oaks, again, are divided into the different species of Oak, till at last we arrive at the individuals themselves. In the same manner we group the phenomena of change or action, as Attractions

into Electric, Magnetic, Elective, &c. of Gravitation, of Cohesion, &c.

Each class is distinguishable by its definition consisting of the *genus* and of the *specific difference*. As science advances new and unlooked for resemblances and differences are observed: and the great instrument of Classification is RESEMBLANCE.

But does Philosophical Inquiry extend only to this knowledge of Natural History? And if we ask *why* such a phenomenon occurs; will our curiosity be satisfied with this classification and description only? Often, very generally indeed, we are directly answered in the affirmative; and are told by modern philosophers that such inquiries into the causes of things are either beside the objects of true Philosophy, or are beyond our limited faculties to determine; and that we must content ourselves with the laws only, or with the resolution

of all particular phenomena into those of a more general nature. "If it be asked," says Dr. Reid, "*why* such a body gravitates towards the earth? all the answer that can be given, is, Because all bodies gravitate towards the earth. This is resolving a particular phenomenon into a general one. If it should be again asked, why do all bodies gravitate towards the earth? we can give no other solution of this phenomenon, but that all bodies whatsoever gravitate towards each other. This is resolving a general phenomenon into a more general one. If it should be asked, why all bodies gravitate to one another? we cannot tell: and if we could tell, it would only be by resolving this universal gravitation of bodies into some other phenomenon still more general, and of which the gravitation of all bodies is a particular instance. The most general phenomena we can reach, are what we call the *laws of nature*. So that the

laws of nature are nothing else but the most general facts relating to the operations of nature, which include a great many particular facts under them."*

On this very common system of philosophizing, a person, making the Inquiry proposed, receives no other than this most unsatisfactory reply—'That *the body gravitates, because it* (in common with every other body) *gravitates.*' It may be true that we are ignorant of any reason; nevertheless the question is not to be evaded. The inquiry is directed to the Cause; and the answer of Dr. Reid is a reply from Natural History to a question upon Causation. And it is one of the most common errors of the philosophy of the present day to confound the second great branch of natural history with causation. Causation, however, is a distinct, and strict object of philosophical inquiry: and, so far from being dismissed as beyond us, it is of

* Inq. p. 278.

more importance both in a scientific and in a practical point of view, than is natural history itself. Both involve considerations of individuals and phenomena in space and time. Natural history is the classification and description of the individuals, phenomena, or facts themselves: Causation is the investigation of the Causes *which* produce these phenomena, of the manner *in which* they are produced, and the purposes *for which* they are produced. The two sciences go hand in hand. By the extension of Natural History, the knowledge of Causation is advanced: nor is Natural History less indebted to Causation, which is continually bringing to light new properties, and phenomena, and unlooked for circumstances, which point out unheeded similarities and differences, among objects and events; and thus corrects and extends the classifications which had hitherto prevailed.

It is most true, that the subject of

Causation is involved in great obscurity. But I conceive, that this arises chiefly from a confusion of words: and, that by the introduction and improper use of certain terms, and too great a reliance upon certain favourite but unproved hypotheses, we have in some measure lost sight of the proper objects of Philosophy.

By the word Cause the ancients appear to have understood *that* without the co-operation of which no sensible phenomenon could be produced:* and they divided Causes into the Material, the Formal, the Efficient, and the Final. And this division was excellent, and in perfect keeping with a system, which held

* See the 67th epistle of Seneca, wherein he explains the common and Platonic division of causes; and unjustly arraigns both, because he conceives that Space, Time, and Motion, ought to be included. Motion, however, was always especially included in the efficient cause, and Space and Time are but the measures of that motion. The objections of Reid to this division are equally inconclusive.

a Soul of the world as a prime mover of Efficient causes, to which every action in the universe was remotely to be referred in a connected chain.* Aristotle is almost inclined, yet hesitates, to claim this division as his own discovery: but it is evidently of a much more ancient standing. He gathers it however by an extensive Induction, and by the resolution of the assumed or proposed causes of all preceding philosophers into those which he enumerates. And Lord Bacon, though he denies to the ancients the knowledge of Induction, must have been satisfied with the Induction of Aristotle in this respect, or from his own researches and examination have arrived at the same conclusion, before he admitted this division of Causes, with such unqualified approbation as he does. There is nevertheless a slight variance between the two, in words, rather than in substance, owing to Bacon's deviation, from the ancient

* See Arist. VII. Phys. 1—VIII. Phys. 5.

language, which is however immaterial to our present investigation.

Among the successors of Lord Bacon, this division of Causes appears to have been but little attended to or understood, and has been generally supposed to be superseded: and, since the time of Hume, by the word Cause they seem at times to understand some *Tye* or *Bond of Connexion* between one event and its preceding: and in this view it is asserted, that no causes of things have ever been discovered; and that philosophy lies not in the discovery of causes, but only in the discovery of the facts and general laws of nature. The same assertion is likewise made, because no one can pretend to have discovered the first of secondary causes. Sometimes the Cause is looked upon as implying nothing more than an *antecedent phenomenon:* and these phenomena, under the names of Cause and Effect, are supposed to be continued in an endless chain of succes-

sive conjunctions. Brown is of this opinion, and he gives the following as a summary of his doctrine of Causation.—"To express shortly what appears to me to be the only intelligible meaning of the three most important words in Physics:

Immediate invariable *antecedence* is *Power*.

The immediate invariable *antecedent*, in any sequence, is *Cause*.

The immediate invariable *consequent*, in any sequence, is the correlative *effect*."* And again.—"The *form* of bodies is the relation of their elements to each other in *space*. The *power* of bodies is their relation to each other in *time;* and both Form and Power, if considered separately from the number of elementary corpuscles and the changes that arise successively, are equally abstractions of the mind and nothing more."

Before we examine any instances of

* 7 Br. 38.

the phenomena, let us dismiss the Final Cause, that is, the ultimate object and end of every action, without further consideration, as less properly a cause than a motive, and equally admitted in all systems, in which nothing is referred to chance, and as unconnected with the *Physical* subject we have now in hand.

To take, then, an example: when we hear a clock strike, if we attend to the chains of successive causes—to go no farther back—they may be traced in the stroke of the hammer, which causes the vibration of the bell, which causes the undulatory movement among the particles of the air, which causes some kind of motion on the organs of hearing and on the brain; a certain *sensation* follows, and the soul *perceives* that the clock has struck. Now, for the production of this ultimate effect, we may observe not only one, but three distinct chains of what the ancients would call Causes. 1st. The chain of the *material substances*,

whose matter is in contact with one another, and without which matter the phenomenon could not have been produced, viz. the matter of the hammer, of the bell, of the air, of the auditorial nerve, of the sensorium, and these are the coexisting *Material causes*. Again, each of these portions of matter is endued with certain *qualities*, without which also the effect could not have been produced: and these depend upon what the ancients would call the *form;* and they consist of the form, texture, elasticity, vibratory and other qualities of the bell, of the air, nerve, &c. These are the *Formal causes*. To these must be superadded the particular *accidents* by which they are affected, viz. the fall of the hammer, the vibration of the bell, and the others, by which motion is successively communicated: and of this chain of causes each accident, action, or phenomenon, is nothing else than *motion*, modified by the body through which it passes, and may

be regarded as a proximate *Efficient cause.**

Let us take another example of a *statical* instead of a *dynamical* nature—If we squeeze a piece of wood in a vice, and have so far squeezed it as to be able to produce no further compression, but nevertheless continue to apply the same force, so that the whole remains in equilibrio, we may here again trace the material and formal causes, in the hand, the lever, the screw, and the limb of

* It might be objected, that the common example of the ancient causes, viz. of a founder casting a statue, does not quadrate with what I have advanced: for in the example, the Efficient cause *a quo* is the Founder, the Material *ex quo* is the brass, the Formal *in quo* is the shape. A more attentive consideration, however, will show that it is only a particular case of the more general that I have taken, as is explained at large by Aristotle (II. Phys. 3.). The Platonists added to the above the Ideal or Exemplary cause, *ad quod*, according to which it is fashioned, which commonly related rather to the metaphysical, than to the physical forms.

the vice; its fulcrum and other parts concurring. And the chain of action, accident, or force, is a continued strain, endeavour, or tendency, propagated from the hand through the parts of the vice, communicating the pressure to the wood: and it may be traced still further if requisite.

Here then we must mark a distinction among Forces or Powers. Where Motion is actually produced, the force by which it is produced, proximately, is nothing more than the Momentum or Quantity of Motion communicated from one body to another in a connected succession, as in the example of the Bell. Such force is called *Dynamical*. *Statical* force is of the same nature, though no motion is produced, the force being counteracted in its effect, as in the example of the Vice. It produces, however, a continual Stress or Endeavour; and is the cause of a continued series of such Stresses, Endeavours, and Ten-

dencies among bodies in contact: and it is only requisite that some impediment be removed that motion may take effect.

In the phenomena, then, above referred to, and indeed in every other with which we are *thoroughly* acquainted, we may trace the Material, Formal, and Efficient or Physical causes of the ancients, a *Chain of Being* coexisting *in Space*, and a *Chain of Action*, Accident, or Force, successive *in Time:* all which are necessary for the production of the Effect. And we may perceive that the ancient and modern doctrines upon the subject of Causation, so far as both of them maintain the connected chain, are not inconsistent with one another: but we must carefully distinguish a circumstance, which is in general wholly overlooked, that is to say, whether the Cause be defined as the *Action* itself, or the *Instrument* affected with the action — the Vibration of the bell, or the Bell in the act of vibrating;—the Strain propa-

gated through the lever, or the Lever itself in the act of straining upon the screw.

I am sorry to differ, upon the subject of causation, with a writer so justly celebrated as Brown. But there seems to be a remarkable vagueness and obscurity* in many of his definitions and explanations relative to the words Power,

* I have given above what appears to me to be Brown's system, as he intended to be understood: but according to different passages, which might be culled, Cause is sometimes a *substance*, an *event*, a *relation*, an *invariable antecedent*, whilst he likewise uses the word Power, as an *object* or *substance in the concrete*, as *antecedence in the abstract*, as a *relation*, as an *event*, as the *priority* of two events. Reid had objected to Hume, that, upon his doctrine of Causation, Day would be the cause of Night, and Night of Day. Brown very needlessly endeavours to assist Hume out of this consequence, while he passes it over as an objection to his own doctrine, to which it appears to me to be much more formidable; as is likewise the whole class of phenomena, in which the same combined set of causes produce alternating effects, such as Vibrations, &c. for they come directly under his definition.

Cause, and Effect. Strange results might be deduced from his doctrines, were we to drive them home, with reference not only to the coexistence of one body with another, but to the continued successive existence of the same body with itself. And again, Time and Space may be abstractions of the mind: and I am inclined to think that such is the case; so is Form *in the abstract:* but the Dynamical and Statical forces, mentioned in the two examples above, are very different from mere *antecedence*, or any abstraction of the mind: and they are Powers in the concrete and in reality, as well as causes. But, by the doctrine of Brown, who follows Hume in this respect, we are either led to exclude all Power, as a reality, from the universe, or to confound it with cause in general.

Again, if we wish to know the cause of roughness, either as a Quality or as a Sensation, where are we to look? Like all continued stresses it is a coexisting

cause in *time*, though it may be preceding in *order*. It is a formal cause, and all formal causes are excluded from this system of mere antecedence in time. In truth the definitions are too limited; and we have no right to restrict the meaning of a common word to any philosophical hypothesis which we may entertain: but we must accommodate our definitions to the common usage of mankind, unless we can refute the notions, upon which that usage proceeds.

Thus far we have examined in its *outline* only the subject of causation. But, in the examples we have produced, there is another subject of examination, in that *Bond of connexion*, which has been so great a stumbling-block among the moderns. When we come more narrowly to inspect this triplicated chain of Causes, between many of the links there is a joint, if I may so call it: for instance, the *aggregate* motion of the hammer is, in the bell, converted into *atomic* mo-

tion. Now this cannot be performed simultaneously, though the manner or *law*, according to which it is performed, escapes the observation of our senses. If ever the Bell itself was regarded by Philosophers, as it is among the vulgar, as the proximate cause of sound; and the intermediate air was unnoticed and unknown, as necessary for the production of that effect; the hammer, the bell, and the ear, alone, would have been considered as the coexisting links in the chain of Causation: whilst the air and its vibrations might have been classed among those obscure phenomena, which were evidently necessary for the completion of the chain; but which the researches of science had not then enabled them to ascertain. In most instances these phenomena, which intervene as joints between the links of the chain, may be resolved into the same triplicated chain of causes, as the advancement of science every day demon-

strates; and nothing mysterious intervenes. The *Latens Processus*, or the latent process, which Bacon is so anxious to have investigated, refers to such a chain of intervening actions: and it is often noticed by the ancients, particularly by Plato in the Parmenides and Phædo; and was one of the leading doctrines of Leucippus, Democritus, and all the Atomists. The *Latens Schematismus* of Bacon, the latent form or structure, upon which the properties of bodies are supposed to depend, refers merely to their qualities, whether formal or derived from Force and Motion: though, perhaps, more accurately, the former should be referred to the Latens Schematismus; and the latter to the Latens Processus. And as the grosser bodies are said to be incapable of contact, a Latens Materia, a Latens Schematismus, and a Latens Processus, at every joint in the chain, become objects of inquiry. The inquiry into the *efficient cause*, the *matter*, the

latent process, and the *latent structure*, constitutes Physics, according to the notions of Bacon; which differs but little from the ancient doctrine.

But there is a still more curious subject yet remaining, a kind of Latens Processus, the examination of which will throw light upon a controversy, which has been as keenly agitated, as any, that has ever attracted the attention of Philosophers. At some of these joints in the chains a most remarkable phenomenon presents itself, the introduction of an extraordinary external force. If we strike a flint and a steel together, a spark is the result. This spark falls upon a charge of powder. An explosion ensues, in which thousands of such sparks are generated in a moment; and the motion which had preceded that event, and was conveyed by the spark itself, (if indeed it is at all to be taken into consideration,) after undergoing some modification of a latens processus, is multiplied, in an in-

stant, to perhaps a millionfold. Whence does all this motion come, what is its antecedent, and from and through what is it derived? If we attempt to reduce it under any of our three laws of motion, each of them is inadequate, and all are equally overthrown. If we suppose that all this motion is *generated* among the particles of gunpowder by a Latens Processus, or in other words that the motion, the high prerogative of Mind, is generated or merely increased and multiplied by the matter itself, such an hypothesis is not worth the consideration of a moment. If we say that the fire forms, or compounds, or merely lets loose an *elastic* fluid—*ignotum per ignotius*—we only remove the difficulty a step further: what is the force which makes this fluid elastic? Elasticity itself and all similar powers are involved in the same consideration. If we should assert, with Brown and many modern philosophers, that the spark is the antecedent; and that the Deity

has ordained the explosion as the consequent, independently of all other secondary causes, we fall into the hypothesis of Malebranch, and hold that the spark is but the *occasional* cause, while the explosion is the immediate production of the Deity himself, the only efficient cause; or we must take refuge in the extravagant hypothesis of the preestablished harmony of Leibnitz: which hypotheses every succeeding philosopher has been at no small trouble to expose. We may set down the spark and the explosion as immediate invariable antecedent and consequent, as phenomena like day and night immediately successive and proximately connected in time, for future consideration, if we please: but, if, in so doing, we assign the one as the efficient cause of the other, we assign a cause wholly inadequate to the effect. We do well to confess our ignorance: but if we imagine that inquiry stops with this confession, and sit down, as Lord Bacon

calls it, with the received and inveterate opinion, that the inquisition of man is not competent to find out such matters, we make the most unphilosophical assumption of all, and forge a chain, which may for ages bind us in our ignorance.

The phenomenon itself is one of those unaccountable, yet not uncommon cases, which have led to the distinction between Physical and Efficient causes—the spark being the Physical cause, and this unknown intervening something, which forms, as it were, the Bond of Connexion, the Efficient. There is manifestly an extraordinary *extrinsic* power introduced between the apparent antecedent and its consequent, which affords at least some ground for the distinction between Physical and Efficient causes, unless the Physical be confounded with the Material. Even the present state of Science gives room to entertain the hope, that all the *proximate* Efficient causes will sooner or later be resolved into Physical, and

that the chain may be completed : yet in the mean time those words are usefully employed to distinguish things so manifestly distinct.

It is this notion of an Efficient intervening cause, extended by analogy to other cases, in which some ordinary Latens Processus intervenes, though no increase of Power is to be observed, extended again, to every case whatsoever, that I imagine has had no small influence in giving rise to the fiction of an intervening *Bond of Connexion*. It has been attended, also, with a much more mischievous effect; and, inasmuch as *no Efficient cause* has hitherto been discovered, and such discovery is deemed impossible, it has led to the assertion, that *no Cause whatever* has been discovered, that the discovery of Causes is impossible, and that Causation is not the proper object of Philosophy.

In Physics, when we look for Causes, we seek nothing more than the chain of

motion, or stress, or force, in Time, and the proximate continuity* of being with its qualities in Space: which are no other than the Material, Formal, and Efficient Causes of the ancients. If it should be asked why it is thus to be *presumed* a priori, that this chain of causes is continued throughout nature, the only answer to it is this,—that, in every branch of science, which has been investigated, and is *thoroughly* understood, such is the case; it has been ascertained by Induction: and as we can reason only from what we *know*, we reason by analogy from this known to the unknown, and draw a strong presumption in its favour. It might, perhaps, be at once objected, not only that such powers as Gravity, Repulsions, &c. are at variance, but that

* The celebrated Law of Continuity, insisted upon by Leibnitz, applies rather to the efficient cause than to the material, i. e. to the continuity of motion rather than of being: the two should be distinguished.

the grosser bodies themselves never come into contact. With respect to this objection I would observe, that all the experiments and observations from which it is deduced, that the grosser bodies never come into contact, particularly the optical experiments, might equally, and, in some instances, almost conclusively, be adduced to prove, that there is some *substance* intervening. That there is a Latens phenomenon between almost every link in the chain of causation is unquestionable. But in collisions, and in most of the other phenomena, upon which Boscovich founds his system, there is evidently no introduction of extrinsic force; because the *momenta* both before and after the collisions, &c. are equal or the same. There is, therefore, only an ordinary Latens phenomenon to be explained. Before philosophical research had extended itself, the *links* only in the chain of causation were observed: and from them, when observation was ex-

tended to the joints of the chain, we were directed by analogy to seek the same continuity of being and action, as was observable from link to link. Many cases of these ordinary latent phenomena at the joints have been investigated, and in all of them, which have been explained, that continuity of being and action has been found universally to obtain. Our proper course then is clearly to pursue the investigation upon that analogy. It is no wild or far-fetched hypothesis, but the very first that rises in the ordinary course of investigation: and, as far as we have proceeded, it rests upon an induction coextensive with our knowledge. Whilst conjecture runs furthest afield, truth is often overlooked, because it is seated almost within the homestall. It is, however, readily granted, that this idea of a connected and continuous chain of causation, though it is established by induction as far as our knowledge actually extends, may, nevertheless, as to its universality,

be false; and it cannot be proved otherwise till all science is perfected; but the burden of finding and demonstrating an exception lies with its opponents, who might thus confute or limit it. Such systems, however, as that of Boscovich, start with hypotheses, far-fetched, and opposed to all the preconceived opinions and prejudices of mankind; and, but for the prevalence of the idea that prejudices ought to be abandoned, instead of being carefully examined, could never have worked themselves into notice, without the preliminary overthrow and new establishment of almost all the fundamental principles of science. With respect to Gravity, Repulsions, and the like, as I shall speak of them more fully presently, I shall here merely point out that it should be particularly noted, that they are phenomena with which we are not *thoroughly* acquainted; and with whose causes we are not acquainted at all. We cannot, therefore, legitimately build an hypo-

thesis upon them; and if we reason from them, we reason from the *unknown* against the *known*, a method of proceeding grossly absurd and altogether inadmissible.

Not only are the causes, which produce any effect, the objects of philosophical research; but the manner, in which those causes act, is an object of such importance, as almost to have superseded the inquiry into Causation itself. In modern experimental Philosophy it is often laid down as a maxim, that the *laws* of nature are the only proper objects of human inquiry: and all investigation of causes is stifled by the dogma, which maintains, that the human faculties are incapable of investigating their nature.

There is scarcely a term in science, so obscure, and so much abused, as this word *Law*. It is said to be a Law, That the three angles of a triangle are equal to two right angles—That certain

substances crystallize in certain forms —That all stones gravitate to the earth —That gravity varies inversely as the square of the distance. It is a law of the understanding, that we are convinced by demonstration; and of the affections, that we love our friends. These different applications of the word agree in this, that they are all *general propositions;* and most of them are *general facts.* The word law sometimes relates to the Classification of objects in Space, or of events in Time, to the phenomena of Causation, Material, Formal, and Efficient, indiscriminately, and frequently to the *Manner* in which these causes act: the latter of which is, perhaps, its most appropriate meaning. But the word Law has even a more extended signification, and is not unfrequently substituted for the Cause itself: and among the generality of men, who have thought somewhat, but not deeply, upon such matters, this usage of the term, with respect to

the phenomena of gravity, is even the most prevalent of all: and, though never entertained for a moment by those who have paid due attention to the subject, it has become a form of speech, so common, that the most eminent philosophers* occasionally fall into it.

If it be not advisable, altogether to discard a term, so generally abused, it might advantageously be confined to the *manner* or *rule* according to which a Cause acts, or an Object is constructed, whether by immediate or secondary

* Dr. Young sometimes uses it in this signification, and Sir J. Herschel has inadvertently fallen into the same manner of speaking; "In the theory of gravitation," says he, in his celebrated Discourse, "the *Law* is all in all, applying itself at once to the materials, and directly producing the result." What produces the result? The Law? 'The laws of nature,' says Dr. Reid, in his maturest work, 'are the *rules*, according to which effects are produced: but there must be a *cause*, which operates according to these rules. The rules of navigation never steered a ship'—nor the law of gravity a planet.

means. Human agents act in a manner capricious and uncertain: but the invariable constancy, observable in all the works of the Creator, enables us to look forward with certainty to the result: and the *manner* according to which it is performed is so determinately appointed, and as it were preordained, that we may not improperly denominate it a LAW.

Natural Philosophy, then, relates to the *Material Substances* which compose the universe: which Substances are known to us only by their *Qualities* as they coexist in *Space*, or their *Forces*, actions, motions, or accidents, as they operate in *Time*. Of these two great branches, Natural History is the mere classification, into genera and species, and description. Causation equally relates to both, and is the investigation of the nature and continuity of the Material, Formal, and Efficient Causes, the Chain of Being existing in Space, and the Chain

of Action successive in Time, together with the manner or Laws, according to which the Individuals are constructed, or Forces propagated; and this not only in the Links, but in the Joints. If the investigation were completed through the connected links only, we should, in a manner, have perfected the grand outline of science; though the more delicate parts, the latent substances, and forms or qualities, and the latent processes at the joints should for ever be concealed. But, above all things, our attention is to be directed to that mighty introduction of Efficient Power, which forms the Bond of Connexion between so many of the phenomena commonly occurring in the universe. "As to the possibility," says Lord Bacon, upon this very subject, "they are ill discoverers, who think there is no land, where they can see nothing but sea." Let the opinion but once be afloat, that such things are not beyond us, and every

hypothesis, that is started, examined, and rejected, will give us a further insight into the subject, or, at least, contract the circle of conjecture: and we might stand a chance of being delivered from that stagnation in this branch of science, which has involved the philosophical world almost ever since the time of Newton. For notwithstanding the vast strides, that *Speculative* Science has made in astronomy, deduced to a degree of accuracy and approximation to the truth, heretofore inconceivable, which however, in its sublimest theorems, are but deductions and links in the descending chain and calculations of effects; notwithstanding the mighty applications of science in the *Operative* division of philosophy; and notwithstanding the great disconnected discoveries, and the mass of facts, which, from time to time, experimentalists have brought to light, rather as it were by chance, than by any well chosen system of investigation; it is not

to be concealed, that in the ascending scale of Causation, we have scarcely advanced one single step for upwards of a century; though every ascent therein must necessarily open to the world prospects, more wide and brilliant than even the discoveries of Newton. And it is here that we must look for the next great step in the advancement of science.

From what has been said, it is evident of what vast importance are Natural history and Classification to philosophical pursuits. And of all the numerous systems of Classification, which the innumerable Resemblances of objects present, it is equally evident, that that system must be the most advantageous, which is rendered subservient to the investigation of Causes. How admirably, for instance, are the classification and nomenclature of Chemistry, describing the component parts, &c. adapted to such a purpose! and how lamentably deficient

is the Linnæan system of Botany! If we proposed to ascertain the causes of the properties of a plant, what possible assistance could be derived from the information that its Class and Order are the Hexandria Monogynia?* And perhaps we may regard it rather as a fortunate circumstance, than otherwise, that none of the systems of Mineralogy have hitherto obtained a universal ascendency. In Natural History the great instrument of Classification is Resemblance: but it is not always that we are able at once to determine upon which, of the vast variety of similarities presented to us, an appropriate Classification may be formed. And, as many of the most important resemblances are intimately connected

* It is true that great service is rendered by any classification if generally adopted. If Hippocrates or Pliny had described their plants, medicines, &c. in the Linnæan system of Botany, it would have been of essential service. But in all systems of Natural history this ought to be but a very secondary consideration.

with causation, a considerable advance must be made in that science, before we can ascertain whether our classifications are either useful or correct. We may class the Elements into Earth, Air, Fire, and Water. Such a classification will afford certain analogies or hypotheses, and assist us, to a certain extent, in our researches into causation. As soon, however, as we shall have pushed that science a little farther, we find it necessary to correct the classification which we had adopted : for we are as apt to err in our classifications, as we are in our analogical reasoning upon causation. The two sciences are intimately connected, and have a mutual tendency to correct each other's errors.

The preceding observations will throw some further light upon the *Method* of proceeding. If we would literally pursue Bacon's method, hunt for facts, classify them in tables according to his directions, and dismiss all prejudice and hypo-

theses, such a method is not in our power. Not only will hypotheses suggest themselves, which we cannot get rid of if we would; for we feel an irresistible desire at every step to bring them to the test; but our discoveries in Causation will be continually disturbing our arrangements in Natural history. If however the tables were already constructed and perfect, if we had Natural History at our command, we could no more proceed in the investigation of Causes without Analogy and Hypothesis, than we could arrange and classify without Resemblance.

Having thus endeavoured to investigate the Method and Objects of Philosophy, to compare the ancient with the modern systems, and to glean from the former what appears to be of indispensable service to the prosecution of the pursuit, let us now turn to the Result.

That *Matter or Substance*, by which

Qualities are supported, exists, is an article of belief the earliest acquired, and the most universal among mankind: though its existence can only be inferred from the qualities which it upholds. And it is by the chemical resolution of compound substances into more simple substances, and by the establishment of the Atomic Theory that this branch of science has of late years made its greatest advancement.

Three out of the four elements of the ancients have been resolved into more simple substances; and, as might naturally be expected at first, the progress of science has multiplied, instead of diminishing, the acknowledged number of undecompounded substances. Its further progress, and the more severe analyses, that are applied, sometimes increase, but have a natural tendency to diminish that number. And it is the business of Philosophy, as far as it regards Matter, to ascertain how many, and what these

simple substances may be, of which it is composed; and whether it consists of ultimate atoms, indivisible impenetrable particles; or whether it is infinitely divisible. It is often supposed that among the ancients, the Epicurean school alone maintained the existence of atoms: but the Pythagoreans and Plato maintained it likewise, though not such a wilful democracy of Atoms as that of Epicurus: nor am I aware that any of the ancients, previously to Aristotle, held the infinite divisibility of matter. Neither of these opinions, perhaps, can be brought to the test of experiment; we can rest only in analogy; but I think the accuracy of the results and calculations upon the Atomic theory, plainly induces us to prefer the atomic opinion, upon the same grounds that our faith in the law of gravitation is strengthened, by the accuracy with which the planetary movements coincide with their calculated courses, that is, it rests upon analogy confirmed by obser-

vation. The inference also, in favour of atoms, drawn by analogy from a substance, always dividing and compounding at the same angle, is far superior to an argument resting upon the infinite divisibility of a mathematical line: inasmuch as it is suggested by a fair analogy from one physical phenomenon to another: whereas the latter is only a mathematical illustration of a physical possibility: they are not at all of the same kind; the subject under consideration is purely material, the illustration purely ideal. The same may be said of Euler's ingenious argument, "All matter is endued with extension. It therefore possesses all the qualities of extension; one of which is infinite divisibility." For it does not follow, because all matter is endued with extension in the concrete, that it has all the properties of extension in the abstract; only that it might have had, if it had pleased God to make it so.

We can never expect to ascertain what

matter itself is, or in what manner it subsists. If we should ever succeed in determining the *number* of the simple substances; and, if they are composed of atoms, the *forms* with which those atoms are invested, we shall then have completed all that is within our reach. And if all the qualities of bodies, independent of force and motion, shall be resolved into the mere form and hardness of these component atoms, what the substances themselves may be, it would be absurd to inquire: but we might fearlessly conclude that the same substance ran throughout the whole.

Almost all the *Qualities of Matter* were resolved by the ancients into its Form: and by the union of Form with Matter the Sensible world was supposed to be produced. As I would bring forward those parts only of the ancient philosophy, which may be turned to account, I omit mention of their ingenious meta-

physical speculations upon the nature of Form and Matter, Bound and the Boundless; and shall merely observe that the system would naturally tend to resolve all the qualities of Matter into the primary ones of its extension or Form, and the absolute hardness or Impenetrability of its component parts.

Besides the obvious formal qualities of matter, there are certain other secondary qualities, which may be termed supposititious, conventional, or occult,* inasmuch as the words Elasticity Colour, Inertia, Gravity, and many others,

* I use the word *supposititious*, which implies spurious, as well as hypothetical, in preference to *occult*, not only to avoid offence, but in better keeping with what I have written upon theory and hypothesis. The word *secondary*, has been used: but it neither expresses the meaning intended to be conveyed, nor includes under it all the qualities which it ought. The word *occult*, as well known, would perhaps be better, but it has been sadly abused. The occult qualities, however, of Aristotle are not the nonsense usually fathered upon him. He uses the words Gravity, for instance,

are words conventionally assumed to express certain phenomena themselves, or the unknown causes of such phenomena, which have been traced no higher, but which still remain desiderata, to which the attention of science should be directed. They may perhaps be resolved into some immediate formal cause, or into several intermediate links in the chain of efficient causes, or latent processes. But it should never be forgotten, for a moment, that these words, expressive of what are called the qua-

and Levity, precisely as we do ourselves in reference to heavy and what we call imponderable bodies, expressly however denying them to be occult qualities or virtues; and endeavours to seek the causes not only of these, but of the properties of the Loadstone, and of the Inertia of Projectiles: and, however nugatory his attempt, it is evident from the attempt itself, that he never dreamt of advocating such doctrines as have been imputed to him. Again, with respect to the abhorrence of a Vacuum, I verily believe there is not one syllable upon the subject throughout his works. See VIII. Phys. 4. 10—III. De Cœlo 2—IV. Met. 14.

lities and properties of matter, in themselves, convey no explanations, but are merely assumed, conventionally, from the necessity, which our ignorance imposes upon us, to use some stated general terms as names for the unknown causes of certain classes of phenomena, the individual phenomena of which classes, however they may differ among themselves in some respects, have nevertheless certain similarities, which obviously point them out as the effects of one and the same kind of cause. If we mean any thing further by the words, we wilfully deceive ourselves. If we really imagine that bodies are attracted by Attraction, we should be equally justified in accounting for their lightness by Levity, for their cohering by Cohesion or Suction, for their parting from one another by Partition, or by any barbarous term it might be our good pleasure to coin: for nothing is easier than to convert the verb, expressive of the effect, into a corresponding

substantive. The words are nevertheless extremely convenient, and are not lightly to be rejected, but must be gradually laid aside as the real causes are ascertained: thus we have laid aside the term Levity as a supposititious Cause, having at length revolved the phenomena of lightness into those of Gravity, confirming the hypothesis of Timæus. In like manner, the word Suction has almost been forgotten, by the resolution of the phenomena of the pump into the weight of the incumbent air. Sir Isaac Newton attempted to resolve the Elasticity of light, as far as it concerned reflection, into a latent process, the attractions of a fluid upon the surfaces of bodies: and if he had succeeded, the word Elasticity would, long ere this, have been lost to us as a supposititious cause.

With respect to the Qualities of matter, we are led, by all the Analogies of nature, to suppose that they may be resolved either into formal causes, or into

phenomena depending upon motion: and it must be our grand object to ascertain the real causes corresponding to the words we use to express them; and gradually to expel those phrases, with which philosophy is overrun. I must, however, defer the further examination of them till I speak of the Efficient causes, to which they more properly belong.

In the phenomenon of Colour, which comes more properly under this division, the Metaphysical distinction drawn between the *Sensation and Perception* by the Mind and the *Quality* of the body, which was the cause of that perception, —between the redness, with which the senses are affected, and the supposititious quality of the body, which so operates upon light as to produce that sensation and perception, cleared away several strange incumbrances. But the grand discovery that redness or any other colour may be communicated to bodies by the mere

alteration of their superficial texture, has gone far to resolve the colouring quality into the texture or form of the superficies, and to merge the supposititious or conventional quality into a formal cause, one of the primary qualities of matter. From the perception of colours we may trace the chain of antecedent causes of Matter and Form through the optic nerve, through the eye, to the light, to the coloured body, and again to the light. And we may trace also the descending chain of action or motion from the general unmodified motions of the light, as first admitted into a chamber, before it strikes upon the body, its alteration at the body, every point of which becomes a centre from which a sphere of motion is propagated, of such a nature, as, when passed through the eye and optic nerve, to produce that sensation, which is followed by the perception of colour.

In England, till within the last few

years, the Newtonian hypothesis of LIGHT has had a very general ascendency; but at present that of Huygens bids fair entirely to supplant it. From the similarity which obtains in nature between one fluid and another, I would venture to suggest, that these two hypotheses may not be altogether and fundamentally opposed, but are capable of being reconciled, at least in part; and that light has not only a *progressive*, but a *vibratory* motion also; that to its progressive motion are to be attributed the phenomena of brightness, illumination, shadow, and some instances of inflection, reflection, and polarity; and that upon its vibrations depend the phenomena of colour, sight, and all the rest; and that the vibratory motion, requisite for the production of Vision, is caused by the progressive, reflected, and impeded motion of the sunbeams, by a change from the *aggregate* progressive motion of the rays into the *atomic* vibrations of the fluid.

Such an hypothesis is suggested by the analogies of air and water, in their progressive motions of wind and streams, and in their vibratory motions of sound and waves. It is a fair hypothesis, which, if it be confuted when brought to the test of experiment by Induction, may afford some results, upon which something more plausible may be offered.

If we cast a stone into a pool of water, waves proceed from the point of the submersion of the stone on every side, forming a number of concentric and expanding circles. As these circular undulations reach the sides of the pool, or if they meet with any stakes set up in the pool, they are rebounded: and the front of each stake or object becomes the centre of another set of concentric waves, which cross and pass over one another in every direction, with little or no interruption. And if the agitation of the pool be great, so as to be well rebutted from its sides, concentric circles will be completely

formed round every stake. If a stream of water be projected through or into the pool, and interrupted in any manner, so as to cause a vibration of the water, the same result may be observed. But it must likewise be remarked that in the production of such effects, the primary momentum, causing the agitation of the pool, either by the stone, or by the injected stream, must necessarily be greater or at least equal to the sum of the momenta of all the separate concentric waves.

If a bell be struck by a hammer, or, in any manner, be put into agitation sufficient to cause similar undulations in the air, similar concentric waves are formed, which, when received upon the ear, affect us with the sensation of sound. If a blast of wind rush violently through any place, in which different bodies are contained, it causes an agitation of the air; and certain objects, peculiarly susceptible, are affected and emit sounds,

becoming centres of vibration; but all the rest are silent. And their silence is a matter of course, because the most violent hurricane, that blows, travels at little more than one-tenth of the velocity of sound: and nothing, that can be opposed to it, is capable of converting its *aggregate* into *atomic* motion. If this could be done, and a shock could be communicated to the air, so intense as to be capable of affecting the particles of the bell, in the same degree as it is affected by a stroke from the hammer, there can be little question, that not only the bell, but even the dullest rocks, under similar circumstances, would ring, and become centres of sonorous undulations, as is partially to be observed under a discharge of artillery, and in an echo. It is even possible that, like some musical pillars, they do so, as it is; for notes so *base and deep*, as they would necessarily produce, probably could not be apprehended by our faculty of hearing.

Having marked the vibratory and progressive properties in water, a gross and inelastic fluid, and again in greater perfection in the air, we might with much reason argue, that in such an elastic and subtile fluid as light, both the vibratory and progressive motions might *a fortiori* be expected.

Ten years ago I commenced a series of experiments in examination of this hypothesis, which were interrupted by occupations of a very different nature. Since that time a complete revolution has taken place in this branch of science. But in the splendid discoveries, which indefatigable research has brought to light, I have seen no reason to think it open to refutation. And in the substitution of an entire Hypothesis of Huygens for that of Newton, I think we are pursuing the course, so common, and indeed so natural in the overthrow of every prejudice, of running into the opposite extreme, and rejecting the truths of the

Newtonian hypothesis with its errors, and pushing the rival system further than is warranted by the facts. I put it forth, however, now, merely as an hypothesis for examination, and shall forbear, in a treatise like the present upon the mere *theory* and not upon the *detail* of science, to enter into any experimental inquiries, further than is necessary to obviate a few of the following objections, which, by the partizans of either of the rival systems, have been deemed insuperable to the other. And I abstain the more readily, because, when an hypothesis is proposed on such a subject as this, in which there is such an ample collection of facts, a hostile hand is more capable of detecting its defects.

Upon the hypothesis that light is a projectile only, it is maintained, that it ought always to have momentum: but, in the phenomena of colour, this is not found to be the case. Upon the hypothesis that light is but a vibratory mo-

tion, it ought to have no perceptible momentum in any case whatever: but when a sunbeam impinges upon any object, it *has* momentum, and causes an atomic motion in the form of heat, sensible to the hand, and intolerable to the eye: and if the aggregate motion of the sunbeam is not the antecedent in the chain of action, being converted into this atomic motion, whence does this atomic motion come? The perceptible momentum of light in a sunbeam is a serious objection to the hypothesis of Huygens; the want of it in the phenomena of colour, is an objection to that of Newton. In the hypothesis, which I have advanced, both these objections vanish: since, in analogy to the air, it has momentum, when projected like the wind: and in its vibratory movements, analogous to the sonorous undulations, none can be perceived.

Again the very common objection, that, upon any vibratory hypothesis, our

vision ought to extend round corners, has no force in it whatever, if properly considered.

All that we see of any object is its *colour* and not its form.

It is quite an acquired perception, and merely a matter of experience, that we are able to refer either colour or form to the object we perceive.

The *visible appearance* of every object is so different from its *tangible form*, that it is likewise by experience alone, that we are capable of judging of the form of any object whatsoever.

Bearing in mind these three preliminary observations, which are well established facts,* let us examine the proposed objection.

If a *single* sound be propagated from any sonorous object, we are sensible of it, though we should hear it behind a corner. In like manner, if any single

* See Berkeley, Reid, and, in short, every metaphysical treatise upon the senses.

colour, such as the glare of a red brick wall, of snow, or the greenness of a forest were presented *alone* behind a corner, we ought according to the analogy to perceive the *tint*, which ought to be conveyed into the room, provided the fluid light were in a state of very intense agitation, as is the air when a bell is struck.

Again, as the ear receives *successive* sounds, and thus we are enabled to comprehend the syllables which compose a sentence; so the analogy requires, that, if objects, glaringly coloured, were *successively* presented behind a corner, we ought to be able to enumerate the *successive* colours, as the red, the white, the green.* And this, from many observations, I have great reason to believe is actually the case, though I should be

* N.B. We must not confound such coloured objects with luminous bodies emitting coloured rays such as blue or red flames, from which the light may be propagated progressively, as well as in vibration.

cautious in positively asserting it, without many more experiments than I have yet been able to direct to that subject: for the total exclusion of reflected rays is so difficult, and the overwhelming influence of any coloured object upon the field of vision is so intense, as to render these experiments extremely inconclusive, from the great delicacy they require.

From the case of sounds and colours, propagated singly or in succession only, let us proceed to that, in which many are propagated at the same time. When several sounds are propagated at once, if we should endeavour to attend to them all together, we quickly find it to be impossible: and it is only by directing attention to each successively, that we are able to comprehend them. Where two or more sounds are in unison, and even when they are only in concord, we receive them together but as one *single* complex harmonious tone: if they are not in concord, we receive them *alternately* as the

successive gratings and jarring of a discord. The analogy then requires us to receive the colours, propagated from several objects, (where those objects are not in the direct line of the eye, but their colours are propagated round a corner indiscriminately,) either as a single complex colour, or in succession only.

Again, not only can we comprehend the successive sounds which compose a sentence uttered behind a corner; but by experience we can form an estimate of their *distance* from the ear, if we are acquainted with the voice. In like manner we might expect, by experience and attention, not only to be able to enumerate the separate colours, if successively presented, but, given their brilliancy, we might form some estimate of their *distance.*

These are all the points of similarity, that the analogy between sounds and colours presents, relative to the subject in hand. In all analogical cases, how-

ever, we must not only look to the resemblances, but to the differences, which appear between the phenomena, that are compared. Now there is one great difference between sounds and colours, in that, the former are, for the most part, of short duration and adapted more particularly to *succession:* whereas the latter are generally *permanent*, every point of every object shedding without intermission its own peculiar sphere of colour. There is likewise a great difference between the articulation of a sentence, and the perception of the distinct parts of any object of vision; which two are often supposed to bear some kind of resemblance to one another. The ear could never comprehend a sentence, whose every syllable was pronounced at once; and the eye is enabled to perform an office analogous to such comprehension, that is to say, of presenting us simultaneously with the different points of the object, only by its telescopic construction in the

peculiar formation of its retina and lenses. The great difference, then, is, that by the ear we comprehend sounds only *in succession*, by the eye we *simultaneously* perceive the different *coexisting* points upon the field of vision.

To enable us to see an object, it is requisite that an image of that object should be formed upon the retina. The principal circumstances, upon which the formation of such an image depends, are the *distance* of the object from the retina, the preservation of the proper *divergency* of the coloured rays emanating from the different points of the object, and the perception of the *real situation* of the object itself, and of the *relative situation*, which every point bears to every other point of the same object.

With respect to the *distance*, if one single colour alone were transmitted round the corner, or a mere succession of colours, then, as I observed before, the analogy of sounds gives us reason to ex-

pect, that if we were acquainted with their brilliancy, we might form some vague estimate of their distance, and nothing more. But any thing so vague as this is evidently not sufficient for the formation of an image.

Again, with respect to the preservation of the *divergency* of the rays, which is the grand requisite for the formation of an image upon the retina, it is manifest, that when each propagated sphere of coloured rays is modified by passing round a corner, the proper divergency must be entirely lost: or if any thing by way of an image could be formed by rays propagated in such a manner, it is clear, from the mathematical principles of optics, that every point of that image must be referred to the corner itself, and not to any object that is behind it. And this must necessarily be the case, unless the divergency of the rays from every point of the object be preserved, by being reflected or refracted by a mirror or some

similar contrivance, which may present to us a *virtual* image in the direct line or axis of vision.

Supposing, however, for a moment, that the divergency were preserved in the vibration so as to form an image of a *point* upon the retina, still no image of an *object* could be formed, unless the *relative situation* of all the points of the object to one another, and the *real situation* of the object itself could be preserved and ascertained. Now the analogy of sound gives us no reason to expect any thing of the kind, but directly the reverse. For though we may form some vague estimate of the distance of a sonorous body, which is out of sight; we are utterly unable, by merely attending to its sound, to determine whereabouts it is: and if we attempt to guess at the precise point, having no previous knowledge of the circumstances in which it is situated, we are *invariably* deceived.

The analogy, therefore, does not teach us to expect to determine the situation of any single point: much less, then, can we expect to ascertain the places, either real or relative of all the innumerable points which compose the object. If we heard two bells tinkling behind a corner, we should be as likely to judge them close to one another as to be two or three yards asunder: and what reason we can have to suppose, that the relative situation of the different points of vision could be more accurately conveyed, I cannot conceive; certainly no analogical reason.

In addition to all this, we must recollect, that the image upon the retina is no real picture of the object, but only, as it were, a transcript of its *visible form*, and that the perception of the object itself is only a *judgment* of what is its *tangible* or *real form* and situation, and an inference of experience only, from our sensa-

tion of the image upon the retina; which image is only, as it were, the sign by which we judge.

But let us suppose that an image could really be formed upon the retina by rays vibrating round a corner, and that thereby we actually perceived the object. Where would the object appear to be situated? Evidently it must appear in the axis of vision, that is, in the straight line drawn from the eye to the corner and produced: and in the very same axis every object behind the corner, and in the same plane, must also appear: so that we should have every object whatsoever behind the corner apparent, as it were, upon the same meridian, together with all the objects which might happen really and actually to be situated upon it: but for all this the analogy of sound does not afford the slightest pretext.

It is perfectly clear, then, that the expectation of seeing objects round corners, upon any vibratory hypothesis

whatever, arises from inattention to the subject. Upon the hypothesis of Huygens, it is not to be expected that an image should be formed, or an object seen, in such circumstances; but only that rays of *light* as well as *colours* should expand themselves in every way. Upon the hypothesis, which I have proposed, *colours* alone, and not the rays of light, should be expanded; and this only when they are presented in succession and never several at a time; and not even could this take place unless the agitation of the fluid were intense.

As an objection, therefore, it is completely a mistake of the question. I have been more particular and I am afraid tediously minute upon this point, because the objection has been considered so extremely formidable, and I do not recollect ever to have met with a proper refutation of it.

But, however futile such an objection may be, when directed against the phe-

nomena of colours, and objects of vision; it assumes a very different aspect, when directed against the supposition, that a sunbeam is propagated by vibration only: for the propagation of light or brightness itself round corners, is a very different thing from the transmission of images or forms. If a sunbeam passes into a chamber, through an aperture; with certain allowances to be made, easily accounted for, on the principles of refraction, inflection,* &c. it never deviates from its course, it never expands itself in a glare of brightness or of colour, as if it were a mere vibration, it forms no concentric spheres or circles round the aperture, but passes in a straight line, direct, as far as it is permitted, like a current of wind or water. And it is apprehended, that, could the

* Under which allowances may perhaps be classed the phenomena, which appear, when the apertures are very small. See Dr. Young's observations upon that subject.

experiment be accurately tried by the exclusion of the motes, which float in it* and break and reflect the ray, and of the cross beams from the aperture, it would pass through an opening on the opposite side of the room, and leave the room itself in darkness as complete, as are the parts behind a planet, over whose edges the light is poured in a continued stream. It is an experiment, that in the heavens is tried on the largest scale: and a shadow is extended from one planet to another, without the appearance of any vibration of the sort. It is likewise apprehended that no objects, which are not in themselves luminous, ever become visible, unless the rays of light introduced be broken and dispersed throughout the chamber, so that their *aggregate* motion is converted into *atomic*, and

* Nam jubar solis in cubiculo tenebroso non cernitur, nisi quatenus lux reflectitur e pulverum et fumorum particulis per aerem semper volitantibus. —*Newt. Princ.* 509. *Edit.* 1726.

causes a general and intense vibration of the fluid.

The objection that if a *sunbeam* or a *ray* of light is a vibration, there could be neither shadow nor darkness, I think, remains in full force against the vibratory system of Huygens. Upon the hypothesis I have proposed, both of projection and vibration, it is evidently harmless: for, if applied to air, it would insist, that, because *sound* is propagated by the vibration of the air, a person could not stand out of the *wind* by placing himself under the lea of some sheltering object.

A ray of light appears to me to follow the laws of other fluids. It acts and is acted upon by mechanical causes in the same manner as a stream of wind or water; and is subject also to similar mechanical operations in a vibratory capacity. In some instances, as in the phenomena of prismatic colours, it seems to combine the two notions at once, analo-

gously to the vibratory blast which issues through a trumpet. And indeed it is highly probable, that, on its progressive motion a vibration is universally attendant. And upon this hypothesis perhaps some of the curious phenomena of polarity would meet with an easy solution.

We see objects for the most part by means of colour, and therefore, as I think, by means of the vibratory motion of the fluid. But it by no means follows that we should not also distinguish them by means of the projected rays. Our perception of the form and superficies of an object, as I observed before, is a mere matter of experience, and a judgment from the visible form impressed upon the retina. When we perceive an object by its colour, we draw our judgment of its tangible form, not always from the colours only, but from the variety of lights and shades apparent upon its surface: and we may form a

similar *judgment* when the lights and shades are exhibited in *splendor* instead of colour, though we cannot perhaps so well examine its minutiæ. Thus, in any luminous body, or in a body from which Splendor is reflected, by its brilliancy in one part, its deficiency in another, and its total absence from a third, or around its external edge we may form a judgment of the inequalities of its surface and of its figure, as in the case of the sun and moon. The phenomena of Splendor and of Lights and Shades have not been properly attended to: and a thorough examination of the subject is a desideratum in philosophy. If we would paint the lights upon the prominent parts of the human face, or upon any metallic utensil, or other object whatsoever, we should paint them, not with a thicker coat of colouring laid upon the part, but with a different and a whiter tint. Is this to be esteemed a more intense vibration, or is it splendor? Inasmuch

as the position of the illuminated spot varies with every variation of the position of our eye, and inasmuch as it makes the angles of incidence and reflection with the luminous point and our eye equal to one another, the ray, by which we perceive it, follows the laws of a *projectile only*. Inasmuch as its brightness may be increased so as to become painful to the eye (and the mildest of these phenomena differ from the most intense only in degree and not in kind,) it follows that they have all *momentum*. And I think that from hence we might infer that the phenomena of Splendor might with propriety be referred to the cases of *projected* light.

The ancients reckoned Splendor as a distinct colour. This however it is not: for when it is attended with great heat, it exhibits the appearance of the red; in its intensest glow, of the white; in a less vivid form as upon ordinary occasions, and in reflected light, it commonly ap-

pears as the yellow: and in such cases, if the reflected ray be a fluid in progressive motion, it is possible that that progressive motion may partake at the same time of the vibration which is peculiar to the yellow tint. In other cases, the reflected ray partakes of the colour of the surface from which it is reflected, and possibly its vibratory motion receives a modification by being reflected at the surface.

Transparency also among the ancients was deemed a distinct colour. In every great continuity of a transparent medium a resemblance is in this respect remarkable. A distant mountain, seen through a considerable space of air, is blue; so is the sky itself, so is a glacier, when we look down into it, and so likewise is the sea off soundings. And this blueness may be the result of a continued but more gentle motion of this universal fluid.

Another observation I would make,

which I deem of much importance to the solution of some of the most intricate optical phenomena, viz. That we have every reason to suppose that the *momentum*, with which a sunbeam is projected into a room, is far greater than, or at least equal to, the sum of the *momenta* of all the vibrations that it causes, such momenta being imperceptible; though its actual *velocity* may probably be less than that of any separate vibration; as the velocity of the hammer, which strikes upon a bell, is incomparably less than the velocity of the faintest sound which it excites.

Upon the different hypotheses of Light, that have been proposed, much confusion has arisen from three distinct significations, in which that single word is used. The fluid, conceived to be *in progress*, as a sunbeam, by the Newtonians, is termed Light or a ray of Light. The fluid in a state of *vibration*, according to the hypothesis of Huygens,

causing sight, analogous to the aerial undulations, causing sound, is likewise termed Light, or when partially examined a ray of Light. Whilst our nomenclature affords us no other term for the *undisturbed fluid* in a room, analogous to the undisturbed air or water in the pool. Hence difficulties frequently occur, which arise only from a misapprehension of the terms.

If we turn our attention to the Chain of Action, we shall find that it consists of Motion or Stress, both of which imply Force, communicated through different portions of the material world.

All motion and tendencies may perhaps be ultimately traced to the forces of Animals, Gravity, Inertia, Elasticity, and the Etherial powers of nature.

The natural or common motions and pressure of Water are resolvable into the forces of Air, Gravity, and the like. The natural or common motions and

powers of the Air may be again resolved into those of Gravity, Elasticity, and Heat. Galvanism, Electricity, and certain Chemical phenomena, might perhaps, if science were properly directed to the investigation, with little difficulty be resolved into a chain of the varied action of one and the same etherial fluid, of which Fire is but another form: inasmuch as chief part of the results appear to be but the conversion of aggregate into some species of atomic motion, and the reconversion of this atomic motion into aggregate. The phenomena of Magnetism might perhaps be similarly resolved.

Now in these phenomena the great dispute among philosophers does not so much concern the chain of *action* and motion, which is, however, far from ascertained, as the chain of *being* through which such action is propagated; whether the motion be communicated through the grosser particles of matter, or through

some subtile fluid which pervades all nature, or through several different fluids endowed with different properties, such as the Galvanic, Electric, Magnetic, and other fluids. From the sameness of many of their effects, and from the consideration that they *all* appear *equally* extended throughout the universe, if we should presume that they were but one and the same fluid, we should start an hypothesis indeed, but an hypothesis particularly worthy of attention, for unless such be the case we shall have in nature several fluids coextended through the universe, all of which, as it has been ably shown, continually perform each other's offices, that is to say, several different causes more than are necessary for the solution of the phenomena.

The investigations of Lord Bacon led him to conclude that HEAT was motion. Many recent philosophers of the greatest eminence incline to the opinion, that it

is a fluid substance, of great subtilty, which they denominate Latent Heat, Caloric, or the like. Between these opinions there is not necessarily any real opposition, and if both of them were ascertained to be true, but little more than one half the problem would be solved. If Heat be Motion, there must be something moved; there must be a chain of being through which such motion is propagated; whether it be a subtile fluid, or only the grosser particles of bodies subjected to the heat. But if Heat be admitted to be an Etherial fluid, surely none of the supporters of that opinion will undertake to deny, that this fluid is in motion, wherever it appears under the form of Heat. When it is at rest we may term it Latent heat, or Caloric, or Ether, if we think proper; but, unless we recollect that such terms are merely conventionally assumed to express a *suppositious material cause*, the use of them is liable to degenerate into an abuse

of a very serious nature: inasmuch as under each of them lurks an hypothesis, which is but flimsily concealed.*

With respect to Heat itself the truth appears to me to be that Lord Bacon, Sir Isaac Newton, Dr. Young, and Sir Humphrey Davy more particularly directed their attention to the chain of its *action* only; whilst other philosophers have gone very far to ascertain, that the chain of *being*, through which this action is propagated, is not the solid particles of bodies, but a substance distinct from

* Ether more than half assumes that all the etherial fluids are reducible to one and the same. Latent Heat and Sensible Heat likewise assume that the fluid is connected with the phenomena of heat alone, to the exclusion of the rest, and are neither more nor less than a revival of the ancient distinctions of Aristotle, of Heat in Capacity, and Heat in Energy. Caloric leans rather too much to Bacon's hypothesis. It is also used sometimes to express a kind of indefinite superfluity of temperature. Caloric, if restricted, seems best adapted to present purposes; though probably Ether will ultimately prevail.

them, a subtile fluid. Yet, if, in all these phenomena, relating to the etherial powers of the Universe, we should make no further question, but were fully satisfied upon this part of the subject, the problem is still unsolved even as to its Natural History, without going into its Causation.

The next step in the investigation is to ascertain what species or kind of motion it may be. Is it vibratory? Is it progressive? Is it direct, or reverberating, or radiating, or circulating, or what? The difference of the species of motion appears to constitute chief part of the difference between Heat, Light, the Electric, Nervous, Magnetic, and other similar phenomena. When we have ascertained what species of motion it is, the further questions remain. Whence is it derived? What are the causes, which produce this motion, and this species of motion rather than any other? and in what manner do they act?

We look with contempt upon the not very happy division of Aristotle; of the different species of motion: and, with much complacency, we reduce them all to one and the same kind, that is to say, a Change of Place: and then we charge him with a misconception of the subject, for thus unnecessarily introducing the same idea, under a different form, as a new idea,—a misconception, as usual, to be found only in our own misapprehension of his doctrine: for upon that subject he maintains * precisely the same tenets that we do ourselves. Motion, as a Change of Place or Position,† is in

* VIII. Phys. 7. See also Plato De Leg. 10.

† We are accustomed to hear that motion is a simple idea, and therefore cannot be defined. Yet Aristotle, Dr. Young, and many of the most eminent philosophers have given definitions of motion. It is evident that no objection to its definition can be maintained on account of its being a simple idea; for, as it is a generic term comprehending under it species and particulars, it can unquestionably be defined as the genus, comprising the particulars, which we may enumerate, such as Progression,

fact the *primary*, which is accessory to all other motions, and indeed the *genus* under which they must be classed: and so far from rejecting all the subdivisions or species of motion, I suspect we shall find it necessary to enlarge, instead of contracting the vocabulary.

The most remarkable of the supposititious qualities of matter, depending

Increase, Diminution, Vibration, Circulation, Walking, Swimming, Running, &c. Aristotle has given its Definition as a *Change of Place or Position*, that is, by a genus and a specific difference. To this it is objected, that we cannot define the word *Change* without the use of the word *Motion* in some form or other. Now this is the real difficulty, which lies, not in motion being a simple idea, and therefore indefinable, but, in the definition of the word *change*, as its genus. It is, however, a matter of curiosity, rather than of difficulty. The Species comprehended under the word Change are, physically, only two, viz. Changes in the material world, which are motions; and Changes in the mental, as in the train of thought, and the like. From the structure of language, it *happens*, that we have no means of describing *any phenomena*

upon action, are Inertia, Gravity, and Attraction.

Gravity, in the present state of science, is an anomaly in nature, to which no parallel exists: for we are acquainted only with its laws, without a trace of the antecedent proximate links in the chains of Being, and Motion or Force.

The conceptions of Sir Isaac Newton, upon the subject of Gravity and Attraction, are perfectly clear and defined:

whatever in the mental world, except in words and images *drawn from the material.* Hence we find it impossible to describe *change* in the mental world, except in words and images taken some way or other from *changes* in the material, that is, except in words expressive of *motion.* Hence it happens, *accidentally*, as it were, that the *generic term* cannot be described, except in terms, involving the specific difference of *one* of its species: and thus the definition, apparently, but not absolutely, becomes imperfect. The same may be said of some other definitions, which have been rejected upon similar grounds. Motion, so far from being a simple idea, is in fact an idea so general, that the real question is, whether or no we can find a generic term, under which to comprehend it.

though there is an ambiguity in the words, as they are used both for the cause, and for the effect, that has led to some misunderstanding. In the Principia, and in general, he uses the words, not for the *effect* itself, as Dr. Clarke, in his controversy with Leibnitz, affirms,—not for any *inherent quality*, with which matter may be endued,—nor for any *stress or motion* with which it may be affected: but he uses them merely conventionally, for the antecedent cause of the effect of gravitation; whether the cause be a formal cause, or whether it be motion or force communicated through an antecedent chain of being, or whatever it may be hereafter ascertained. By the universal *effect* of gravitation or the *tendency* itself, proved by Induction from Experiment and Observation upon bodies within our reach, and extended by Analogy, confirmed by Observation, to the celestial bodies and those which are beyond us, it is evident that such a

cause exists, be it material or be it spiritual: and the knowledge of its existence, and of the *law* according to which it acts, are sufficient for all the purposes, to which, in mathematical deductions, it can be applied.

Sir Isaac Newton laid down as the first rule of philosophizing, 'that no other causes ought to be introduced than such as are true, and sufficient to account for the phenomena.' And he followed his predecessors in maintaining the Inertia of Matter as exerted in the first law of motion, as an inherent, though it may be supposititious quality. But, to account for the undiminished motions of the planets, he was compelled to assert a Vacuum, or at least a *quasi* vacuum. Yet he hesitated to maintain Gravity as an innate quality of matter, as it would have involved him in an inconsistency in his idea of causation, as expressed in his own rule. He therefore left directions to succeeding philosophers to seek its

cause; and pointed out, as a fit subject for speculation, an hypothetical subtile ether, with which the supposed vacuum might be filled, as capable of supplying the deficient links in the chain of causation. And he left such directions expressly to clear himself from the imputation of holding gravity among the essential properties of bodies.* The notion, however, of attraction or gravity, as an occult quality actually inherent in matter, is extremely ancient: and, as it has ever been a received opinion among very eminent men, the philosophical world would

* "Et nequis *gravitatem* inter *essentiales* corporum proprietates me habere existimet, quæstionem unam de *ejus* causâ investigandâ subjeci. *Quæstionem*, inquam: quippe qui *experimentis* rem istam nondum habeam exploratam."—*Monitio altera ad lectorem;* prefixed to the *Optics*. Again, in the second letter to Dr. Bentley, he says; "You sometimes speak of Gravity as essential, and inherent to matter. Pray do not ascribe that notion to me: for the cause of Gravity is what I do not pretend to know, and therefore would take more time to consider." p. 20.

not be exactly justified in rejecting it at once with the contemptuous expressions,* in which it has pleased Sir Isaac Newton to reprobate it.

Many of the professed followers of Sir Isaac Newton, little appreciating the depth of his views, but sufficiently alive to the physical inconsistency of main-

* "It is inconceivable that inanimate brute matter should, without the mediation of something else, which is not material, operate upon, and affect other matter without mutual contact, as it must be, if Gravitation in the sense of Epicurus, be essential and inherent in it. And this is one reason why I desired you would not ascribe innate Gravity to me. That Gravity should be innate, inherent, and essential to Matter, so that one body may act upon another at a distance through a *vacuum* without the mediation of any thing else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws; but whether that agent be material or immaterial I have left to the consideration of my readers." *Newton's III. Letter to Dr. Bentley*, p. 26.

taining the Vacuum and rejecting Gravity as a quality, hesitated not to assert the absolute vacuum, and gravitation as an inherent quality of matter; not adverting to the insuperable metaphysical difficulty thus introduced, that they eventually maintained two distinct and independent chains of causation, continually crossing each other and assuming each other's offices: by one of which motion was communicated, through matter in contact, by impulse and vibration, in continued succession; and by the other through vacuum by means of occult qualities commonly so called: by either of which the same effects might be produced. Euler and other foreign philosophers, more sensible of the real difficulty of the case, rejected without a scruple such a version of Sir Isaac Newton's opinions, upon the express grounds, that two secondary causes of motion, one from Inertia, the other from Attraction, were utterly incongruous and inadmis-

sible: and such has been no less generally the opinion of all metaphysicians than of Sir Isaac himself. Stewart, equally sensible of the same insuperable difficulty, strangely proposes to resolve all such phenomena into attractions and repulsions, upon the principles of Boscovich. This, as I observed before, is the strangest method of philosophizing, that human ingenuity ever devised: for, instead of arguing from the known to the unknown, we are desired to reverse the process, build an hypothesis upon the unknown, upon phenomena, respecting which hardly any two individuals agree, and argue from it against the known, against phenomena and causes, which even the most speculative and hypothetical have scarcely even ventured to call in question.

With respect to the Causes of Gravitation, if we had reasoned justly, and from what we knew, to what was unknown, we should never have been in-

volved in the difficulties, with which this subject is perplexed. Let us but follow out the analogies of nature, and much of the obscurity will vanish. In *all* the phenomena, which we *really understand*, motion does not ensue, but by the communication of motion, from some proximate body; or by the exertion of a force, propagated through some proximate body, whose action is counteracted by some impediment. If we examine the bodies subject to the force of gravity, we find them, either in motion, or, in all, that are not actually in motion, we find a continued tendency to move towards the centre of the earth, and we find that this tendency in them is converted into motion on the removal of some impeding obstacle. Now if we argued, by Analogy, from similar phenomena with which we are acquainted, we should without hesitation be led to infer, that the motion is communicated to the gravitating body through some proximate substance, and

that the tendency is derived from a stress impressed upon it, likewise through the instrumentality of some proximate substance. And this is in the true spirit of Newton's second rule of philosophizing; —'That the same causes are to be assigned to natural effects of the same kind, as nearly as may be.'

In the legitimate use of analogy we are entitled to start such an hypothesis: and it is the business of Philosophy to bring it to the test of Experiment or Observation by Induction; by which it may be confuted, proved, or limited to something less general. Now, by Newton's first rule of philosophizing, no other causes ought to be admitted, than such as are *true* and *sufficient* to account for the phenomena. The inquiry therefore instantly resolves itself into the two following. First, with respect to the causes assigned; Is there such a chain of being, or any such substance, as is supposed, in contact with the gravitating body? And

if there be, Is there a stress propagated through that substance to it, causing that tendency, which, by experiment, we find it has? And secondly, If such causes be realities, are they sufficient to account for the phenomena?

The present state of science enables us to resolve the first of these three resulting questions at once into the Inquiry, whether there is a PLENUM or a VACUUM in the heavens? *A priori*, from analogy, we should infer a plenum, from the very phenomenon itself. Yet the notion of a vacuum has obtained such a general ascendency, and is so commonly supposed to be founded upon demonstration, that upon such analogy, in this case, it would be unphilosophical to lay even the ordinary stress. The belief in a vacuum has become an established prejudice. I conceive, therefore, that it is entitled to the privileges of prejudice: and though it is to be subjected to examination, it would be highly

improper to lay it aside, till it be overthrown, or rendered improbable, if refutation be impossible from the nature of the case.

It is true that the Vacuum has an appearance of demonstration. But if such demonstration depend upon *hypothetical data*, the vacuum, so proved, is but an *hypothesis:* and, what is worse, it is but an *hypothesis deduced;* and is therefore liable, not only to all the individual defects of its data, and to erroneous deduction, but also to that complication of error, which may arise from the combination of two or more hypothetical data.*

The data, upon which all the demonstrations of a vacuum rest, are these—I. *The undiminished motions of the planets.* This may be granted as a fact. But even this, late observations upon the periodic times of the comets have rendered extremely questionable. Nevertheless let it be granted. II. *The Iner-*

* See p. 36.

tia of Matter. That bodies in motion will continue to move uniformly forward in a right line, or to maintain a rotatory motion communicated to them, is also granted as a *fact:* and it is likewise granted that the more *extraneous* obstacles we remove, such as the air, friction, &c. the longer such motion will continue. But it must be observed, that all such extraneous obstacles are *consequents* in the chain of being; and, as consequents, they receive motion from, and therefore of course abstract from the motion of the projectile, which, with regard to them, is itself the *antecedent*. But whether the propensity to proceed uniformly in a right line is an inherent and independent property of matter, or whether it is maintained by any stress or action propagated through any etherial medium or *antecedent* chain of being, is a question, which the experiments, that establish the mere fact, have not the slightest tendency to determine. And

the assumption of the Inertia of matter, as an inherent property, independent of such external action, (the only supposition that can avail for the demonstration of a vacuum,) is an assumption of the very point in question, a *petitio principii.* This, then, as one of the data for the demonstration of a vacuum, is only an hypothesis. III. Another of the data is the assumption, *That perpetual motion can only be maintained in a vacuum.* This again is an hypothesis. And it is an hypothesis deduced: and the proof of it is, That if a body be put in motion in a plenum, it communicates part of its motion to the surrounding particles; and what it communicates, it loses; and hence a perpetual motion cannot be maintained in a plenum. This is exactly the same petitio principii as the last, though in another form, involving the same confusion between the consequents and antecedents, and assuming, that such motion is not maintained by

any external force, but that the body, as it were, runs away with the motion primarily communicated: And the whole of this deduction is in the teeth of thousands of the most familiar experiments, which daily prove, that a perpetual motion* might be preserved by Fire, Steam, Air, Electricity and other powers of nature, but for the wear and tear of the machinery, the lack of fuel, and other *extrinsic* circumstances: and this, in many instances, in spite of friction; but in all, an absolute plenum of one or

* When I say perpetual motion, of course, I do not allude to the frivolous attempts often made to produce it by mechanical combinations acted upon by gravity. As a general refutation of such schemes, it may be considered, that if there were no friction of the machine or air, Gravity and Inertia would always *exactly* produce a perpetual motion in pendulums, or combinations of machinery whose centre of Gravity is at rest; but it could produce *nothing more*, no constantly accelerated motion. If, therefore, friction is to be taken into account, it must produce *something less*: or a regular diminution of motion must be the result.

more fluids is necessary for the production of the effect: while it is far from evident, that a man could move any one of his limbs if it were placed in perfect vacuo.

A vacuum never has been demonstrated: and if we can find no better data, from which it may be deduced, than these, it never will: for all such demonstrations are, at best, but arguments in a circle. And if we apply Newton's first rule to the vacuum, it is not shewn to be a true cause; and though, upon the assumption of the planets being projectiles, and upon the further assumption of an innate gravitating property of matter, it is sufficient to account for the astronomical phenomena; it is utterly insufficient to account for, but is directly at variance with almost all the rest.

It is scarcely worth while to notice a small vacuum, upon which, sometimes an argument is built in favour of the possibility of a larger, viz. that, which must continually occur, as an interstice between the finest atoms in nature, when they are

in motion. Of course such a vacuum is granted, but it has no bearing upon the question. *A posse ad esse* gives no conclusion: and this gives not even a probability. Still less conclusive are several other metaphysical and mathematical curiosities of a similar description, which have been sometimes urged as arguments on both sides.

From the strong analogies of nature we should *a priori* infer a PLENUM, as an hypothesis: nor does it signify, or make the slightest difference to the propositions of astronomy, whether a Vacuum with Inertia as an independent quality, or whether a Plenum, capable of maintaining motion according to the same laws is supposed. Having obtained such an hypothesis, the next step in philosophical investigation is to bring it to the test.

First then with respect to the *possibility* of perpetual motion being maintainable in a plenum. Among the innu-

merable and every-day experiments which might be advanced, it may be brought to the test at once, by the following decisive experimentum crucis, which I shall merely abridge, and attach to it some of the reflections of its author.*

'At the extremities of a rod of about two feet in length let two lights be suspended. Over these lights let there be two vanes fixed to the rod with contrary aspects, and inclined at half a right angle. The rod thus furnished is to be poised upon a point, supported by a foot and pillar. As soon as the lamps are lighted the machine will begin to turn upon its centre, making several revolutions in a minute, and will continue thus to move so long as the lights continue burning: and supposing the lights to have a perpetual supply, the consequence would be a perpetual motion in the machine.†

* Rev. W. Jones's Essay on the First Principles of Natural Philosophy—1762.

† I have often seen the above experiment tried

'Let us suppose' continues the ingenious author, 'Let us suppose a philosopher to be contemplating this sight at a distance. If his eye is in the plane of the motion, the lights will appear [like two stars in a binary combination] to move backward and forward in a straight line: but as their velocity will be apparently unequal in different parts of the line, he will conclude they move in a curve: and, by considering attentively in what proportion the apparent motion is accelerated and retarded, he will discover that curve to be a perfect circle. Thus far he argues as an *astronomer* and a *geometrician:* therefore his conclusion will be undeniable: and I mention this to shew the distinction be-

with an apparatus of no greater expense than two pieces of tin, two bits of candle, and the rod of a staircase carpet. Might not this machine be introduced with advantage as a regulating fly wheel, or even as a source of motion, in some of the delicate branches of the arts?

tween *astronomy* and *physics*. But in the next place he proceeds to investigate the *causes* of this motion: and, having found, as he imagines, that all matter must *resist* motion in proportion to its quantity; if the lights circulate in a *resisting medium*, their velocity, he concludes, must be diminished, and by degrees utterly lost. But having observed for several days, and he might do it for as many hundred years, that they continue to move with the same velocity, and complete their periods in exactly the same time, as when he first began to make his observations, he concludes that they must move in an unresisting space: and, having dispatched all material impulses out of the way, he assigns a *projectile* force as the cause of their *progressive* motion, and an *attractive* force, exactly counterbalanced to it, as the cause of their *circular* motion, affirming at the same time that these two forces are sufficient to account for all the phenomena,

and will do it better than *any material medium whatsoever;* and that in the whole course of this reasoning he has not *made one supposition: Hypotheses non fingo.*'

If we examine by the help of this experiment the foundations upon which, the assumption, that perpetual motion can only be sustained in a Vacuum, is hazarded—'In the first place the lamps do not *communicate their motion* to the surrounding fluid, because they were left *at rest*, and had *none to communicate.* They are no projectiles, and had no original motion independently of the air. 2dly, Instead of losing motion, they are continually receiving a fresh and equable supply: [or rather they receive the supply from the air as *the antecedent* in the chain of causation, and communicate it to the machine as *the consequent*]. For which reason, 3dly, they are not *retarded*, but are possessed of a motion, which in Theory is absolutely a *perpetual* one.

And 4thly the well known inference from a continuance of motion is worst of all: for if the machine were placed in a *vacuum*, that is, in a space void of air, the lights would expire, and *motion* be at an end. If a projectile force were then given to the machine, without its lights, it is true that it would continue to move round in the exhausted receiver, and for a much longer time than if the receiver under such circumstances were filled with air: for the air without the lights would be but a resisting medium instead of an impelling one, a consequent in the chain of being, instead of an antecedent, and to preserve such a motion, communicated by a projectile force, the sooner it were removed the better. Cotes, and several philosophers of eminence, have been so assured of the truths of these suppositions, that they have actually given us some ingenious mathematical demonstrations, that a plain every-day matter of fact is an impossibility in nature.'

The truth indeed is, that, from a few particulars relative to projectiles, we have skipped to a generality. This generality, thus lawfully obtained, ought to have been regarded only as an hypothesis, and like every other hypothesis ought to have been subjected to the test of Induction: but instead of so testing it, not only with regard to projectiles, but as it relates to other phenomena of bodies in motion, we have received it as a fact, applicable to every case, and founded upon it a mighty system as baseless as a dream. We have assumed a vacuum as a demonstrated and indisputable truth, and we have banished with the plenum all the mighty powers of nature, with which we are surrounded: and all the discoveries of these powers, which we have made, have been owing rather to accident than to any really scientific process of investigation.

Having thus refuted the alleged impossibility of perpetual motion existing

in a plenum; the ground upon which the hypothesis of a plenum already stands, is preferable to that upon which the vacuum is maintained: inasmuch as it is an hypothesis, inferred directly by analogy from the known to the unknown in the proper course of philosophical proceeding: whereas the hypothesis of a vacuum is but an hypothesis deduced, its data being hypothetical, and one of them absolutely false. And with respect to all astronomical phenomena and laws, each hypothesis may be equally applicable.

In attempting, then, to establish the plenum as a truth, I observe—If Light be a material substance, it is manifest, that there is at least a *partial* plenum, both in the heavens and in an exhausted receiver. But a *partial* plenum, whose only effect could be to counteract motion, is not suggested by the analogies, but a plenum through which a force could be propagated which might act as a con-

tinued stress or as a continued preservative of motion. Such a partial plenum, then, however it must embarrass the hypothesis of a projectile force and a vacuum, is but a very small step towards the establishment of the plenum required.

'In the year 1719, a *meteor* very far exceeding the moon in lustre, and nearly as large in appearance, was seen over all the parts of Great Britain, Ireland, and Holland, the near parts of Germany, France, and Spain, at one and the same instant of time. Its apparent altitudes were accidentally observed by skilful persons at London, Oxford, and Worcester; and near enough to the truth by the assistance of the stars. From these observations its absolute height was determined to have been above 70 statute miles high. Over Devonshire, Cornwall, and the neighbouring counties, an explosion was heard equal to a report from a broadside of the heaviest cannon at some dis-

tance, which was soon followed by a rattling noise, as if many small arms had been promiscuously discharged. This sound was attended with an uncommon tremor of the air, and every where in those counties shook the glass windows and doors of the houses, and, according to some accounts, even the houses themselves, beyond the usual effects of cannon, when fired near at hand. It was also heard in the neighbourhood of London and beyond Lewes in Sussex. The meteor continued its course at the same height till it at length expired with a more violent explosion over the coast of Brittany. The account of this meteor was drawn up at length by Dr. Halley from the intelligence received upon the occasion by the Royal Society :* and he adds to the account the following reflec-

* Phil. Trans. No. 360, p. 978. The above description is from Jones's Essay, before referred to, slightly corrected from Motte's Continuation of Lowthorp's Abridgment, vol. ii. p. 138.

tion—" What may be said to the propagation of sound through a medium, according to the received theory of the air, about 300,000 times rarer than what we breathe, and next to a vacuum, I must confess I know not." A similar observation might have been made with respect to the appearance of a meteor at all at such a height beyond the limits of the atmosphere.

This meteor, then, to which might be added several of a similar nature,* appears fully to establish the fact, that there is an absolute plenum at 70 miles at least above the surface of the earth. Thus far then we have established a partial plenum throughout the whole heavens, and an absolute plenum to about twice the height which the received hypothesis allows. Further than this from the very nature of the case, we can only reason upon analogy and observation. In the

* See references in page 160.

heavens experiment is not within our reach.

It might be urged that the vacuum of an exhausted receiver, affords the foundation for an analogical argument in favour of the vacuum in the heavens. It must be admitted that it does. And if the vacuum of the receiver prove to be plenum, it must be admitted likewise, and *a fortiori*, that such a plenum of the receiver affords an analogical argument in favour of the plenum of the heavens. Let us then examine the case of an exhausted receiver.

The notion of a vacuum has so completely taken possession of the scientific world, that experiments upon this subject are extremely scarce, attention never having been properly directed to the point. Of late years, however, we have been introduced to a more familiar acquaintance with a fluid, or perhaps several fluids, more rare than air. To the Magnetic we have learned to attribute

the Magnetic properties. Place a compass in any part of an exhausted receiver. Its natural action and the operations upon it by a magnet are in no wise interrupted by such a vacuum; whence it is clear, that, at least, the magnetic fluid, whatever that may be, pervades every part of this receiver; and not only the chain of being, but the chain of action is propagated through it. Divert the northerly position of the needle with a magnet, and let it return. Whence does it receive its motion? By several experiments with the thermometer and other instruments, we find such an exhausted receiver is replete with Heat* as well as with Light, and with the Electric and Galvanic fluids, and this not in a diffuse and scattered manner, but in every part and point subjected to human observation. And it is of little consequence which hypothesis we adopt as to these

* See Newton Opt. 18th Query.

phenomena of Heat, Magnetism, and the rest, for if the hypotheses be rejected, which maintain them to be one, or to be distinct fluids and substances, the hypothesis, which would resolve them into motion only, answers the purpose of proving that the receiver is not a vacuum just as well, for these electric or any other motions, as we well know, cannot be propagated but through some substance moved, be it subtile medium or the grosser particles of bodies.

Again, if an elastic fluid, such as air, be projected into a vacuum, or into such a space as is only partially occupied, or occupied only by a rarer fluid, (under one or other of which denominations we must place an exhausted receiver, if it be not a plenum,) we find by experiment that it will not pass through such a space in a defined column; but, by its elastic force, immediately expands itself to every part of the receiver: nor will it pass to any distance, unless it is confined in the

column by a surrounding medium of about its own specific density. Light and Electricity are even more elastic than air. But when they are projected into an exhausted receiver, we find that, instead of expanding by their elasticity, they pass directly through it, in a condensed column. From this experiment we can draw but two conclusions. We must either conclude, that the space through which these columns pass, is not a vacuum, nor any part thereof, but that the whole is occupied by a fluid, at least about as dense as the projected column;* or we must conclude, that such fluids as Light and Electricity are not elastic. Upon the former of these conclusions the exhausted receiver is a plenum: and the latter makes a more fatal inroad among the qualities, and as applied to any of the hypotheses of light in the former experiments, involves within itself the

* For this experiment see Jones's Essay before referred to.

most complete refutation of the heavenly vacuum, that can be desired.

Carrying with us this analogy into the heavens; if they are but a vacuum, how comes it that the solar light glances along the edges of a planet, leaving behind the planet such a defined and extended shadow as is apparent in eclipses? It is not conceivable that such an elastic fluid as light would pass by such an empty space, without filling it by its immediate expansion. Whether we assume the hypothesis of Newton, or that of Huygens, with respect to the nature of light, or combine them both, the consequences involved are as absolutely conclusive of the plenum as any analogical argument is capable of being.

Sir Isaac Newton directs our attention to the following analogy upon the ascent of a comet's tail to the higher regions of the heavens.* 'Smoke ascends in a chimney

* See Jones's Essay, p. 121.

by the impulse of the air, in which it floats. The air, rarefied by heat, ascends on account of the diminution of its specific gravity : and it carries off the smoke entangled with it. Why may not the tail of a comet ascend from the sun after the same manner ?'* It is a fair and obvious analogy ; and if it accounts for the ascent of the comet's tail, it leads us directly to inference of a plenum, instead of the inferences which Kepler or Sir Isaac would deduce. The smoke and vapour from the fire do not ascend because they are carried up by the light, but because they are more rarefied than the air descending to the earth and fire. If, then, we strictly follow out the analogy, we must infer, not that the tail of the comet is carried up through vacuum by the

* Ascendit fumus in camino impulsu aeris cui innatat. Aer ille per calorem rarefactus ascendit, ob diminutam suam gravitatem specificam, et fumum implicatum rapit secum. Quidni cauda cometæ ad eundem modum ascenderit a sole.—*Pr.* 514.

light, but that the tail and light ascend together by the descent of some denser fluid towards the solar fire. And this is the more particularly decisive, when we consider, that the sun itself is the great centre of gravitation; and that the only philosophical account, that can be given of the ascent of any such body, is, that it is the well known consequence of the descent of some denser fluid or substance towards the centre of gravitation.

Lord Bacon, cautious as he was with respect to every hypothesis, decidedly and unhesitatingly maintained the plenum. Every analogy in nature leads to the same inference: and the few experiments and observations, that have hitherto been directed to the point, go far to convert that inference into a conclusion. If it be thus suggested as an hypothesis, it is the duty of philosophy to test it. And if it shall be hereafter admitted as a reality, the great chain of being is supplied, which is requisite to

unite the different, and often apparently conflicting phenomena of Physics with each other in one connected system.

The same analogies, which suggest a plenum as the connecting chain of *being*, suggest likewise a continued stress impressed upon the plenum, and everlastingly maintained by its Creator, as the chain of *action*, to which the motions and powers of nature must be referred.

Having started such an hypothesis, if we pleased, we might amuse ourselves, with respect to Gravity, by calculating, upon our present theories of pressure, what would be the effect, upon two independent solid bodies, placed in a plenum, affected on all sides with a continued strain. We might perhaps arrive at the conclusion, that, each intercepting the strain from the other, a mutual gravitation would ensue. We might also attempt to calculate the laws of such a gravitation; and, if our theories of pressure had been well established by Induc-

tion, such a calculation would at once bring the hypothesis to the test, and determine whether it were sufficient or no to account for the phenomena. But, unfortunately, those, which we call our theories, are one of the most deficient branches of philosophy, raised upon very partial inductions, and are only hypothetical systems. As we have not the data, upon which these calculations can be made, such a proceeding would be no better than ingenious trifling. Our only resource, then, is to bring it to the test of Experiment; and, what would be the effect, it is not in our power *a priori* to decide. Experiments for such a purpose may easily be devised. But in this treatise it is not my intention to follow up, by such experiments, the suggestions which the present state of science enables us to propose. Nor should I have said so much upon the vacuum, but that the prejudices of the philosophical world lie so strongly in the opposite direction, that

the doctrine of a plenum has never yet had an impartial examination: yet I humbly conceive, that this notion of a vacuum is the main obstacle to the introduction of a new era in science, and even to its completion in the ascending scale.

Here it might be required—Upon the hypothesis of a plenum how are the celestial motions to be accounted for? If, by such a question, a complete explanation of the causes, which maintain those motions, be demanded; it is a demand for an hypothetic system, and mere trifling. Galileo, Kepler, and Sir Isaac Newton, have ascertained the *laws* of the system of the universe. These laws are admitted by all: and thus far there is neither question nor dispute. The next object is to ascertain the *causes*. And of these, almost all men, whether they believe in the hypothesis of a plenum or of a vacuum, profess themselves in equal ignorance. Such, as presume in the

present state of science to any real knowledge of the causes, only display that ignorance the more, by proving that they do not even comprehend what is the subject under consideration.

To the causes, then, we must inductively ascend step by step. The first and fundamental question in this new inquiry is, whether there is a plenum or a vacuum. Two opposite hypotheses are started. And, until one of them is actually proved, all further proceedings must necessarily be purely hypothetical. To explain the phenomena upon the hypothesis of a vacuum we must graft upon it two more hypotheses, viz. the Inertia of Matter as an *inherent quality*, and Gravity likewise as an *inherent quality*. To explain the phenomena upon the hypothesis of a plenum, we might in like manner graft upon that assumption two more hypotheses; one to account for the continuance of the motion in a right line, such

as the hypothesis of Aristotle, that a stream of air follows* a projectile, or a stream of ether, or of electricity, or the like, maintained by a continued external stress upon the fluid; the other to account for the gravitation of one body to another, such as intercepted pressure, or intercepted stellar rays, or some such hypothesis as has been founded upon the circumstance that the circle of illumination on a body enlightened by the sun varies inversely as the square of the distance, or that the action of the electric fluid varies according to the same laws, or any other of the numerous hypotheses, that have been suggested. But in both

* If the arm be bared and whisked swiftly through the air, the action of the air behind it, and apparently impelling it, is far more sensibly felt, than the resistance in front of it. It might be a question, by how much the resistance exceeds the impulse? and whether such impulse be in fact aerial or etherial? It is evident, however, that the supposition of a vacuum behind a projectile is only an hypothesis deduced.

cases it is only laying one hypothesis upon another, a method of proceeding not to be admitted. The first hypothesis must be converted into a conclusion, before we can legitimately proceed. If, however, we use the terms Inertia, Gravity, and the like, only conventionally, to express the unknown causes of the phenomena, all is right. And every dispute, that can arise, will be a disputation upon words, and not upon things: and it may be immediately settled, by a demand for the definition of the terms employed.

I might adduce some curious observations, I have met with, to show that the Attraction of Cohesion, as well as all the phenomena of Repulsion, might also be resolved into this continued strain, impressed upon the etherial plenum. But such a course would be also deviating into the regions of hypothesis and placing one hypothesis upon another. It may, therefore, be sufficient, here, to obviate

an objection, upon which some stress has been unnecessarily laid. If we examine any solid body, we find it is constructed of independent particles, but loosely as it were, and permeated by pores, through which such a fluid, or it may be motion, as the electric, flies almost uninterruptedly: and, if these pores be pervaded by the supposed etherial fluid, a strain, operating upon that fluid, would not act upon the surface of the body, as Sir Isaac Newton suggests, but on its internal structure, and upon every particle which composes it. But whether it would operate to its dissolution, or to its cohesion, and gravitation to any other body directly as its mass or as its surface, is not matter for our mere conjecture, but is a subject for experimental examination.

Upon the other Powers of Nature I shall say but little at present. It is well known to Mechanicians, that man cannot

increase his power, by any combination of Machinery, save only as by such means he can bring his force to bear more regularly and uninterruptedly. What he gains in power, he loses in time. And if by the aid of simple machinery he can raise an undivided ton in 5 minutes to the height of 20 feet, he could raise a quarter of hundred weight to the same height by his unassisted power in 1-80th part of the same time. How comes it, then, that he is enabled to construct machinery, by which he can produce effects far beyond all human power? It is thus. By various contrivances and combinations he is enabled to press into his service powers, that are not his powers—forces with which he is surrounded, and which are at his bidding in every place and time. The powers supplied him are not created nor increased by his machinery, but are supplied indefinitely to the exertions of his skill. Knowledge is indeed power, in-

asmuch as it enables its possessor to bend to his will powers superior to his own. And the extension of knowledge has given to this kingdom in particular a supply of force unequalled by any nation upon earth.

Again, If we examine some of the common operations of nature, over which man has little or no control, we find new forces and movements introduced, unaccountable upon any of the received systems of philosophy. Wherever a fire is lighted, a wonderful kind of motion commences among the elements, very different from what can be supposed to have been communicated by the agent that produced the spark, or could have resided within the spark itself. Light issues on all sides from the fire, and an incessant draft of air sets into it; and there ensues a motion continually accumulating and increasing, and communicated to the objects around it; and instead of losing motion by such communication, the

longer it continues the more violent, intense, and extended it becomes, producing such a variety of movements by the descent of walls and timbers, by the overthrow of houses, trees, and all obstacles within its reach, as to bid defiance to all ordinary rules of action and re-action, cause and effect: 'and no man knoweth whence it cometh, or whither it goeth.'

To the explanation of such phenomena as these, our laws of motion are utterly inadequate: and in every attempt we feel ourselves beyond our depth. Not that these laws of motion are overthrown so far as they relate to projectiles and the like; for, with respect to them, they are founded upon Induction. And when we shall have advanced into these higher regions of philosophy, I question not, but that their empire will be extended, so as to embrace these phenomena themselves. Or perhaps some more general laws of motion will be discovered, which will

comprehend the present under them, in like manner as the law of gravity, constant upon the surface of the earth, was nevertheless, by the extension of science, comprehended under the more general law of its inverse variation.

That, in a great multitude of instances, new efficient forces are introduced is very evident. We may satisfy our immediate purposes of use and language by calling them the Powers of Elasticity, Expansion, Inertia, and the like: but the question still returns—Whence are these forces proximately derived? Stewart* has enumerated the following hypotheses, which have been started for the solution of this question.

That the phenomena of nature are the result of certain active powers essentially inherent in matter. This doctrine is commonly called Materialism.

* See his Outlines, p. 184, and also his Appendix to the first volume of his Essay on the Active Powers.

That they result from certain active powers communicated to matter at its first formation.

That they take place in consequence of general laws established by the Deity.

That they are produced by a vital and spiritual, but unintelligent and necessary agent, created by the Deity for the execution of his purposes—the hypothesis of Cudworth, which he attributes to Plato and Aristotle.

That they are produced by mind, connected with the particles of matter.

That the universe is a machine founded and put in motion by the Deity; and that the multiplicity of effects which take place may perhaps have all proceeded from one single act of his power.

To which he adds the following, which he maintains, That the order of the universe is not only at first established, but, every moment, maintained by the incessant agency of one supreme mind : which

doctrine, says he, does not exclude the possibility of the Deity's acting occasionally by subordinate agents or instruments.*

That the powers of nature are powers independently inherent in matter, none but the materialist maintains: and we must admit them either immediately or ultimately to be the result of some spiritual agency. To pass over such of the hypotheses as no one now maintains, the inquiry resolves itself into the following—Whether, in the present constitution of the world, the spiritual agent acts directly by his immediate power, or by secondary causes.

That subordinate material instruments are *occasionally* employed is manifest to every observer every moment of his life. Upon the notion of a vacuum and the impressed or inherent qualities, it is equally manifest that secondary causes cannot be *universally* instrumental to the

* Page 185.

phenomena. Upon this system, then, as proposed by Stewart, we either miss the real question entirely, or we are driven to conclude, that the operations are conducted, partly by secondary causes, though chiefly by immediate influence. Thus, for instance, when the twig of a tree is bent by the *wind*, and recovers its former position by its *elasticity;* the first operation is performed by means of secondary causes, the other by the immediate interference of the Deity: and if a perpetual vibration of the twig is kept up, it is kept up alternately by the one and by the other. Again, in the working of a steam engine, the pressure and operations of the water, the air, and the different combinations of the wheels and machinery attached, are secondary causes, acted upon, and acting upon each other, according to mechanical laws and principles: while the *gravity* of the piston, the *elasticity* of the steam, and the *inertia* of the fly-wheel, are the

result of the immediate interference of the Deity, likewise acting according to mechanical laws. And upon this supposition of *immediate* interference and control, we are urged to conceive, that we ascribe unto the Lord a mightier display of majesty and power, which cannot fail to impress a more devout dependence upon him, as our Ruler and Creator. We ascribe unto him however a broken, confused, and disjointed production; and such an hypothesis, as I before observed, has been almost universally rejected by the ablest metaphysicians upon the a priori argument of Causation. Alphonso, King of Spain, would probably have received it with the same sarcasm as he used toward the Ptolemaic hypothesis of the universe. The implied censure of Newton rests upon it. But it has been more sternly reprobated by that great philosopher, whom we justly venerate as the father of modern science, whose enlarged views and chastened wisdom, in

every thing which concerns this branch of philosophy, have been most lamentably overlooked. "Certain it is," says Lord Bacon,* "that God worketh nothing in nature but by second causes; and if they would have it otherwise believed, it is mere imposture, as it were in favour towards God; and nothing else but to offer to the Author of truth the unclean sacrifice of a lie."

Of the Force of Animals, it may well be questioned whence it is derived, whether it be originally communicated by the Soul of the animal itself to the material world through its connexion with the body, or whether the soul has power only to influence and divert the motion and force, with which that body may be surrounded. No part of physical science is involved in such obscurity. "I will to raise a weight," says Dr. Reid,† "and

* Advancement of Learning, page 12.

† Active Powers, 109.

no sooner is this volition exerted than the machinery behind the curtain falls to work, and raises the weight." This is well nigh the sum and substance of all we know about the matter. The Galvanic powers and structure of the brain, alluded to by Dr. Arnott and Sir J. Herschel,* have a tendency to show that the mere animal motions are conducted upon the same principles as is the other mechanism of nature, whatever may be the influence, through which the soul operates to govern and promote its action.

To the ancients, who held the World to be their God, Matter its body, and the Etherial powers of the heavens its soul, little difficulty could occur in resolving the motions and forces of the elements and gravity, as well as all individual animal force into the powers of this present universal Deity. By such a solu-

* See also Aristotle, VIII. Phys. 2. 6. and his treatise De Motu Animalium, and III. De Cœlo 2.

tion, it is true, they completed and perfected their bastard system of Physics; and reduced all causes to one simple triplicated chain: and the Efficient, the Formal, and the Material, might be successively traced from the highest intellectual operation to the lowest sensible phenomenon.

To us, however, who hold the Spiritual world perfectly distinct from the Material, it must be the grand object of philosophy to trace the chain of causes from matter to matter, to the first of secondary causes. At these secondary causes, previously to the great reformation of their religious systems, introduced shortly before the time of Pythagoras, the earlier nations of the world unfortunately stopped, nor raised their minds above the material system of the universe. They appear originally to have been acquainted with revealed truth, and by the refinements of philosophy to have fallen into materialism, and naturally and gradually

to have descended to the grossest depth of atheism and idolatry.

It is well observed by Lord Bacon—That it is "an assured truth and a conclusion of experience, that a little or superficial knowledge of philosophy may incline the mind of man to atheism: but a further proceeding therein doth bring the mind back again to religion: for, in the entrance of philosophy, when the second causes, which are next unto the senses, do offer themselves to the mind of man, if it dwell and stay there, it may induce some oblivion of the highest cause: but when a man passeth on further, and seeth the dependance of causes and the works of providence; then, according to the allegory of the poets, he will easily believe that the highest link of nature's chain must needs be tied to the foot of Jupiter's chair." Natural history leads us to the contemplation of the wisdom and goodness of the Almighty: and Causation directs us to a

perception of his power; to regard this universal frame, with all its myriads of worlds, as one connected whole, and as it were his footstool, bearing upon it the continued impress of his might.

Such is the hypothesis upon the construction and the powers of the universe, which I would venture to suggest, or, with greater propriety I would say, to revive. That all physical force is proximately dependant upon the powers of the heavens, and that they consist of a plenum, is no new hypothesis, but as old as Heathenism itself: and the hypothesis properly modified, I believe, is even of still higher antiquity. Yet it is advanced, not as a system to be believed, but as an hypothesis to be tested by Induction. In England, every such hypothesis, of late, has generally been passed by unnoticed, and unworthy even of examination, upon the idle unfounded supposition, that the Vacuum has been demonstrated in the Principia of Newton, and that the Ple-

num runs counter to the mathematical principles of the Newtonian philosophy. It is a fallacy, however, by which, few of the most celebrated philosophers have ever been misled: and unhesitatingly they have received the *laws* of gravitation, announced by Newton, without in any manner abandoning their speculations upon Causation.

We profess to follow Bacon, we admit his principles and experimental *method* to be correct, and we desert him in the very next step, upon Causation, that is to say, upon the *objects*, to which our attention should be directed. He argues justly, from what he knew to what was unknown, and arrives at the same *result* as did the ancients, that the Heavens are a plenum, and that all the operations in the world are conducted by the Almighty through the instrumentality of second causes. Modern philosophers generally maintain a position directly the reverse.

It is not for any one at present to venture a decision on the question: and herein I have but endeavoured to bring the subject more fairly before the world. And Time will shew, whether this, which is held to be the weak part of Bacon's philosophy, is weaker than the rest.

The origin of motion and force is one of the grandest physical problems that ever engaged the attention of philosophers. Perpetual motions acting in any system must influence all things within their reach: and from them secondary motions must in a great measure, or at least in some measure be derived. All motions imply force: and such force must be derived ultimately or immediately from a spiritual agent. It was a favourite problem among the ancients to distinguish the primary from the derivative motions, and to ascertain at what parts of the system the spiritual forces were applied.

The hypothesis and opinions of celebrated men upon such a question, however wild and vague, are not unworthy of consideration. Many, like Descartes, have conceived that a certain quantity of motion was originally communicated to the world; that no part of it was ever lost; but that it was bandied from one portion of matter to another in an eternal succession.

I omit further mention of the speculations of Cudworth, Berkeley, and of some eminent philosophers, ancient as well as modern, who have taken singular views upon the subject, as their speculations have been frequently and fully examined, and have been the subject of much controversy among metaphysicians, and their attendant difficulties ably pointed out.

Lord Bacon, as a strenuous advocate for the plenum, has forcibly directed our attention to several curious phenomena, connected with the preservation and origin of motion, which unfortunately

have never received that consideration from the philosophical world, which the suggestions of Lord Bacon of right demand, and usually obtain.

If we pass on into antiquity, in the writings of Aristotle we find a clearer and a steadier light. He connects the problem at once with Causation: and from a very extensive induction and examination of the opinions of preceding philosophers, he presents us with the two chains of *Being* and *Motion*,* as the proper objects of physical investigation. He derives the chain of motion proximately from the Heavens, which, in common with almost all the heathens, he regarded as a vast, incorruptible, and ever circulating God: but through the intervention of this deity, he derives it ultimately from the immoveable first

* He does not, that I am aware of, make any distinction between the Dynamical and Statical forces, both which I have comprehended under the term *action* as a generic word.

principle of all things. And he conceived that it was applied at the circumference to revolve the sphere: while many others, as he informs us, imagined that it was applied at the centre. Plato has handed down to us much the same conceptions: but he has not entered so fully into the discussion of the chain of action. Both Plato and Aristotle, however, appear to have derived their notions chiefly from the Pythagoreans,* who imported them from abroad. It is true that Aristotle is inclined to claim for himself the discovery of the causes upon the induction, which he has given. Yet his arguments, as well as those of Plato, on these and very many other subjects are so inconclusive, with so many omissions of the intermediate steps, in the natural progress to such generalities, which appear to have been, to them, unnoticed

* The Pythagoreans, however, conceived it was applied at the centre.

and unknown, and which have only been supplied by the science of modern times, that the conclusions seem rather to be the broken fragments of some earlier connected system than any inventions of their own. And if we had not been acquainted with the fact, that they had largely borrowed elsewhere, we could hardly have given them credit as the original inventors of such speculations as are to be met with in their writings.

With their philosophical speculations, the Heathens invariably blended their theology. I have elsewhere collected the fragments, and endeavoured to trace the changes and modifications, which took place in the philosophical and theological speculations of the higher ancients. Nothing perhaps is more uniformly insisted upon among them than the plenum, and divinity of the heavens, and that the first great moving principle of the universe sprung forth from them. In the beginning were the

Ether, and Chaos, or, in the language of the philosophers, Mind and Matter, which were regarded as two primeval, eternal, and independent principles, the first of a vivifying and intellectual nature, the other, a watery chaos, boundless and without form; both which continued for a time without motion, and in darkness. By a mystic union of the two was formed the great Pantheistic deity, the One, the Universe itself; of which the Chaotic matter presently became the body, and the Etherial Intellectual principle the soul. At the commencement of this union, from the Ether sprung forth the Triad, Phanes or Eros, a triple divinity, the most prominent character of which was Light. He organized and completed the fabrication of the system, and, at the conclusion of his work, he became the sun, thenceforth the Soul and Ruler of the world. The primeval Ether and a triad of three distinct and coequal powers or persons, concentred in the sun, cor-

responding in their human character to the great Patriarch of mankind and his three sons, appear not only from the fragments, which have reached us through the medium of the Greek language, but from the Hindu, Peruvian, and many other independent mythological sources, to have been the original Monad and Triad of the Gentile world. An examination and comparison of the different systems show, that the persons of this solar triad, viewed under a physical aspect, were regarded as the Fire, the Light, and the Ether, three conditions of one and the same etherial fluid substance of the heavens: while in a metaphysical aspect they were commonly conceived as certain attributes of the Supreme mind, and were variously combined as the Principle of action, Power, or Will, the Intellect or Reason, and the Spirit of the world; accordingly as the prior Monad was contemplated, physically in its Etherial, or metaphysically in its Intellectual subsistence.

The constitution of this triad of the Sun, as the secondary origin of motion to the system, scarcely enters into the subject of the present inquiry. But as we have arrived, by a very different path, to nearly the same hypothesis, which, in his excentric speculations, was maintained by Hutchinson, as the physical system of the Scriptures, it may not be amiss to say some few words upon it, as a subject of curiosity, which, in the earliest ages, appears to have been maintained as a fundamental tenet of a mighty system of speculation; traces of which are to be found in the antiquities of every nation upon earth.

Neither Hutchinson nor any of his followers seem to have been aware, what strong confirmation of their hypothesis, in this particular, is to be found among the relics of the earlier Gentile world. And he appears to have fallen into the very same mistake, which originally tended to mislead, and plunge the nations into

materialism, and the worship of the heavens, in that he resolved the strain upon the heavens, and all the derived force in the universe, into the expansion caused by the motions of the solar triad. And he regarded the world as a machine, originally constructed and set in motion by its Creator, and thereafter left as a self-acting and independent combination, whose powers were concentred in the sun; instead of reversing the hypothesis, and resolving the motions of the solar triad, and of all the mundane operations, into the force upon the plenum, originally impressed, and still maintained by, and dependent upon, its Creator. The system of Hutchinson has long since passed into oblivion; or is remembered only as an ingenious speculation. The discovery of the bases and component gases of the air overthrew its fundamental tenet, that the Fire, Light, and Air, were only different appearances of the same etherial substance. Yet, from the resemblance

of the Sun to common fire, and the discovery of the chemical union of the bases of the air with those of the consumed fuel, in the process of combustion, evolving water, and carbonic acid gas, accounting *accurately* for all the materials, except the ether of the gases lost or destroyed, and the light generated or thrown off, leaving these as residual phenomena, perhaps convertible into one another, I conceive that the substitution of the word Caloric or Latent Heat or Ether, for Air in that hypothesis, or it may be only the converging force converted at the centre into that diverging motion which may be light, would suggest a modification right well worthy of attention. Many, however, are the steps, which must be proved, before this part of the subject can even be legitimately approached. By all such speculations we are only tacking one supposition to another, and weaving but an hypothetic system; using analogy not in its legiti-

mate province, but, as Lord Bacon calls it, for the purpose of anticipating nature; and running into the common error of the ancients, of proceeding from one step to another without stopping to prove our progress.

Upon the Metaphysical triad of the ancients, most probably derived, at least in part, by analogical reasoning from the contemplation of the human mind; and upon the divisions of the mental powers which have obtained among philosophers, I would make some few observations.

Metaphysicians have at length approximated to a truth, which, in the Metaphysics of Christianity, is laid down with as much perspicuity and decision, as is the Immortality of the Soul, or any other of those points which have been so continually agitated among philosophers, modern as well as ancient. The distinction between the Intellect, and the Emotions or Affections, to which, simple

as it may appear, such laborious approaches have been made through the mazy paths of Metaphysics, is clearly drawn in the Scriptures; and the respective seats of them are assigned, it may be figuratively, but most naturally, to the Head and Heart:* and to the heart the Scriptures most constantly appeal, as Religion is rather directed to the Feelings than to the Understanding.

The old division of the Mental Powers into those of the Will and the Understanding, has long been superseded by the division of the school of Reid, into the Intellectual and Active Powers. But, under the name of the Active Powers, are comprehended the Will and some

* The Faith mentioned by St. James is evidently the mere opinion or belief, which arises upon the conviction of the Intellect alone. Nor does it become the justifying faith, insisted upon by St. Paul, till this belief is enlivened by the Affections of the heart. When the Head and Heart concur, the Works of the whole man must of course tend to one and the same object.

part of the Emotions: while the more refined Emotions, and the complex Intellectual and Emotional Feelings have been confounded with the Intellect; an error, which likewise runs through the writings of Kant, Plato, and many of the ancients. Metaphysical science is greatly indebted to Brown, for having so forcibly directed attention to the distinction between the Intellect and the Emotions; but, in common with later writers, he appears generally to regard the Will as a subordinate appendage to the Emotions, connected perhaps with the material structure of the animal.

There is an ambiguity in the words Will and Volition. The Will may be divided into the general capability of *Wishing*, and into the general *Power of acting*; the Volition into the particular *Wish*, and into the particular exertion of the *Power*.* The Soul *thinks*, *wishes*, *acts*;

* Dr. Clarke draws a distinction somewhat similar. "But it plainly appears to me, that there

and the Power to act appears to me to be a mental Power, as distinct from the Wish or any of the Emotions, as it is independent of any material structure or combination. We may conceive a disembodied spirit with the Intellectual Powers, the Train of Thought, only, without the Emotions; and again such a spirit, with the Intellect and Emotions, without the Power of action: and such

is an error which lies under the word Volition. Under that term you include both the *final perception* of the Understanding, which is passive, and also the *first operation* or exertion of the Active faculty or Self-motive Power. These two you think to be necessarily connected. I think there is no connexion at all between them: and that in their not being connected lies the difference between Action and Passion; which difference is the essence of Liberty." *II. Letter to a Gentleman*, p. 410. Here the Active faculty or Self-motive Power is distinguished from the Intellect: but no notice is taken of the Emotions: yet it is most questionable, whether the Self-motive Power is ever exercised without the intervention of some Desire or Emotion.

a being might be susceptible of every sentiment terminating in contemplation, such as all intellectual Tastes, Memory, Regret, and a variety of others. Stewart, in his speculations upon persons dreaming, supposes the Intellectual Powers with the Train of Thought in exercise, while the Active powers are suspended. But, of the Faculties which are confounded under the name of Active Powers, it is manifest that the Emotions are not suspended: and, though the voluntary Power over the material frame is very generally unexerted during sleep, it is a very singular phenomenon, that when the Wish or desire itself to do any particular action arises, the Soul presently takes it for granted that the deed required is actually done; and the train of thought is influenced and diverted though the power is not exercised; and, though the wish is not really gratified. And there is nothing more common in nature than to have the wish without

the power to act, or the power without the wish.

That animal motions are in a great measure carried on by the mechanical powers of nature, supplied externally to the occasion, is highly and extremely probable: yet at the same time it is evident that the soul must exercise some *Power* of action distinct from the desire, however hidden and mysterious it may be: and that Power of action, whatever it is, I conceive should be ranked as a distinct division of the Faculties.

It is ably shown by Brown, that to the Power of action in the human frame, we are indebted, as to another sense, for our ideas of Causation, which is, as it were, the object of that mental faculty; as Science is the proper object of the Intellect and Head; and Religion and Ethics of the Feelings and the Heart; while what we distinguish, as Sensation, is but the *internal* feeling of the mind, when excited by some *external* cause.

If we look more closely into the construction of animal bodies, we may observe in their involuntary motions, and a variety of other phenomena, something of a material or corporeal spirit or frame of life, acting independently, though occasionally influenced by the immortal soul. It is common also to vegetable beings: and its operations appear to be carried on solely by the powers of nature through the instrumentality of the Sympathetic nerve. Many philosophers have attempted to account for it by a secondary soul, as did Plato; others by a plastic nature, or by the immediate interference of the Creator. But analogy seems to direct us to seek it among secondary causes only; and would lead us to the inference, that *Nature*, with all its powers, is no other than this Machine of the universe, for which it is but a name, a machine wonderfully and fearfully contrived, whose action, motions, and forces are preserved by the continued

impress of Almighty Power. To this beautiful and wonderful combination of the material frame, not only of the universe, but of all the organic bodies it contains, carried on apparently with so little of external aid, is to be attributed much of that materialism, which is to be met with among men, of some philosophical pretensions indeed, but whose views are so warped by the pursuit of one particular branch of science, as to rest solely in the secondary causes first presented to the senses, without lifting up their eyes to comprehend the higher and more intellectual bearings of philosophy.

Upon the metaphysical speculations, drawn from the material world, and upon the proper use and abuse of Analogy in that respect, I would make some further observations.

Of all arguments whatever, the most dangerous are those, which are deduced

by analogies drawn from the material to the mental world; between which there is no natural similarity. Mind and Matter, in their *substances* are equally to us unknown; and in their *qualities* or properties, if we may justly apply such terms to mental phenomena at all, they are the very reverse of one another. What similarity can possibly be traced between the solid, extended, tangible, visible, divisible, inert, and moveable masses of matter; and the invisible, unextended, impartible, ever-active, and probably immoveable essence, which we conceive under the name of mind? When, therefore, we reason analogically from one to the other, so far from arguing from like to like, from species to species, we argue not even from genus to genus in the most remote degree, but from one thing to its contrary. Is it then at once to be acknowledged, that no analogy whatever can be sustained between them? The experience of every moment tells us

that this is not the case: for, though it is most true, that they exhibit no similarity of substance, form, or quality, yet, strange as it may appear, there are nevertheless the strongest analogies upheld between them. And it is upon these analogies, that some of the most important interests and speculations of the human race depend. "The analogy of the material world," says Sir James Mackintosh, "is indeed faint, and often delusive, yet we dare not utterly reject that, upon which the *whole technical language* of *mental* and *moral science* is necessarily framed."* All our *ideas of sensation* are necessarily derived from the Sensible world: and in the language of its images are all our mental speculations clothed. We might indeed have gathered up *metaphysical notions* from mental contemplation and analysis; but unless we expressed them in the language of *physical ideas*, and of the ma-

* Dissertation, 406.

terial world, we should have been altogether unable to converse upon such subjects. Had there, then, been no kind of similarities between them, the most important subjects could never have been disseminated amongst us: and, unless a different constitution had been provided us, we must for ever have remained in the deepest ignorance of the great ends and objects of our existence.

It has not unfrequently been a puzzling question to philosophers to account for this strange paradox, of such striking analogies as are presented between these two great classes of subjects, the most unlike in nature, and the very opposite of one another. I would venture to suggest that this apparent anomaly takes its rise from inattention to the subject of Causation, and its two distinct chains of *Being* and *Action*. Between the mental and material *Beings*, it is true, that no similarity exists; but between the chains of mental and material *Ac-*

tion, between their Adjuncts, Relations, and Circumstances, the most striking resemblances must be acknowledged. Nor do these Resemblances appear to be accidental; but rather to be thus adjusted and contrived by the Creator, for the purposes to which they have been so universally applied. Force, Motion, Place, and Time, have precisely the same relation to Matter, as Power, Change, Coexistence, and Succession, have to Mind, and, as it were, typify each other to our comprehension; whilst all the relations of Number are equally applicable to both.

We talk justly of *analyzing* and *combining* ideas; for, as we must express ourselves in some material images, the language of Chemistry is perhaps the most adapted to explain our sentiments. Moral qualities are said to excite our moral feelings of disgust or approbation, pain or pleasure, as the same feelings are actually excited by the physical qua-

lities of the bodies with which we are conversant. But it is in the unceasing agency, exerted by external causes, in the continued action by the powers of nature upon our bodies, maintaining their life, and functions, and involuntary motions—and in the unceasing, ever-flowing train of thought and feelings in our souls, maintained in like manner, independently of our will, we know not how, but it must be by some spiritual and not mechanical agency, that the closest similarities are to be observed. Nor are such similarities to be traced only in the individuals; but perhaps more decidedly in the great continued chain of external action, by which each individual is connected with each of its own world.

The independent chains of mental and material successions of action appear, as it were, continually to come into contact, yet never cross. When a clock has struck, a material movement is conveyed along the auditorial apparatus to the

sensorium ; and according to other systems besides those of the materialists, *motion* is communicated to the soul itself. Yet analogy, I may say experience upon all natural bodies, would lead us immediately to presume that the motion, after a momentary concentration in the sensorium, is again communicated through the brain and skull to the surrounding air, and that no part of it can be lost to the material world by being communicated to the immaterial. Through our sensations the internal train of thought is continually varied by the external chain of action : and through our mental power the external chain of action is influenced and diverted in compliance with our inward thoughts and designs. And by means of this subservient chain of material action our communication with each other is upheld.

Yet by such analogies, how often are we led astray ! We talk of being acted upon by motives, as by weights in a

balance. We *ponder*, we *weigh* arguments, we *balance* objections, and we *decide*. In these instances we do not speak improperly; yet, if, by such language, we are led to fancy, that the mind, which weighs, is to be compared with the balance itself, instead of with the person, who holds the balance and judges of the operation of the weights;— if we are led to imagine that the same irresistible influence is exerted upon our minds, as is exerted upon the scales; we use analogy, not in its proper sphere, as the mere *suggestion* of a probability, but as a *proof:* and we wander still further from the path, and conceive a similarity, where none exists, comparing the weight itself a *material being*, an *antecedent cause*, with the *Motive*, no being at all, no antecedent cause, but a mere *object*, a *final cause*, which some spiritual agent or *antecedent cause* proposes to compass or avoid. Yet it is to this favourite and fallacious argument, that the assertors

of the philosophical scheme of Fatalism and Necessity have most commonly recourse: and chiefly upon such grounds as these are our Free will and Responsibility denied.

Analogy, as an instrument of *proof*, is feeble, and never to be relied on: as an instrument of *invention*, founded upon similarities, suggesting probabilities and hypotheses, it is the very right arm of science: and as a weapon of *defensive argument* against the sceptic, it is one of the most powerful that was ever wielded. In its first capacity, unfortunately, it has been but too generally used; in its second, almost wholly overlooked; but in its third, its powers and temper have been most ably proved in one of the first metaphysical works in the English language, Butler's Analogy.

The analogical arguments of Butler are unanswerable. If such and such particular circumstances occur, or are

permitted here in the material world, God's book of nature, why should we object to similar apparent anomalies in the moral: or why should we think certain truths in God's book of Revelation too hard for us, when we behold them, typified before our eyes?

> If plagues and earthquakes break not heaven's design,
> Why then a Borgia or a Cataline?

If the Chrysalis, having put off the earthy existence of the worm, is raised to an aerial and more glorious life: why should not this corruptible put on incorruption, this mortal, immortality? Where is the stumbling block to the resurrection of the body?

If the slightest incident occurs not in the material world by chance; but the causes of its occurrence may be traced in the great chain of universal guidance; if every flower of the field is reared by second causes, nor broken but by direction—Is it to be supposed that war, and

pestilence, and suffering, are loosed upon mankind by accident; or that any human being is subjected to injury or sorrow by mere chance, or at the caprice of such a creature as himself? Are we not a fortiori instructed by the analogy, unhesitatingly to receive the truths of revelation, that there is a moral and a final cause for moral suffering? Are we not directed to look beyond the chilling figment of the Optimist and Heathen, which would limit the power of omnipotence to general workings only, and to rely upon an overruling providence having an especial regard to the welfare of every individual creature?—to rest in faith, that no Spirit can inflict an injury upon another, unless by its own assistance or default;—that the crimes of the oppressor are only injuries to himself; and, if humbly received and appreciated, are converted immediately or ultimately into blessings to the oppressed?

When we see that every particle of the material world is connected in its bearings with every other portion of the same, not on this earth alone, but throughout the system of which it is a part—when we observe likewise that the conduct of each individual upon the surface of that earth extends its moral influence to his neighbours, expanding in a wider and a wider circle, concurring with the rest, till it influences the destiny of the whole—May we not conceive the possibility of a moral connexion beyond its sphere?—And when we comprehend the glorious discoveries of Herschel, and find the earth 'and all that it inherit' shrinking to a less conspicuous station in the whole, than we may now conceive is occupied by the humblest individual upon her surface—Are we not almost tempted to regard, not only the material globe but the moral system, to which it is subservient, as a small and individual part of a comprehensive and connected whole;

and *a priori* to suppose that a primeval taint upon its purity, like the crime of any human being, would remain with it in its consequences, rankling to the last hour of its existence, unless redeemed and rectified, according to its wants, by superhuman aid?

And if future discovery should ever present to us the great ruler of our material system here below, under the trinitarian aspect of Fire at its orb, of Light proceeding from it, and of Spirit returning to it, three conditions of one and the same etherial substance—if such an hypothesis is merely conceivable, though unproved—if such a mystery can take place in matter—why should the minute philosopher shrink from the revelation, that has condescended to instruct him in the great mystery of the Christian faith, of Three Persons in one God, each uncreate, almighty and incomprehensible, in glory equal, in majesty co-eternal?

The passages in the Scriptures in which the persons of the Christian Trinity are shadowed forth, physically, by the same natural powers which are supposed to constitute the original triad of the Gentiles,—and spiritually, not as the mere attributes or faculties of a supreme mind, as represented in the heathen triads, but as distinct persons, claiming such peculiar attributes or respectively condescending, in the covenant of grace, to address themselves to such faculties of man, are too numerous to require to be specifically referred to. The Father is continually typified as a Fire accepting the sacrifices, consuming and punishing the guilty, as the Lord of all power and might, the dispenser of blessings, to whom all prayers are commonly addressed, the fountain of divinity, approached and known to us only through the mediation of the Son—the Son as Light, as a Mediator and a Teacher, enlightening

the understanding, addressing himself more particularly to the Intellect, pointing out the distinctions between good and evil ;—the Spirit, as Spirit or Air, a mighty rushing wind, operating upon the Affections, Feelings, or Emotions. We are commanded by the Christian faith to look to the Son for knowledge, to obey his instructions, and to accept the conditions of Salvation he has offered —to the Spirit, for grace to influence us in all our feelings, wishes and intentions —and to the Father, our prayers are to be directed for pardon for blessings and for the power to act.

I would not presume to lay stress upon any of the hypotheses I may have advanced or adduced in this inquiry. Man is apt to indulge his fancy in building systems, which he conceives may set forth the wisdom and goodness or magnify the power of his Creator ; but when he brings them to the test, and finds the

truth itself, he finds it infinitely more sublime than the happiest flight of his imagination. Yet as we must necessarily take all our ideas, as well as our language, from the sensible world—as we are taught that it is a glass, in which things spiritual are purposely, but darkly, shadowed forth—and as Physical science is naturally subservient to Mental, and both are but the handmaids of Religion; I deem that we outstep not the bounds of true philosophy, when, in the glorious works of the Almighty, we humbly trace a confirmation of his word.

FINIS.

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