Man, being the servant and interpreter of Nature, can do and understand so much and so much only as he has observed in fact or in thought of the course of nature. . . .

Human knowledge and human power meet in one; for where the cause is not known the effect cannot be produced. Nature to be commanded must be obeyed; and that which in contemplation is as the cause is in operation as the rule. . . .

It would be an unsound fancy and self-contradictory to expect that things which have never yet been done can be done except by means which have never yet been tried.

The productions of the mind and hand seem very numerous in books and manufactures. But all this variety lies in an exquisite subtlety and derivations from a few things already known, not in the number of axioms.

Moreover, the works already known are due to chance and experiment rather than to sciences; for the sciences we now possess are merely systems for the nice ordering and setting forth of things already invented, not methods of invention or directions for new works.

The cause and root of nearly all evils in the sciences is this—that while we falsely admire and extol the powers of the human mind we neglect to seek for its true helps.

The subtlety of nature is greater many times over than the subtlety of the senses and understanding; so that all those specious meditations, speculations, and glosses in which men indulge are quite from the purpose, only there is no one by to observe it.

As the sciences which we now have do not help us in finding out new works, so neither does the logic which we now have help us in finding out new sciences.

The logic now in use serves rather to fix and give stability to the errors which have their foundation in commonly received notions than to help the search after truth. So it does more harm than good. . . .

The syllogism consists of propositions, propositions consist of words, words are symbols of notions. Therefore if the notions themselves (which is the root of the matter) are confused and overhastily abstracted from the facts, there can be no firmness in the superstructure. Our only hope therefore lies in a true induction.

There is no soundness in our notions, whether logical or physical. Substance, Quality, Action, Passion, Essence itself, are not sound notions; much less are Heavy, Light, Dense, Rare, Moist, Dry, Generation, Corruption, Attraction, Repulsion, Element, Matter, Form, and the like; but all are fantastical and ill defined.

Our notions of less general species, as Man, Dog, Dove, and of the immediate perceptions of the sense, as Hot, Cold, Black, White, do not materially mislead us; yet even these are sometimes confused by the flux and alteration of matter and the mixing of one thing with another. All the others which men have hitherto adopted are but wanderings, not being abstracted and formed from things by proper methods.

Nor is there less of willfulness and wandering in the construction of axioms than in the formation of notions, not excepting even those very principles which are obtained by common induction; but much more in the axioms and lower propositions educed by the syllogism.

The discoveries which have hitherto been made in the sciences are such as lie close to vulgar notions, scarcely beneath the surface. In order to penetrate into the inner and further recesses of nature, it is necessary that both notions and axioms be derived from things by a more sure and guarded way, and that a method of intellectual operation be introduced altogether better and more certain.

There are and can be only two ways of searching into and discovering truth. The one flies from the senses and particulars to the most general axioms, and from these principles, the truth of which it takes for settled and immovable, proceeds to judgment and to the discovery of middle axioms. And this way is now in fashion. The other derives axioms from the senses and particulars, rising by a gradual and unbroken ascent, so that it arrives at the most general axioms last of all. This is the true way, but as yet untried.
The understanding left to itself takes the same course (namely, the former) which it takes in accordance with logical order. For the mind longs to spring up to positions of higher generality, that it may find rest there, and so after a little while wearies of experiment. But this evil is increased by logic, because of the order and solemnity of its disputations. . . .

Both ways set out from the senses and particulars, and rest in the highest generalities; but the difference between them is infinite. For the one just glances at experiment and particulars in passing, the other dwells duly and orderly among them. The one, again, begins at once by establishing certain abstract and useless generalities, the other rises by gradual steps to that which is prior and better known in the order of nature.

There is a great difference between the Idols of the human mind and the Ideas of the divine. That is to say, between certain empty dogmas, and the true signatures and marks set upon the works of creation as they are found in nature.

It cannot be that axioms established by argumentation should avail for the discovery of new works, since the subtlety of nature is greater many times over than the subtlety of argument. But axioms duly and orderly formed from particulars easily discover the way to new particulars, and thus render sciences active.

The axioms now in use, having been suggested by a scanty and manip- ular experience and a few particulars of most general occurrence, are made for the most part just large enough to fit and take these in; and therefore it is no wonder if they do not lead to new particulars. And if some opposite instance, not observed or not known before, chance to come in the way, the axiom is rescued and preserved by some frivolous distinction; whereas the truer course would be to correct the axiom itself.

The conclusions of human reason as ordinarily applied in matters of nature, I call for the sake of distinction *Anticipations of Nature* (as a thing rash or premature). That reason which is elicited from facts by a just and methodical process, I call *Interpretation of Nature*. . . .

For the winning of assent, indeed, anticipations are far more powerful than interpretations, because being collected from a few instances, and those for the most part of familiar occurrence, they straightway touch the understanding and fill the imagination; whereas interpretations, on the other hand, being gathered here and there from very various and widely dispersed facts, cannot suddenly strike the understanding; and therefore they must needs, in respect of the opinions of the time, seem harsh and out of tune, much as the mysteries of faith do. . . .
It is idle to expect any great advancement in science from the superinducing and engrafting of new things upon old. We must begin anew from the very foundations, unless we would revolve forever in a circle with mean and contemptible progress.

Even to deliver and explain what I bring forward is no easy matter, for things in themselves new will yet be apprehended with reference to what is old.

One method of delivery alone remains to us which is simply this: we must lead men to the particulars themselves, and their series and order; while men on their side must force themselves for a while to lay their notions by and begin to familiarize themselves with facts.

The doctrine of those who have denied that certainty could be attained at all has some agreement with my way of proceeding at the first setting out; but they end in being infinitely separated and opposed. For the holders of that doctrine assert simply that nothing can be known. I also assert that not much can be known in nature by the way which is now in use. But then they go on to destroy the authority of the senses and understanding; whereas I proceed to devise and supply helps for the same.

There are four classes of Idols which beset men’s minds. To these for distinction’s sake I have assigned names, calling the first class Idols of the Tribe; the second, Idols of the Cave; the third, Idols of the Market Place; the fourth, Idols of the Theater.

The Idols of the Tribe have their foundation in human nature itself, and in the tribe or race of men. For it is a false assertion that the sense of man is the measure of things. On the contrary, all perceptions as well of the sense as of the mind are according to the measure of the individual and not according to the measure of the universe. And the human understanding is like a false mirror, which, receiving rays irregularly, distorts and discolors the nature of things by mingling its own nature with it.

The Idols of the Cave are the idols of the individual man. For everyone (besides the errors common to human nature in general) has a cave or den of his own, which refracts and discolors the light of nature, owing either to his own proper and peculiar nature; or to his education and conversation with others; or to the reading of books, and the authority of those whom he esteems and admires; or to the differences of impressions, accordingly as they take place in a mind preoccupied and predisposed or in a mind indifferent and settled; or the like. So that the spirit of man (according as it is meted out to different individuals) is in fact a thing variable and full of perturbation, and governed as it were by chance.
There are also Idols formed by the intercourse and association of men with each other, which I call Idols of the Market Place, on account of the commerce and consort of men there. For it is by discourse that men associate, and words are imposed according to the apprehension of the vulgar. And therefore the ill and unfit choice of words wonderfully obstructs the understanding. Nor do the definitions or explanations wherewith in some things learned men are wont to guard and defend themselves, by any means set the matter right. But words plainly force and overrule the understanding, and throw all into confusion, and lead men away into numberless empty controversies and idle fancies.

Lastly, there are Idols which have immigrated into men’s minds from the various dogmas of philosophies, and also from wrong laws of demonstration. These I call Idols of the Theater, because in my judgment all the received systems are but so many stage plays, representing worlds of their own creation after an unreal and scenic fashion.

But of these several kinds of Idols I must speak more largely and exactly, that the understanding may be duly cautioned.

The human understanding is of its own nature prone to suppose the existence of more order and regularity in the world than it finds. And though there be many things in nature which are singular and unmatched, yet it devises for them parallels and conjugates and relatives which do not exist.

The human understanding when it has once adopted an opinion (either as being the received opinion or as being agreeable to itself) draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises, or else by some distinction sets aside and rejects, in order that by this great and pernicious predetermination the authority of its former conclusions may remain inviolate.

The human understanding is moved by those things most which strike and enter the mind simultaneously and suddenly, and so fill the imagination; and then it feigns and supposes all other things to be somehow, though it cannot see how, similar to those few things by which it is surrounded. But for that going to and fro to remote and heterogeneous instances by which axioms are tried as in the fire, the intellect is altogether slow and unfit, unless it be forced thereto by severe laws and overruling authority.

The human understanding is unquiet; it cannot stop or rest, and still presses onward, but in vain. But this inability interferes... mischievously in the discovery of causes; for although the most general principles in nature ought to be held merely positive, as they are discovered, and cannot
with truth be referred to a cause, nevertheless the human understanding being unable to rest still seeks something prior in the order of nature. And then it is that in struggling toward that which is further off it falls back upon that which is nearer at hand, namely, on final causes, which have relation clearly to the nature of man rather than to the nature of the universe; and from this source have strangely defiled philosophy.

The human understanding is no dry light, but receives an infusion from the will and affections; whence proceed sciences which may be called “sciences as one would.” For what a man had rather were true he more readily believes. Therefore he rejects difficult things from impatience of research; sober things, because they narrow hope; the deeper things of nature, from superstition; the light of experience, from arrogance and pride, lest his mind should seem to be occupied with things mean and transitory; things not commonly believed, out of deference to the opinion of the vulgar. Numberless, in short, are the ways, and sometimes imperceptible, in which the affections color and infect the understanding.

But by far the greatest hindrance and aberration of the human understanding proceeds from the dullness, incompetency, and deceptions of the senses; in that things which strike the sense outweigh things which do not immediately strike it, though they be more important. Hence it is that speculation commonly ceases where sight ceases; insomuch that of things invisible there is little or no observation.

The human understanding is of its own nature prone to abstractions and gives a substance and reality to things which are fleeting. But to resolve nature into abstractions is less to our purpose than to dissect her into parts; as did the school of Democritus, [atomist] which went further into nature than the rest. Matter rather than forms should be the object of our attention, its configurations and changes of configuration, and simple action, and law of action or motion; for forms are figments of the human mind, unless you will call those laws of action forms.

Such then are the idols which I call Idols of the Tribe, and which take their rise either from the homogeneity of the substance of the human spirit, or from its preoccupation, or from its narrowness, or from its restless motion, or from an infusion of the affections, or from the incompetency of the senses, or from the mode of impression.

The Idols of the Cave take their rise in the peculiar constitution, mental or bodily, of each individual; and also in education, habit, and accident. Of this kind there is a great number and variety. But I will instance those the
pointing out of which contains the most important caution, and which have most effect in disturbing the clearness of the understanding.

Men become attached to certain particular sciences and speculations, either because they fancy themselves the authors and inventors thereof, or because they have bestowed the greatest pains upon them and become most habituated to them. But men of this kind, if they betake themselves to philosophy and contemplation of a general character, distort and color them in obedience to their former fancies; a thing especially to be noticed in Aristotle, who made his natural philosophy a mere bond servant to his logic, thereby rendering it contentious and well-nigh useless. . . .

There is one principal and as it were radical distinction between different minds, in respect of philosophy and the sciences, which is this: that some minds are stronger and apter to mark the differences of things, others to mark their resemblances. . . . Both kinds, however, easily err in excess, by catching the one at gradations, the other at shadows.

There are found some minds given to an extreme admiration of antiquity, others to an extreme love and appetite for novelty; but few so duly tempered that they can hold the mean, neither carping at what has been well laid down by the ancients, nor despising what is well introduced by the moderns. . . . Truth is to be sought for not in the felicity of any age, which is an unstable thing, but in the light of nature and experience, which is eternal. These factions therefore must be abjured, and care must be taken that the intellect be not hurried by them into assent.

Contemplations of nature and of bodies in their simple form break up and distract the understanding, while contemplations of nature and bodies in their composition and configuration overpower and dissolve the understanding, a distinction well seen in the school of Leucippus and Democritus [atomists] as compared with the other philosophies. For that school is so busied with the particles that it hardly attends to the structure, while the others are so lost in admiration of the structure that they do not penetrate to the simplicity of nature. . . .

Let such then be our provision and contemplative prudence for keeping off and dislodging the Idols of the Cave, which grow for the most part either out of the predominance of a favorite subject, or out of an excessive tendency to compare or to distinguish, or out of partiality for particular ages, or out of the largeness or minuteness of the objects contemplated. And generally let every student of nature take this as a rule: that whatever his mind seizes and dwells upon with peculiar satisfaction is to be held in suspicion, and that so
much the more care is to be taken in dealing with such questions to keep the understanding even and clear.

But the *Idols of the Market Place* are the most troublesome of all—idols which have crept into the understanding through the alliances of words and names. For men believe that their reason governs words; but it is also true that words react on the understanding; and this it is that has rendered philosophy and the sciences sophistical and inactive. Now words, being commonly framed and applied according to the capacity of the vulgar, follow those lines of division which are most obvious to the vulgar understanding. And whenever an understanding of greater acuteness or a more diligent observation would alter those lines to suit the true divisions of nature, words stand in the way and resist the change. Whence it comes to pass that the high and formal discussions of learned men end oftentimes in disputes about words and names; with which (according to the use and wisdom of the mathematicians) it would be more prudent to begin, and so by means of definitions reduce them to order. Yet even definitions cannot cure this evil in dealing with natural and material things, since the definitions themselves consist of words, and those words beget others. So that it is necessary to recur to individual instances, and those in due series and order, as I shall say presently when I come to the method and scheme for the formation of notions and axioms.

The idols imposed by words on the understanding are of two kinds. They are either names of things which do not exist (for as there are things left unnamed through lack of observation, so likewise are there names which result from fantastic suppositions and to which nothing in reality corresponds), or they are names of things which exist, but yet confused and ill-defined, and hastily and irregularly derived from realities. Of the former kind are Fortune, the Prime Mover, Planetary Orbits, Element of Fire, and like fictions which owe their origin to false and idle theories. And this class of idols is more easily expelled, because to get rid of them it is only necessary that all theories should be steadily rejected and dismissed as obsolete.

But the other class, which springs out of a faulty and unskillful abstraction, is intricate and deeply rooted.

But the *Idols of the Theater* are not innate, nor do they steal into the understanding secretly, but are plainly impressed and received into the mind from the playbooks of philosophical systems and the perverted rules of demonstration. To attempt refutations in this case would be merely inconsistent with what I have already said, for since we agree neither upon principles nor upon demonstrations there is no place for argument.
But the course I propose for the discovery of sciences is such as leaves but little to the acuteness and strength of wits, but places all wits and understandings nearly on a level. For as in the drawing of a straight line or a perfect circle, much depends on the steadiness and practice of the hand, if it be done by aim of hand only, but if with the aid of rule or compass, little or nothing; so is it exactly with my plan.

... 

So much concerning the several classes of Idols and their equipage; all of which must be renounced and put away with a fixed and solemn determination, and the understanding thoroughly freed and cleansed; the entrance into the kingdom of man, founded on the sciences, being not much other than the entrance into the kingdom of heaven, whereinto none may enter except as a little child.

But vicious demonstrations are as the strongholds and defenses of idols; and those we have in logic do little else than make the world the bondslave of human thought, and human thought the bondslave of words. Demonstrations truly are in effect the philosophies themselves and the sciences. For such as they are, well or ill established, such are the systems of philosophy and the contemplations which follow. Now in the whole of the process which leads from the sense and objects to axioms and conclusions, the demonstrations which we use are deceptive and incompetent. This process consists of four parts, and has as many faults. In the first place, the impressions of the sense itself are faulty; for the sense both fails us and deceives us. But its shortcomings are to be supplied, and its deceptions to be corrected. Secondly, notions are ill-drawn from the impressions of the senses, and are indefinite and confused, whereas they should be definite and distinctly bounded. Thirdly, the induction is amiss which infers the principles of sciences by simple enumeration, and does not, as it ought, employ exclusions and solutions (or separations) of nature. Lastly, that method of discovery and proof according to which the most general principles are first established, and then intermediate axioms are tried and proved by them, is the parent of error and the curse of all science. . . .

But the best demonstration by far is experience, if it go not beyond the actual experiment. For if it be transferred to other cases which are deemed similar, unless such transfer be made by a just and orderly process, it is a fallacious thing. But the manner of making experiments which men now use is blind and stupid. And therefore, wandering and straying as they do with no settled course, and taking counsel only from things as they fall out, they fetch
a wide circuit and meet with many matters, but make little progress; and
sometimes are full of hope, sometimes are distracted; and always find that
there is something beyond to be sought. For it generally happens that men
make their trials carelessly, and as it were in play; slightly varying experi-
ments already known, and, if the thing does not answer, growing weary and
abandoning the attempt. And even if they apply themselves to experiments
more seriously and earnestly and laboriously, still they spend their labor in
working out some one experiment, as Gilbert with the magnet, and the
chemists with gold; a course of proceeding not less unskillful in the design
than small in the attempt. For no one successfully investigates the nature of
a thing in the thing itself; the inquiry must be enlarged so as to become more
general.

And even when they seek to educe some science or theory from their
experiments, they nevertheless almost always turn aside with overhasty and
unseasonable eagerness to practice; not only for the sake of the uses and
fruits of the practice, but from impatience to obtain in the shape of some new
work an assurance for themselves that it is worth their while to go on; and
also to show themselves off to the world, and so raise the credit of the busi-
ness in which they are engaged. . . . So must we likewise from experience of
every kind first endeavor to discover true causes and axioms; and seek for
experiments of Light, not for experiments of Fruit. For axioms rightly dis-
covered and established supply practice with its instruments, not one by one,
but in clusters, and draw after them trains and troops of works. . . .

The sciences which we possess come for the most part from the
Greeks. . . . Now the wisdom of the Greeks was professorial and much given
to disputations, a kind of wisdom most adverse to the inquisition of truth.

...
them. They, too, who have busied themselves with natural magic, as they call it, have but few discoveries to show, and those trifling and imposture-like. Wherefore, as in religion we are warned to show our faith by works, so in philosophy by the same rule the system should be judged of by its fruits, and pronounced frivolous if it be barren, more especially if, in place of fruits of grape and olive, it bear thorns and briers of dispute and contention.

Signs also are to be drawn from the increase and progress of systems and sciences. For what is founded on nature grows and increases, while what is founded on opinion varies but increases not. If therefore those doctrines had not plainly been like a plant torn up from its roots, but had remained attached to the womb of nature and continued to draw nourishment from her, that could never have come to pass which we have seen now for twice a thousand years; namely, that the sciences stand where they did and remain almost in the same condition, receiving no noticeable increase, but on the contrary, thriving most under their first founder, and then declining. Whereas in the mechanical arts, which are founded on nature and the light of experience, we see the contrary happen, for these (as long as they are popular) are continually thriving and growing, as having in them a breath of life, at the first rude, then convenient, afterwards adorned, and at all times advancing.

I now come to the causes of these errors. . . . Now, in the first place, those so many ages, if you weigh the case truly, shrink into a very small compass. For out of the five and twenty centuries over which the memory and learning of men extends, you can hardly pick out six that were fertile in sciences or favorable to their development. In times no less than in regions there are wastes and deserts. For only three revolutions and periods of learning can properly be reckoned: one among the Greeks, the second among the Romans, and the last among us, that is to say, the nations of Western Europe. And to each of these hardly two centuries can justly be assigned. The intervening ages of the world, in respect of any rich or flourishing growth of the sciences, were unprosperous. . . .

In the second place there presents itself a cause of great weight in all ways, namely, that during those very ages in which the wits and learning of men have flourished most, or indeed flourished at all, the least part of their diligence was given to natural philosophy. Yet this very philosophy it is that ought to be esteemed the great mother of the sciences. For all arts and all sciences, if torn from this root, though they may be polished and shaped and made fit for use, yet they will hardly grow. . . .
To this it may be added that natural philosophy, even among those who have attended to it, has scarcely ever possessed, especially in these later times, a disengaged and whole man (unless it were some monk studying in his cell, or some gentleman in his country house), but that it has been made merely a passage and bridge to something else. And so this great mother of the sciences has with strange indignity been degraded to the offices of a servant, having to attend on the business of medicine or mathematics, and likewise to wash and imbue youthful and unripe wits with a sort of first dye, in order that they may be the fitter to receive another afterwards. Meanwhile let no man look for much progress in the sciences—especially in the practical part of them—unless natural philosophy be carried on and applied to particular sciences, and particular sciences be carried back again to natural philosophy. . . . Because after these particular sciences have been once distributed and established, they are no more nourished by natural philosophy. . . .

Again there is another great and powerful cause why the sciences have made but little progress, which is this. It is not possible to run a course aright when the goal itself has not been rightly placed. Now the true and lawful goal of the sciences is none other than this: that human life be endowed with new discoveries and powers. . . .

And as men have misplaced the end and goal of the sciences, so again, even if they had placed it right, yet they have chosen a way to it which is altogether erroneous and impassable. . . . Now let any man soberly and diligently consider what the way is by which men have been accustomed to proceed in the investigation and discovery of things, and in the first place he will no doubt remark a method of discovery very simple and inartificial, which is the most ordinary method, and is no more than this. When a man addresses himself to discover something, he first seeks out and sets before him all that has been said about it by others; then he begins to meditate for himself; and so by much agitation and working of the wit solicits and as it were evokes his own spirit to give him oracles; which method has no foundation at all, but rests only upon opinions and is carried about with them.

Another may perhaps call in logic to discover it for him, but that has no relation to the matter except in name. . . .

There remains simple experience which, if taken as it comes, is called accident; if sought for, experiment. But this kind of experience is no better than a broom without its band, as the saying is—a mere groping, as of men in the dark. . . .

This evil, however, has been strangely increased by an opinion or conceit, which though of long standing is vain and hurtful, namely, that the dignity of
the human mind is impaired by long and close intercourse with experiments and particulars, subject to sense and bound in matter; especially as they are laborious to search, ignoble to meditate, harsh to deliver, illiberal to practice, infinite in number, and minute in subtlety. So that it has come at length to this, that the true way is not merely deserted, but shut out and stopped up; experience being, I do not say abandoned or badly managed, but rejected with disdain.

Again, men have been kept back as by a kind of enchantment from progress in the sciences by reverence for antiquity, by the authority of men accounted great in philosophy, and then by general consent.

But by far the greatest obstacle to the progress of science and to the undertaking of new tasks and provinces therein is found in this—that men despair and think things impossible. For wise and serious men are wont in these matters to be altogether distrustful, considering with themselves the obscurity of nature, the shortness of life, the deceitfulness of the senses, the weakness of the judgment, the difficulty of experiment, and the like; and so supposing that in the revolution of time and of the ages of the world the sciences have their ebbs and flows; that at one season they grow and flourish, at another wither and decay, yet in such sort that when they have reached a certain point and condition they can advance no further.

Now if anyone of ripe age, unimpaired senses, and well-purged mind, apply himself anew to experience and particulars, better hopes may be entertained of that man. . . . [T]here is no hope except in a new birth of science; that is, in raising it regularly up from experience and building it afresh, which no one (I think) will say has yet been done or thought of. . . .

But then only will there be good ground of hope for the further advance of knowledge when there shall be received and gathered together into natural history a variety of experiments which are of no use in themselves but simply serve to discover causes and axioms, which I call Experimenta lucifera, experiments of light, to distinguish them from those which I call fructifera, experiments of fruit.

Now experiments of this kind have one admirable property and condition: they never miss or fail. For since they are applied, not for the purpose of producing any particular effect, but only of discovering the natural cause of some effect, they answer the end equally well whichever way they turn out; for they settle the question.
But not only is a greater abundance of experiments to be sought for and procured, and that too of a different kind from those hitherto tried; an entirely different method, order, and process for carrying on and advancing experience must also be introduced. For experience, when it wanders in its own track, is, as I have already remarked, mere groping in the dark, and confounds men rather than instructs them. But when it shall proceed in accordance with a fixed law, in regular order, and without interruption, then may better things be hoped of knowledge. . . .

Moreover, since there is so great a number and army of particulars, and that army so scattered and dispersed as to distract and confound the understanding, little is to be hoped for from the skirmishings and slight attacks and desultory movements of the intellect, unless all the particulars which pertain to the subject of inquiry shall, by means of Tables of Discovery, apt, well arranged, and, as it were, animate, be drawn up and marshaled; and the mind be set to work upon the helps duly prepared and digested which these tables supply.

But after this store of particulars has been set out duly and in order before our eyes, we are not to pass at once to the investigation and discovery of new particulars or works; or at any rate if we do so we must not stop there. For although I do not deny that when all the experiments of all the arts shall have been collected and digested, and brought within one man’s knowledge and judgment, the mere transferring of the experiments of one art to others may lead, by means of that experience which I term literate, to the discovery of many new things of service to the life and state of man, yet it is no great matter that can be hoped from that; but from the new light of axioms, which having been educed from those particulars by a certain method and rule, shall in their turn point out the way again to new particulars, greater things may be looked for. For our road does not lie on a level, but ascends and descends; first ascending to axioms, then descending to works.

The understanding must not, however, be allowed to jump and fly from particulars to axioms remote and of almost the highest generality (such as the first principles, as they are called, of arts and things), and taking stand upon them as truths that cannot be shaken, proceed to prove and frame the middle axioms by reference to them; which has been the practice hitherto, the understanding being not only carried that way by a natural impulse, but also by the use of syllogistic demonstration trained and inured to it. But then, and then only, may we hope well of the sciences when in a just scale of ascent, and by successive steps not interrupted or broken, we rise from particulars to lesser
axioms; and then to middle axioms, one above the other; and last of all to the most general. . . .

The understanding must not therefore be supplied with wings, but rather hung with weights, to keep it from leaping and flying. Now this has never yet been done; when it is done, we may entertain better hopes of the sciences.

In establishing axioms, another form of induction must be devised than has hitherto been employed, and it must be used for proving and discovering not first principles (as they are called) only, but also the lesser axioms, and the middle, and indeed all. For the induction which proceeds by simple enumeration is childish; its conclusions are precarious and exposed to peril from a contradictory instance; and it generally decides on too small a number of facts, and on those only which are at hand. But the induction which is to be available for the discovery and demonstration of sciences and arts, must analyze nature by proper rejections and exclusions; and then, after a sufficient number of negatives, come to a conclusion on the affirmative instances—which has not yet been done or even attempted. . . . And this induction must be used not only to discover axioms, but also in the formation of notions. And it is in this induction that our chief hope lies.

But in establishing axioms by this kind of induction, we must also examine and try whether the axiom so established be framed to the measure of those particulars only from which it is derived, or whether it be larger and wider. And if it be larger and wider, we must observe whether by indicating to us new particulars it confirm that wideness and largeness as by a collateral security, that we may not either stick fast in things already known, or loosely grasp at shadows and abstract forms, not at things solid and realized in matter. And when this process shall have come into use, then at last shall we see the dawn of a solid hope.

I must request men not to suppose that after the fashion of ancient Greeks, and of certain moderns . . . I wish to found a new sect in philosophy. . . .

But for my part I do not trouble myself with any such speculative and withal unprofitable matters. My purpose, on the contrary, is to try whether I cannot in very fact lay more firmly the foundations and extend more widely the limits of the power and greatness of man.
There will be found, no doubt, when my history and tables of discovery are read, some things in the experiments themselves that are not quite certain, or perhaps that are quite false, which may make a man think that the foundations and principles upon which my discoveries rest are false and doubtful. But this is of no consequence, for such things must needs happen at first...

There will be met with also in my history and experiments many things which are trivial and commonly known; many which are mean and low; many, lastly, which are too subtle and merely speculative, and that seem to be of no use; which kind of things may possibly avert and alienate men’s interest.

And first, for those things which seem common. Let men bear in mind that hitherto they have been accustomed to do no more than refer and adapt the causes of things which rarely happen to such as happen frequently, while of those which happen frequently they never ask the cause, but take them as they are for granted. And therefore they do not investigate the causes of weight, of the rotation of heavenly bodies, of heat, cold, light, hardness, softness, rarity, density, fluidity, solidity, animation, inanimation, similarity, dissimilarity, organization, and the like; but admitting these as self-evident and obvious, they dispute and decide on other things of less frequent and familiar occurrence.

But I, who am well aware that no judgment can be passed on uncommon or remarkable things, much less anything new brought to light, unless the causes of common things, and the causes of those causes, be first duly examined and found out, am of necessity compelled to admit the commonest things into my history. Nay, in my judgment philosophy has been hindered by nothing more than this, that things of familiar and frequent occurrence do not arrest and detain the thoughts of men, but are received in passing without any inquiry into their causes; insomuch that information concerning things which are not known is not oftener wanted than attention concerning things which are.

And for things that are mean or even filthy, . . . such things, no less than the most splendid and costly, must be admitted into natural history. Nor is natural history polluted thereby, for the sun enters the sewer no less than the palace, yet takes no pollution. And for myself, I am not raising a capitol or pyramid to the pride of man, but laying a foundation in the human understanding for a holy temple after the model of the world. That model therefore I follow. For whatever deserves to exist deserves also to be known, for
knowledge is the image of existence; and things mean and splendid exist alike.

But there is another objection which must be more carefully looked to, namely, that there are many things in this History which to common apprehension, or indeed to any understanding accustomed to the present system, will seem to be curiously and unprofitably subtle. Upon this point, therefore, above all I must say again what I have said already: that at first, and for a time, I am seeking for experiments of light, not for experiments of fruit, following therein.

To suppose, therefore, that things like these are of no use is the same as to suppose that light is of no use, because it is not a thing solid or material. And the truth is that the knowledge of simple natures well examined and defined is as light: it gives entrance to all the secrets of nature’s workshop, and virtually includes and draws after it whole bands and troops of works, and opens to us the sources of the noblest axioms; and yet in itself it is of no great use.

It may be thought also a strange and a harsh thing that we should at once and with one blow set aside all sciences and all authors; and that, too, without calling in any of the ancients to our aid and support, but relying on our own strength.

And I know that if I had chosen to deal less sincerely, I might easily have found authority for my suggestions by referring them either to the old times. But for my part, relying on the evidence and truth of things, I reject all forms of fiction and imposture. For new discoveries must be sought from the light of nature, not fetched back out of the darkness of antiquity.

And now it is time for me to propound the art itself of interpreting nature.

It is a correct position that “true knowledge is knowledge by causes.” And causes again are not improperly distributed into four kinds: the material, the formal, the efficient, and the final. But of these the final cause rather corrupts than advances the sciences, except such as have to do with human action. The discovery of the formal is despaired of. The efficient and the material (as they are investigated and received, that is, as remote causes, without reference to the latent process leading to the form) are but slight and superficial, and contribute little, if anything, to true and active science.
But whosoever is acquainted with forms embraces the unity of nature in substances the most unlike, and is able therefore to detect and bring to light things never yet done, and such as neither the vicissitudes of nature, nor industry in experimenting, nor accident itself, would ever have brought into act, and which would never have occurred to the thought of man. From the discovery of forms therefore results truth in speculation and freedom in operation.

Although the roads to human power and to human knowledge lie close together and are nearly the same, nevertheless, on account of the pernicious and inveterate habit of dwelling on abstractions it is safer to begin and raise the sciences from those foundations which have relation to practice, and to let the active part itself be as the seal which prints and determines the contemplative counterpart. We must therefore consider, if a man wanted to generate and superinduce any nature upon a given body, what kind of rule or direction or guidance he would most wish for, and express the same in the simplest and least abstruse language. . . .

For a true and perfect rule of operation, then, the direction will be *that it be certain, free, and disposing or leading to action*. And this is the same thing with the discovery of the true form. For the form of a nature is such, that given the form, the nature infallibly follows. Therefore it is always present when the nature is present, and universally implies it, and is constantly inherent in it. Again, the form is such that if it be taken away the nature infallibly vanishes. Therefore it is always absent when the nature is absent, and implies its absence, and inheres in nothing else. Lastly, the true form is such that it deduces the given nature from some source of being which is inherent in more natures, and which is better known in the natural order of things than the form itself. For a true and perfect axiom of knowledge, then, the direction and precept will be, *that another nature be discovered which is convertible with the given nature and yet is a limitation of a more general nature, as of a true and real genus*. Now these two directions, the one active the other contemplative, are one and the same thing; and what in operation is most useful, that in knowledge is most true.

The rule or axiom for the transformation of bodies is of two kinds. The first regards a body as a troop or collection of simple natures. In gold, for example, the following properties meet. It is yellow in color, heavy up to a certain weight, malleable or ductile to a certain degree of extension; it is not volatile and loses none of its substance by the action of fire; it turns into a liquid with a certain degree of fluidity; it is separated and dissolved by particular means; and so on for the other natures which meet in gold. This kind
of axiom, therefore, deduces the thing from the forms of simple natures. For he who knows the forms of yellow, weight, ductility, fixity, fluidity, solution, and so on, and the methods for superinducing them and their gradations and modes, will make it his care to have them joined together in some body, whence may follow the transformation of that body into gold. And this kind of operation pertains to the first kind of action. For the principle of generating some one simple nature is the same as that of generating many; only that a man is more fettered and tied down in operation, if more are required, by reason of the difficulty of combining into one so many natures which do not readily meet, except in the beaten and ordinary paths of nature. It must be said, however, that this mode of operation (which looks to simple natures though in a compound body) proceeds from what in nature is constant and eternal and universal, and opens broad roads to human power, such as (in the present state of things) human thought can scarcely comprehend or anticipate.

The second kind of axiom, which is concerned with the discovery of the latent process, proceeds not by simple natures, but by compound bodies, as they are found in nature in its ordinary course. As, for instance, when inquiry is made from what beginnings, and by what method and by what process, gold or any other metal or stone is generated, from its first menstrua and rudiments up to the perfect mineral; or in like manner, by what process herbs are generated, from the first concretion of juices in the ground or from seeds up to the formed plant, with all the successive motions and diverse and continued efforts of nature. So also in the inquiry concerning the process of development in the generation of animals, from coition to birth; and in like manner of other bodies.