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APHORISMS

[BOOK ONE]

I

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. Beyond this he neither knows anything nor can do anything.

II

Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand. And as the instruments of the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions.

III

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.

IV

Toward the effecting of works, all that man can do is to put together or put asunder natural bodies. The rest is done by nature working within.

V

The study of nature with a view to works is engaged in by the mechanic, the mathematician, the physician, the alchemist, and the magician; but by all (as things now are) with slight endeavor and scanty success.

VI

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.

VII

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.

VIII

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.

IX

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 is not applied to the first principles of sciences, and is applied in vain to intermediate axioms, being no match for the subtlety of nature. It commands assent therefore to the proposition, but does not take hold of the thing.

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 over hastily 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.

XIX

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.

XX

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 tip 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.

XXI

The understanding left to itself, in a sober, patient, and grave mind, especially if it be not hindered by received doctrines, tries a little that other way, which is the right one, but with little progress, since the understanding, unless directed and assisted, is a thing unequal, and quite unfit to contend with the obscurity of things.

XXII

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 too that which is prior and better known in the order of nature.

XXIII

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.

XXIV

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.

XXV

The axioms now in use, having been suggested by a scanty and manipular 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.
XXVI

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*.

XXVII

Anticipations are a ground sufficiently firm for consent, for even if men went mad all after the same fashion, they might agree one with another well enough.

XXVIII

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.

XXIX

In sciences founded on opinions and dogmas, the use of anticipations and logic is good; for in them the object is to command assent to the proposition, not to master the thing.

XXX

Though all the wits of all the ages should meet together and combine and transmit their labors, yet will no great progress ever be made in science by means of anticipations; because radical errors in the first concoction of the mind are not to be cured by the excellence of functions and subsequent remedies.

XXXI

It is idle to expect any great advancement in science from the superinducing and engraffing 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.

XXXII

The honor of the ancient authors, and indeed of all, remains untouched, since the comparison I challenge is not of wits or faculties, but of ways and methods, and the part I take upon myself is not that of a judge, but of a guide.

XXXIII

This must be plainly avowed: no judgment can be rightly formed either of my method or of the discoveries to which it leads, by means of anticipations (that is to say, of the reasoning which is now in use); since I cannot be called on to abide by the sentence of a tribunal which is itself on trial.

XXXIV

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.
XXXV

It was said by Borgia of the expedition of the French into Italy, that they came with chalk in their hands to mark out their lodgings, not with arms to force their way in. I in like manner would have my doctrine enter quietly into the minds that are fit and capable of receiving it; for confutations cannot be employed when the difference is upon first principles and very notions, and even upon forms of demonstration.

XXXVI

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.

XXXVII

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.

XXXVIII

The idols and false notions which are now in possession of the human understanding, and have taken deep root therein, not only so beset men's minds that truth can hardly find entrance, but even after entrance is obtained, they will again in the very instauration of the sciences meet and trouble us, unless men being forewarned of the danger fortify themselves as far as may be against their assaults.

XXXIX

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.

XL

The formation of ideas and axioms by true induction is no doubt the proper remedy to be applied for the keeping off, and clearing away of idols. To point them out, however, is of great use; for the doctrine of Idols is to the interpretation of nature what the doctrine of the refutation of sophisms is to common logic.

XLI

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 se rise 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. Whence it was well observed by Heraclitus that men look for sciences in their own lesser worlds, and not in the greater or common world.

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. Nor is it only of the systems now in vogue, or only of the ancient sects and, philosophics, that I speak; for many more plays of the same kind may yet be composed and in like artificial manner set forth; seeing that errors the most widely different have nevertheless causes for the most part alike. Neither again do I mean this only of entire systems, but also of many principles and axioms in science, which by tradition, credulity, and negligence have come to be received.

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. Hence the fiction that all celestial bodies move in perfect circles, spirals and dragons being (except in name) utterly rejected. Hence too the element of fire with its orb is brought in, to make up the square with the other three which the sense perceives. Hence also the ratio of density of the so-called elements is arbitrarily fixed at ten to one. And so on of other dreams. And these fancies affect not dogmas only, but simple notions also.

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. And therefore it was a good answer that was made by one who, when they showed him hanging in a temple a picture of those who had paid their vows as having escaped shipwreck, and would have him say whether he did not now acknowledge the power of the gods — "Aye," asked he again, "but where are they painted that were drowned after their vows?" And such is the way of all superstition, whether in astrology, dreams, omens, divine judgments, or the like;
wherein men, having a delight in such vanities, mark the events where they are fulfilled, but where they fail, though this happen much oftener, neglect and pass them by. But with far more subtlety does this mischief insinuate itself into philosophy and the sciences; in which the first conclusion colors and brings into conformity with itself all that come after, though far sounder and better. Besides, independently of that delight and vanity which I have described, it is the peculiar and perpetual error of the human intellect to be more moved and excited by affirmatives than by negatives; whereas it ought properly to hold itself indifferently disposed toward both alike. Indeed, in the establishment of any true axiom, the negative instance is the more forcible of the two.

XLVII

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.

XLVIII

The human understanding is unquiet; it cannot stop or rest, and still presses onward, but in vain. Therefore it is that we cannot conceive of any end or limit to the world, but always as of necessity it occurs to us that there is something beyond. Neither, again, can it be conceived how eternity has flowed down to the present day, for that distinction which is commonly received of infinity in time past and in time to come can by no means hold; for it would thence follow that one infinity is greater than another, and that infinity is wasting away and tending to become finite. The like subtlety arises touching the infinite divisibility of lines, from the same inability of thought to stop. But this inability interferes more 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. But he is no less an unskilled and shallow philosopher who seeks causes of that which is most general, than he who in things subordinate and subaltern omits to do so.

XLIX

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.

L

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. Hence all the working of the spirits enclosed in tangible bodies lies hid and unobserved of men. So also all the more subtle changes of form in the parts of coarser substances (which they commonly call alteration, though it is in truth local motion through exceedingly small spaces) is in like manner unobserved. And yet unless these two things just mentioned be searched out and brought to light, nothing great can be achieved in nature, as far as the production of works is concerned. So again the essential nature of our common
air, and of all bodies less dense than air (which are very many), is almost unknown. For the sense by itself is a thing infirm and erring; neither can instruments for enlarging or sharpening the senses do much; but all the truer kind of interpretation of nature is effected by instances and experiments fit and apposite; wherein the sense decides touching the experiment only, and the experiment touching the point in nature and the thing itself.

L I

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, 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.

L II

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.

L III

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.

L IV

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. The race of chemists, again out of a few experiments of the furnace, have built up a fantastic philosophy, framed with reference to a few things: and Gilbert also, after he had employed himself most laboriously in the study and observation of the loadstone, proceeded at once to construct an entire system in accordance with his favorite subject.

L V

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. The steady and acute mind can fix its contemplations and dwell and fasten on the subtlest distinctions; the lofty and discursive mind recognizes and puts together the finest and most general resemblances. Both kinds, however, easily err in excess, by catching the one at gradations, the other at shadows.

L VI

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. This, however, turns to the great injury of the sciences and philosophy, since these affectations of antiquity and novelty are the humors of partisans rather than judgments; and 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.

LVII

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 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. These kinds of contemplation should therefore be
alternated and taken by turns, so that the understanding may be rendered at once penetrating and comprehensive, and the
inconveniences above mentioned, with the idols which proceed from them, may be avoided.

LVIII

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.

LIX

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
ture 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.

LX

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. Let us
take for example such a word as humid and see how far the several things which the word is used to signify agree with
each other, and we shall find the word humid to be nothing else than a mark loosely and confusedly applied to denote a
variety of actions which will not bear to be reduced to any constant meaning. For it both signifies that which easily
spreads itself round any other body; and that which in itself is indeterminate and cannot solidize; and that which readily
yields in every direction; and that which easily divides and scatters itself; and that which easily unites and collects itself;
and that which readily flows and is put in motion; and that which readily clings to another body and wets it; and that
which is easily reduced to a liquid, or being solid easily melts. Accordingly, when you come to apply the word, if you
take it in one sense, flame is humid; if in another, air is not humid; if in another, fine dust is humid; if in another, glass is
humid. So that it is easy to see that the notion is taken by abstraction only from water and common and ordinary liquids,
without any due verification.

There are, however, in words certain degrees of distortion and error. One of the least faulty kinds is that of names
of substances, especially of lowest species and well-deduced (for the notion of chalk and of mud is good, of earth bad); a
more faulty kind is that of actions, as to generate, to corrupt, to alter; the most faulty is of qualities (except such as are
the immediate objects of the sense) as heavy, light, rare, dense, and the like. Yet in all these cases some notions are of
necessity a little better than others, in proportion to the greater variety of subjects that fall within the range of the human
sense.

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. And this is so far well,
inasmuch as it leaves the honor of the ancients untouched. For they are no wise disparaged — the question between them
and me being only as to the way. For as the saying is, the lame man who keeps the right road outstrips the runner who
takes a wrong one. Nay, it is obvious that when a man runs the wrong way, the more active and swift he is, the further he
will go astray.

But the course I propose for the discovery of sciences is such is 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. But though particular confutations would be of no avail, yet
touching the sects and general divisions of such systems I must say something; something also touching the external signs
which show that they are unsound; and finally something touching the causes of such great infelicity and of such lasting
and general agreement in error; that so the access to truth may be made less difficult, and the human understanding may
the more willingly submit to its purgation and dismiss its idols.

Idols of the Theater, or of Systems, are many, and there can be and perhaps will be yet many more. For were it
not that now for many ages men's minds have been busied with religion and theology; and were it not that civil
governments, especially monarchies, have been averse to such novelties, even in matters speculative; so that men labor
therein to the peril and harming of their fortunes — not only unrewarded, but exposed also to contempt and envy —
doubtless there would have arisen many other philosophical sects like those which in great variety flourished once among
the Greeks. For as on the phenomena of the heavens many hypotheses may be constructed, so likewise (and more also)
many various dogmas may be set up and established on the phenomena of philosophy. And in the plays of this
philosophical theater you may observe the same thing which is found in the theater of the poets, that stories invented for
the stage are more compact and elegant, and more as one would wish them to be, than true stories out of history.

In general, however, there is taken for the material of philosophy either a great deal out of a few things, or a very
little out of many things; so that on both sides philosophy is based on too narrow a foundation of experiment and natural
history, and decides on the authority of too few cases. For the Rational School of philosophers snatches from experience
a variety of common instances, neither duly ascertained nor diligently examined and weighed, and leaves all the rest to
meditation and agitation of wit.

And there is also another class of philosophers who, having bestowed much diligent and careful labor on a few
experiments, have thence made bold to educate and construct systems, wresting all other facts in a strange fashion to
conformity therewith.

And there is yet a third class, consisting of those who out of faith and veneration mix their philosophy with
theology and traditions; among whom the vanity of some has gone so far aside as to seek the origin of sciences among
spirits and genii. So that this parent stock of errors — this false philosophy — is of three kinds: the Sophistical, the Empirical, and the Superstitious.

**LXIII**

The most conspicuous example of the first class was Aristotle, who corrupted natural philosophy by his logic: fashioning the world out of categories; assigning to the human soul, the noblest of substances, a genus from words of the second intention; doing the business of density and rarity (which is to make bodies of greater or less dimensions, that is, occupy greater or less spaces), by the frigid distinction of act and power; asserting that single bodies have each a single and proper motion, and that if they participate in any other, then this results from an external cause; and imposing countless other arbitrary restrictions on the nature of things; being always more solicitous to provide an answer to the question and affirm something positive in words, than about the inner truth of things; a failing best shown when his philosophy is compared with other systems of note among the Greeks. For the homoeomera of Anaxagoras; the Atoms of Leucippus and Democritus; the Heaven and Earth of Parmenides; the Strife and Friendship of Empedocles; Heraclitus' doctrine how bodies are resolved into the indifferent nature of fire, and remolded into solids, have all of them some taste of the natural philosopher — some savor of the nature of things, and experience, and bodies; whereas in the physics of Aristotle you hear hardly anything but the words of logic, which in his metaphysics also, under a more imposing name, and more forsooth as a realist than a nominalist, he has handled over again. Nor let any weight be given to the fact that in his books on animals and his problems, and other of his treatises, there is frequent dealing with experiments. For he had come to his conclusion before; he did not consult experience, as he should have done for the purpose of framing his decisions and axioms, but having first determined the question according to his will, he then resorts to experience, and bending her into conformity with his placets, leads her about like a captive in a procession. So that even on this count he is more guilty than his modern followers, the schoolmen, who have abandoned experience altogether.

**LXIV**

But the Empirical school of philosophy gives birth to dogmas more deformed and monstrous than the Sophistical or Rational school. For it has its foundations not in the light of common notions (which though it be a faint and superficial light, is yet in a manner universal, and has reference to many things), but in the narrowness and darkness of a few experiments. To those therefore who are daily busied with these experiments and have infected their imagination with them, such a philosophy seems probable and all but certain; to all men else incredible and vain. Of this there is a notable instance in the alchemists and their dogmas, though it is hardly to be found elsewhere in these times, except perhaps in the philosophy of Gilbert. Nevertheless, with regard to philosophies of this kind there is one caution not to be omitted; for I foresee that if ever men are roused by my admonitions to betake themselves seriously to experiment and bid farewell to sophistical doctrines, then indeed through the premature hurry of the understanding to leap or fly to universals and principles of things, great danger may be apprehended from Philosophies of this kind, against which evil we ought even now to prepare.

**LXV**

But the corruption of philosophy by superstition and an admixture of theology is far more widely spread, and does the greatest harm, whether to entire systems or to their parts. For the human understanding is obnoxious to the influence of the imagination no less than to the influence of common notions. For the contentious and sophistical kind of philosophy ensnares the understanding; but this kind, being fanciful and tumid and half poetical, misleads it more by flattery. For there is in man an ambition of the understanding, no less than of the will, especially in high and lofty spirits. Of this kind we have among the Greeks a striking example in Pythagoras, though he united with it a coarser and more cumbrous superstition; another in Plato and his school, more dangerous and subtle. It shows itself likewise in parts of other philosophies, in the introduction of abstract forms and final causes and first causes, with the omission in most cases of causes intermediate, and the like. Upon this point the greatest caution should be used. For nothing is so mischievous as the apotheosis of error; and it is a very plague of the understanding for vanity to become the object of veneration. Yet in this vanity some of the moderns have with extreme levity indulged so far as to attempt to found a system of natural philosophy on the first chapter of Genesis, on the book of Job, and other parts of the sacred writings,
seeking for the dead among the living; which also makes the inhibition and repression of it the more important, because from this unwholesome mixture of things human and divine there arises not only a fantastic philosophy but also a heretical religion. Very meet it is therefore that we be sober-minded, and give to faith that only which is faith's.

**LXVI**

So much, then, for the mischievous authorities of systems, which are founded either on common notions, or on a few experiments, or on superstition. It remains to speak of the faulty subject matter of contemplations, especially in natural philosophy. Now the human understanding is infected by the sight of what takes place in the mechanical arts, in which the alteration of bodies proceeds chiefly by composition or separation, and so imagines that something similar goes on in the universal nature of things. From this source has flowed the fiction of elements, and of their concourse for the formation of natural bodies. Again, when man contemplates nature working freely, he meets with different species of things, of animals, of plants, of minerals; whence he readily passes into the opinion that there are in nature certain primary forms which nature intends to educe, and that the remaining variety proceeds from hindrances and aberrations of nature in the fulfillment of her work, or from the collision of different species and the transplanting of one into another.

To the first of these speculations we owe our primary qualities of the elements; to the other our occult properties and specific virtues; and both of them belong to those empty compendia of thought wherein the mind rests, and whereby it is diverted from more solid pursuits. It is to better purpose that the physicians bestow their labor on the secondary qualities of matter, and the operations of attraction, repulsion, attenuation, conspissation,\(^1\) dilatation, astriction, dissipation, maturation, and the like; and were it not that by those two compendia which I have mentioned (elementary qualities, to wit, and specific virtues) they corrupted their correct observations in these other matters—either reducing them to first qualities and their subtle and incommensurable mixtures, or not following them out with greater and more diligent observations to third and fourth qualities, but breaking off the scrutiny prematurely they would have made much greater progress. Nor are powers of this kind (I do not say the same, but similar) to be sought for only in the medicines of the human body, but also in the changes of all other bodies.

But it is a far greater evil that they make the quiescent principles, *wherefrom*, and not the moving principles, *whereby*, things are produced, the object of their contemplation and inquiry. For the former tend to discourse, the latter to works. Nor is there any value in those vulgar distinctions of motion which are observed in the received system of natural philosophy, as generation, corruption, augmentation, diminution, alteration, and local motion. What they mean no doubt is this: if a body in other respects not changed be moved from its place, *this is local motion*; if without change of place or essence, it be changed in quality, *this is alteration*; if by reason of the change the mass and quantity of the body do not remain the same, *this is augmentation or diminution*; if they be changed to such a degree that they change their very essence and substance and turn to something else, *this is generation and corruption*. But all this is merely popular, and does not at all go deep into nature; for these are only measures and limits, not kinds of motion. What they intimate is *how far, not by what means, or from what source*. For they do not suggest anything with regard either to the desires of bodies or to the development of their parts. It is only when that motion presents the thing grossly and palpably to the sense as different from what it was that they begin to mark the division. Even when they wish to suggest something with regard to the causes of motion, and to establish a division with reference to them, they introduce with the greatest negligence a distinction between motion natural and violent, a distinction which is itself drawn entirely from a vulgar notion, since all violent motion is also in fact natural; the external efficient simply setting nature working otherwise than it was before. But if, leaving all this, anyone shall observe (for instance) that there is in bodies a desire of mutual contact, so as not to suffer the unity of nature to be quite separated or broken and a vacuum thus made; or if anyone say that there is in bodies a desire of congregating toward masses of kindred nature—of dense bodies, for instance, toward the globe of the earth, of thin and rare bodies toward the compass of the sky; all these and the like are truly physical kinds of motion—but those others are entirely logical and scholastic, is abundantly manifest from this comparison.

Nor again is it a lesser evil that in their philosophies and contemplations their labor is spent in investigating and handling the first principles of things and the highest generalities of nature; whereas utility and the means of working result entirely from things intermediate. Hence it is that men cease not from abstracting nature till they come to potential

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\(^{1}\) [Conspissalio.-Ed.]
and uninformed matter, nor on the other hand from dissecting nature till they reach the atom; things which, even if true, can do but little for the welfare of mankind.

LXVII

A caution must also be given to the understanding against the intemperance which systems of philosophy manifest in giving or withholding assent, because intemperance of this kind seems to establish idols and in some sort to perpetuate them, leaving no way open to reach and dislodge them.

This excess is of two kinds: the first being manifest in those who are ready in deciding, and render sciences dogmatic and magisterial; the other in those who deny that we can know anything, and so introduce a wandering kind of inquiry that leads to nothing; of which kinds the former subdues, the latter weakens the understanding. For the philosophy of Aristotle, after having by hostile confutations destroyed all the rest (as the Ottomans serve their brothers), has laid down the law on all points; which clone, he proceeds himself to raise new questions of his own suggestion, and dispose of them likewise, so that nothing may remain that is not certain and decided; a practice which holds and is in use among his successors.

The school of Plato, on the other hand, introduced *Acatalepsia*, at first in jest and irony, and in disdain of the older sophists, Protagoras, Hippias, and the rest, who were of nothing else so much ashamed as of seeming to doubt about anything. But the New Academy made a dogma of it, and held it as a tenet. And though theirs is a fairer seeming way than arbitrary decisions, since they say that they by no means destroy all investigation, like Pyrrho and his Refrainers, but allow of some things to be followed as probable, though of none to be maintained as true; yet still when the human mind has once despaired of finding truth, its interest in all things grows fainter, and the result is that men turn aside to pleasant disputations and discourses and roam as it were from object to object, rather than keep on a course of severe inquisition.

But, as I said at the beginning and am ever urging, the human senses and understanding, weak as they are, are not to be deprived of their authority, but to be supplied with helps.

LXVIII

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, where into none may enter except as a little child.

LXIX

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. Of these things, however, which now I do but touch upon, I will speak more largely when, having performed these expiations and purgings of the mind, I come to set forth the true way for the interpretation of nature.
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 experiments 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 business in which they are engaged. Thus, like Atalanta, they go aside to pick the golden apple, but meanwhile they interrupt their course, and let the victory escape them. But in the true course of experience, and in carrying it on to the effecting of new works, the divine wisdom and order must be our pattern. Now God on the first day of creation created light only, giving to that work an entire (lay, in which no material substance was created. 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 discovered and established supply practice with its instruments, not one by one, but in clusters, and draw after them trains and troops of works. Of the paths, however, of experience, which no less than the paths of judgment are impeded and beset, I will speak hereafter; here I have only mentioned ordinary experimental research as a bad kind of demonstration. But now the order of the matter in hand leads me to add something both as to those signs which I lately mentioned (signs that the systems of philosophy and contemplation in use are in a bad condition), and also as to the causes of what seems at first so strange and incredible. For a knowledge of the signs prepares assent; an explanation of the causes removes the marvel — which two things will do much to render the extirpation of idols from the understanding more easy and gentle.

The sciences which we possess come for the most part from the Greeks. For what has been added by Roman, Arabic, or later writers is not much nor of much importance; and whatever it is, it is built on the foundation of Greek discoveries. Now the wisdom of the Greeks was professorial and much given to disputations, a kind of wisdom most adverse to the inquisition of truth. Thus that name of Sophists, which by those who would be thought philosophers was in contempt cast back on and so transferred to the ancient rhetoricians, Gorgias, Protagoras, Hippias, Polus, does indeed suit the entire class: Plato, Aristotle, Zeno, Epicurus, Theophrastus, and their successors Chrysippus, Carneades, and the rest. There was this difference only, that the former class was wandering and mercenary, going about from town to town, putting up their wisdom to sale, and taking a price for it, while the latter were more pompous and dignified, as composed of men who had fixed abodes, and who opened schools and taught their philosophy without reward. Still both sorts, though in other respects unequal, were professorial; both turned the matter into disputations, and set up and battled for philosophical sects and heresies; so that their doctrines were for the most part (as Dionysius not unaptly rallied Plato) "the talk of idle old men to ignorant youths." But the elder of the Greek philosophers, Empedocles, Anaxagoras, Leucippus, Democritus, Parmenides, Heraclitus, Xenophanes, Philolaus, and the rest (I omit Pythagoras as a mystic), did not, so far as we know, open schools; but more silently and severely and simply — that is, with less affectation and parade — betook themselves to the inquisition of truth. And therefore they were in my judgment more successful; only that their works were in the course of time obscured by those slighter persons who had more which suits and pleases the capacity and tastes of the vulgar; time, like a river, bringing down to us things which are light and puffed up, but letting weighty matters sink. Still even they were not altogether free from the failing of their nation, but leaned too much to the ambition and vanity of founding a sect and catching popular applause. But the inquisition of truth must be despaired of when it turns aside to trifles of this kind. Nor should we omit that judgment, or rather divination, which was given concerning the Greeks by the Egyptian priest — that "they were always boys, without antiquity of knowledge or
knowledge of antiquity." Assuredly they have that which is characteristic of boys: they are prompt to prattle, but cannot generate; for their wisdom abounds in words but is barren of works. And therefore the signs which are taken from the origin and birthplace of the received philosophy are not good.

LXXII

Nor does the character of the time and age yield much better signs than the character of the country and nation. For at that period there was but a narrow and meager knowledge either of time or place, which is the worst thing that can be, especially for those who rest all on experience. For they had no history worthy to be called history that went back a thousand years — but only fables and rumors of antiquity. And of the regions and districts of the world they knew but a small portion, giving indiscriminately the name of Scythians to all in the North, of Celts to all in the West; knowing nothing of Africa beyond the hither side of Ethiopia, of Asia beyond the Ganges. Much less were they acquainted with the provinces of the New World, even by hearsay or any well-founded rumor; nay, a multitude of climates and zones, wherein innumerable nations breathe and live, were pronounced by them to be uninhabitable; and the travels of Democritus, Plato, and Pythagoras, which were rather suburban excursions than distant journeys, were talked of as something great. In our times, on the other hand, both many parts of the New World and the limits on every side of the Old World are known, and our stock of experience has increased to an infinite amount. Wherefore if (like astrologers) we draw signs from the season of their nativity or birth, nothing great can be predicted of those systems of philosophy.

LXXIII

Of all signs there is none more certain or more noble than that taken from fruits. For fruits and works are as it were sponsors and sureties for the truth of philosophies. Now, from all these systems of the Greeks, and their ramifications through particular sciences, there can hardly after the lapse of so many years be adduced a single experiment which tends to relieve and benefit the condition of man, and which can with truth be referred to the speculations and theories of philosophy. And Celsus ingenuously and wisely owns as much when he tells us that the experimental part of medicine was first discovered, and that afterwards men philosophized about it, and hunted for and assigned causes; and not by an inverse process that philosophy and the knowledge of causes led to the discovery and development of the experimental part. And therefore it was not strange that among the Egyptians, who rewarded inventors with divine honors and sacred rites, there were more images of brutes than of men; inasmuch as brutes by their natural instinct have produced many discoveries, whereas men by discussion and the conclusions of reason have given birth to few or none.

Some little has indeed been produced by the industry of chemists; but it has been produced accidentally and in passing, or else by a kind of variation of experiments, such as mechanics use, and not by any art or theory. For the theory which they have devised rather confuses the experiments than aids them. They, too, who have busied themselves with natural magic, as they call it, have but few discoveries to show, and those trilling 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.

LXXIV

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.
There is still another sign remaining (if sign it can be called, when it is rather testimony, nay, of all testimony the most valid). I mean the confession of the very authorities whom men now follow. For even they who lay down the law on all things so confidently, do still in their more sober moods fall to complaints of the subtlety of nature, the obscurity of things, and the weakness of the human mind. Now if this were all they did, some perhaps of a timid disposition might be deterred from further search, while others of a more ardent and hopeful spirit might be whetted and incited to go on farther. But not content to speak for themselves, whatever is beyond their own or their master's knowledge or reach they set down as beyond the bounds of possibility, and pronounce, as if on the authority of their art, that it cannot be known or done; thus most presumptuously and invidiously turning the weakness of their own discoveries into a calumny of nature herself, and the despair of the rest of the world. Hence the school of the New Academy, which held Acatalepsia as a tenet and doomed men to perpetual darkness. Hence the opinion that forms or true differences of things (which are in fact laws of pure act) are past finding out and beyond the reach of man. Hence, too, those opinions in the department of action and operation; as, that the heat of the sun and of fire are quite different in kind — lest men should imagine that by the operations of fire anything like the works of nature can be educed and formed. Hence the notion that composition only is the work of man, and mixture of none but nature — lest men should expect from art some power of generating or transforming natural bodies. By this sign, therefore, men will easily take warning not to mix up their fortunes and labors with dogmas not only despaired of but dedicated to despair.

Neither is this other sign to be omitted: that formerly there existed among philosophers such great disagreement, and such diversities in the schools themselves, a fact which sufficiently shows that the road from the senses to the understanding was not skillfully laid out, when the same groundwork of philosophy (the nature of things to wit) was torn and split up into such vague and multifarious errors. And although in these times disagreements and diversities of opinion on first principles and entire systems are for the most part extinguished, still on parts of philosophy there remain innumerable questions and disputes, so that it plainly appears that neither in the systems themselves nor in the modes of demonstration is there anything certain or sound.

And as for the general opinion that in the philosophy of Aristotle, at any rate, there is great agreement, since after its publication the systems of older philosophers died away, while in the times which followed nothing better was found, so that it seems to have been so well laid and established as to have drawn both ages in its train — I answer in the first place, that the common notion of the falling off of the old systems upon the publication of Aristotle's works is a false one; for long afterwards, down even to the times of Cicero and subsequent ages, the works of the old philosophers still remained. But in the times which followed, when on the inundation of barbarians into the Roman empire human learning had suffered shipwreck, then the systems of Aristotle and Plato, like planks of lighter and less solid material, floated on the waves of time and were preserved. Upon the point of consent also men are deceived, if the matter be looked into more keenly. For true consent is that which consists in the coincidence of free judgments, after due examination. But far the greater number of those who have assented to the philosophy of Aristotle have addicted themselves thereto from prejudgment and upon the authority of others; so that it is a following and going along together, rather than consent. But even if it had been a real and widespread consent, still so little ought consent to be deemed a sure and solid confirmation, that it is in fact a strong presumption the other way. For the worst of all auguries is from consent in matters intellectual (divinity excepted, and politics where there is right of vote). For nothing pleases the many unless it strikes the imagination, or binds the understanding with the bands of common notions, as I have already said. We may very well transfer, therefore, from moral to intellectual matters the saying of Phocion, that if the multitude assent and applaud, men ought immediately to examine themselves as to what blunder or fault they may have committed. This sign, therefore, is one of the most unfavorable. And so much for this point; namely, that the signs of truth and soundness in the received systems and sciences are not good, whether they be drawn from their origin, or from their fruits, or from their progress, or from the confessions of their founders, or from general consent.
I now come to the causes of these errors, and of so long a continuance in them through so many ages, which are
ever many and very potent; that all wonder how these considerations which I bring forward should have escaped men's
notice till now may cease, and the only wonder be how now at last they should have entered into any man's head and
become the subject of his thoughts — which truly I myself esteem as the result of some happy accident, rather than of
any excellence of faculty in me — a birth of Time rather than a birth of Wit. 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. For neither the
Arabians nor the Schoolmen need be mentioned, who in the intermediate times rather crushed the sciences with a
multitude of treatises, than increased their weight. And therefore the first cause of so meager a progress in the sciences is
duly and orderly referred to the narrow limits of the time that has been favorable to them.

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. Now it is well known that after the Christian religion was received and grew strong, by far the greater
number of the best wits applied themselves to theology; that to this both the highest rewards were offered, and helps of
all kinds most abundantly supplied; and that this devotion to theology chiefly occupied that third portion or epoch of time
among us Europeans of the West, and the more so because about the same time both literature began to flourish and
religious controversies to spring up. In the age before, on the other hand, during the continuance of the second period
among the Romans, the meditations and labors of philosophers were principally employed and consumed on moral
philosophy, which to the heathen was as theology to us. Moreover, in those times the greatest wits applied themselves
very generally to public affairs, the magnitude of the Roman empire requiring the services of a great number of persons.
Again, the age in which natural philosophy was seen to flourish most among the Greeks was but a brief particle of time;
for in early ages the Seven Wise Men, as they were called (all except Thales), applied themselves to morals and politics;
and in later times, when Socrates had drawn down philosophy from heaven to earth, moral philosophy became more
fashionable than ever, and diverted the minds of men from the philosophy of nature.

Nay, the very period itself in which inquiries concerning nature flourished, was by controversies and the
ambitious display of new opinions corrupted and made useless. Seeing therefore that during those three periods natural
philosophy was in a great degree either neglected or hindered, it is no wonder if men made but small advance in that to
which they were not attending.

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. For want of this, astronomy,
optics, music, a number of mechanical arts, medicine itself — nay, what one might more wonder at, moral and political
philosophy, and the logical sciences — altogether lack profundness, and merely glide along the surface and variety of
things. Because after these particular sciences have been once distributed and established, they are no more nourished by
natural philosophy, which might have drawn out of the true contemplation of motions, rays, sounds, texture and
configuration of bodies, affections, and intellectual perceptions, the means of imparting to them fresh strength and
growth. And therefore it is nothing strange if the sciences grow not, seeing they are parted from their roots.

LXXXI

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. But of this the great
majority have no feeling, but are merely hireling and professorial; except when it occasionally happens that some
workman of acuter wit and covetous of honor applies himself to a new invention, which he mostly does at the expense of
his fortunes. But in general, so far are men from proposing to themselves to augment the mass of arts and sciences, that
from the mass already at hand they neither take nor look for anything more than what they may turn to use in their
lectures, or to gain, or to reputation, or to some similar advantage. And if any one out of all the multitude court science
with honest affection and for her own sake, yet even with him the object will be found to be rather the variety of
contemplations and doctrines than the severe and rigid search after truth. And if by chance there be one who seeks after
truth in earnest, yet even he will propose to himself such a kind of truth as shall yield satisfaction to the mind and
understanding in rendering causes for things long since discovered, and not the truth which shall lead to new assurance of
works and new light of axioms. If then the end of the sciences has not as yet been well placed, it is not strange that men
have erred as to the means.

LXXXII

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. And an astonishing thing it is to one who rightly
considers the matter, that no mortal should have seriously applied himself to the opening and laying out of a road for the
human understanding direct from the sense, by a course of experiment orderly conducted and well built up, but that all
has been left either to the mist of tradition, or the whirl and eddy of argument, or the fluctuations and mazes of chance
and of vague and ill-digested experience. 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. For
logical invention does not discover principles and chief axioms, of which arts are composed, but only such things as
appear to be consistent with them. For if you grow more curious and importunate and busy, and question her of
probations and invention of principles or primary axioms, her answer is well known; she refers you to the faith you are
bound to give to the principles of each separate art.

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, that feel all round them for the chance of finding their way, when they had much better wait for daylight, or light a
candle, and then go. But the true method of experience, on the contrary, first lights the candle, and then by means of the
candle shows the way; commencing as it does with experience duly ordered and digested, not bungling or erratic, and
from it educating axioms, and from established axioms new experiments; even as it was not without order and
method that the divine word operated on the created mass. Let men therefore cease to wonder that the course of science is
not yet wholly run, seeing that they have gone altogether astray, either leaving and abandoning experience entirely, or
losing their way in it and wandering round and round as in a labyrinth. Whereas a method rightly ordered leads by an
unbroken route through the woods of experience to the open ground of axioms.
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. Of the last I have spoken above.

As for antiquity, the opinion touching it which men entertain is quite a negligent one and scarcely consonant with the word itself. For the old age of the world is to be accounted the true antiquity; and this is the attribute of our own times, not of that earlier age of the world in which the ancients lived, and which, though in respect of us it was the elder, yet in respect of the world it was the younger. And truly as we look for greater knowledge of human things and a riper judgment in the old man than in the young, because of his experience and of the number and variety of the things which he has seen and heard and thought of, so in like manner from our age, if it but knew its own strength and chose to essay and exert it, much more might fairly be expected than from the ancient times, inasmuch as it is a more advanced age of the world, and stored and stocked with infinite experiments and observations.

Nor must it go for nothing that by the distant voyages and travels which have become frequent in our times many things in nature have been laid open and discovered which may let in new light upon philosophy. And surely it would be disgraceful if, while the regions of the material globe — that is, of the earth, of the sea, and of the stars — have been in our times laid widely open and revealed, the intellectual globe should remain shut up within the narrow limits of old discoveries.

And with regard to authority, it shows a feeble mind to grant so much to authors and yet deny time his rights, who is the author of authors, nay, rather of all authority. For rightly is truth called the daughter of time, not of authority. It is no wonder therefore if those enchantments of antiquity and authority and consent have so bound up men's powers that they have been made impotent (like persons bewitched) to accompany with the nature of things.

Nor is it only the admiration of antiquity, authority, and consent, that has forced the industry of man to rest satisfied with the discoveries already made, but also an admiration for the works themselves of which the human race has long been in possession. For when a man looks at the variety and the beauty of the provision which the mechanical arts have brought together for men's use, he will certainly be more inclined to admire the wealth of man than feel his wants; not considering that the original observations and operations of nature (which are the life and moving principle of all that variety) are not many nor deeply fetched, and that the rest is but patience, and the subtle and ruled motion of the hand and instruments — as the making of clocks (for instance) is certainly a subtle and exact work: their wheels seem to imitate the celestial orbs, and their alternating and orderly motion, the pulse on animals; and yet all this depends on one to two axioms of nature.

Again, if you observe the refinement of the liberal arts, or even that which relates to the mechanical preparation of natural substances, and take notice of such things as the discovery in astronomy of the motions of the heavens, of harmony in music, of the letters of the alphabet (to this day not in use among the Chinese) in grammar; or again in things mechanical; the discovery of the works of Bacchus and Ceres — that is, of the arts of preparing wine and beer, and of making bread; the discovery once more of the delicacies of the table, of distillations and the like; and if you likewise bear in mind the long periods which it has taken to bring these things to their present degree of perfection (for they are all ancient except distillation), and again (as has been said of clocks) how little they owe to observations and axioms of nature, and how easily and obviously and as it were by casual suggestions they may have been discovered; you will easily cease from wondering, and on the contrary will pity the condition of mankind, seeing that in a course of so many ages
there has been so great a dearth and barrenness of arts and inventions. And yet these very discoveries which we have just
mentioned are older than philosophy and intellectual arts. So that, if the truth must be spoken, when the rational and
dogmatical sciences began, the discovery of useful works came to an end.

And again, if a man turn from the workshop to the library, and wonder at the immense variety of books he sees
there, let him but examine and diligently inspect their matter and contents, and his wonder will assuredly be turned the
other way. For after observing their endless repetitions, and how men are ever saying and doing what has been said and
done before, he will pass from admiration of the variety to astonishment at the poverty and scantiness of the subjects
which till now have occupied and possessed the minds of men.

And if again he descend to the consideration of those arts which are deemed curious rather than safe, and look
more closely into the works of the alchemists or the magicians, he will be in doubt perhaps whether he out rather to laugh
over them or to weep. For the alchemist nurses eternal hope and when the thing fails, lays the blame upon some error of
his own; fearing either that he has not sufficiently understood the words of his art or of his authors (whereupon he turns
to traditions and auricular whispers), or else that in his manipulations he has made some slip of a scruple in weight or a
moment in time (whereupon he repeats his trials to infinity). And when, meanwhile, among the chances of experiment he
lights upon some conclusions either in aspect new or for utility not contemptible, he takes these for earnest of what is to
come, and feeds his mind upon them, and magnifies them to the most, and supplies the rest in hope. Not but that the
alchemists have made a good many discoveries and presented men with useful inventions. But their case maybe be well
compared to the fable of the old man who bequeathed to his sons gold buried in the vineyard, pretending not to know the
exact spot; whereupon the sons applied themselves diligently to the digging of the vineyard, and although no gold was
found there, yet the vintage by that digging was made more plentiful.

Again the students of natural magic, who explain everything by sympathies and antipathies, have this idle and
most slothful conjectures ascribed to substances wonderful virtues and operations; and if ever they have produced works,
they have been such as aim rather at admiration and novelty that an utility and fruit.

In superstitious magic on the other hand (if of this also we must speak), it is especially to be observed that they are
but subjects of a certain and definite kind wherein the curious and superstitious arts, in all nations and ages, and religious
also, have worked or played. These therefore we may pass. Meanwhile it is nowise strange if opinion of plenty has been
the cause of want.

LXXXVI

Further, this admiration of men for knowledge and arts — an admiration in itself weak enough, and well-nigh
childish — has been increased by the craft and artifices of those who have handled and transmitted sciences. For they set
them forth with such ambition and parade, and bring them into the view of the world so fashioned and masked as if they
were complete in all parts and finished. For if you look at the method of them and the divisions, they seem to embrace
and comprise everything which can belong to the subject. And although these divisions are ill filled out and are but as
empty cases, still to the common mind they present the form an plan of a perfect science. But the first and most ancient
seekers after truth were wont, with better faith and better fortune, too, to throw the knowledge which they gathered from
the contemplation of things, and which they meant to store up for use, into aphorisms; that is, into short and scattered
sentences, not linked together by an artificial method; and did not pretend or profess to embrace the entire art. But as the
matter now is, it is nothing strange if men do not seek to advance in things delivered to them as long since perfect and
complete.

LXXXVII

Moreover, the ancient systems have received no slight accession of reputation and credit from the vanity and
levity of those who have propounded new ones, especially in the active and practical department of natural philosophy.
For there have not been wanting talkers and dreamers who, partly from credulity, partly in imposture, have loaded
mankind with promises, offering and announcing the prolongation of life, the retardation of age, the alleviation of pain,
the repairing of natural defects, the deceiving of the senses; arts of binding and inciting the affections, of illuminating and
exalting the intellectual faculties, of transmuting substances, of strengthening and multiplying motions at will, of making
impressions and alterations in the air, of bringing down and procuring celestial influences; arts of divining things future,
and bringing things distant near, and revealing things secret; and many more. But with regard to these lavish promisers,
this judgment would not be far amiss: that there is as much difference in philosophy between their vanities and true arts
as there is in history between the exploits of Julius Caesar or Alexander the Great, and the exploits of Amadis of Gaul or
Arthur of Britain. For it is true that those illustrious generals really did greater things than these shadowy heroes are even
feigned to have done; but they did them by means and ways, of action not fabulous or monstrous. Yet surely it is not fair
that the credit of true history should be lessened because it has sometimes been injured and wronged by fables.
Meanwhile it is not to be wondered at if a great prejudice is raised against new propositions, especially when works are
also mentioned, because of those impostors who have attempted the like; since their excess of vanity, and the disgust it
has bred, have their effect still in the destruction of all greatness of mind in enterprises of this kind.

Far more, however, has knowledge suffered from littleness of spirit and the smallness and slightness of the tasks
which human industry has proposed to itself. And what is worst of all, this very littleness of spirit comes with a certain
air of arrogance and superiority.

For in the first place there is found in all arts one general device, which has now become familiar — that the
author lays the weakness of his art to the charge of nature: whatever his art cannot attain he sets down on the authority of
the same art to be in nature impossible. And truly no art can be condemned if it be judge itself. Moreover, the philosophy
which is now in vogue embraces and cherishes certain tenets, the purpose of which (if it be diligently examined) is to
persuade men that nothing difficult, nothing by which nature may be commanded and subdued, can be expected from art
or human labor; as with respect to the doctrine that the heat of the sun and of fire differ in kind, and to that other
concerning mixture, has been already observed. Which things, if they be noted accurately, tend wholly to the unfair
circumscription of human power, and to a deliberate and factitious despair, which not only disturbs the auguries of hope,
but also cuts the sinews and spur of industry, and throws away the chances of experience itself. And all for the sake of
having their art thought perfect, and for the miserable vainglory of making it believed that whatever has not yet been
discovered and comprehended, can never be discovered or comprehended hereafter.

And even if a man apply himself fairly to facts, and endeavor to find out something new, yet he will confine his
aim and intention to the investigation and working out of some one discovery and no more; such as the nature of the
magnet, the ebb and flow of the sea, the system of the heavens, and things of this kind, which seem to be in some measure
secret, and have hitherto been handled without much success. Whereas it is most unskillful to investigate the nature of
any thing in the thing itself, seeing that the same nature which appears in some things to be latent and hidden is in others
manifest and palpable; wherefore in the former it produces wonder, in the latter excites no attention; as we find it in the
nature of consistency, which in wood or stone is not observed but is passed over under the appellation of solidity without
further inquiry as to why separation or solution of continuity is avoided; while in the case of bubbles, which form
themselves into certain pellicles, curiously shaped into hemispheres, so that the solution of continuity is avoided for a
moment, it is thought a subtle matter. In fact, what in some things is accounted a secret has in others a manifest and
well-known nature, which will never be recognized as long as the experiments and thoughts of men are engaged on the
former only.

But generally speaking, in mechanics old discoveries pass for new if a man does but refine or embellish them, or
unite several in one, or couple them better with their use, or make the work in greater or less volume than it was before,
or the like.

Thus, then, it is no wonder if inventions noble and worthy of mankind have not been brought to light, when men
have been contented and delighted with such trifling and puerile tasks, and have even fancied that in them they have been
endeavoring after, if not accomplishing, some great matter.

Neither is it to be forgotten that in every age natural philosophy has had a troublesome and hard to deal with
adversary — namely, superstition, and the blind and immoderate zeal of religion. For we see among the Greeks that
those who first proposed to men's then uninitiated ears the natural causes for thunder and for storms were thereupon
found guilty of impiety. Nor was much more forbearance shown by some of the ancient fathers of the Christian church to
those who on most convincing grounds (such as no one in his senses would now think of contradicting) maintained that
the earth was round, and of consequence asserted the existence of the antipodes.
Moreover, as things now are, to discourse of nature is made harder and more perilous by the summaries and systems of the schoolmen who, having reduced theology into regular order as well as they were able, and fashioned it into the shape of an art, ended in incorporating the contentious and thorny philosophy of Aristotle, more than was fit, with the body of religion.

To the same result, though in a different way, tend the speculations of those who have taken upon them to deduce the truth of the Christian religion from the principles of philosophers, and to confirm it by their authority, pompously solemnizing this union of the sense and faith as a lawful marriage, and entertaining men's minds with a pleasing variety of matter, but all the while disparaging things divine by mingling them with things human. Now in such mixtures of theology with philosophy only the received doctrines of philosophy are included; while new ones, albeit changes for the better, are all but expelled and exterminated.

Lastly, you will find that by the simpleness of certain divines, access to any philosophy, however pure, is well-nigh closed. Some are weakly afraid lest a deeper search into nature should transgress the permitted limits of sober-mindedness, wrongfully wresting and transferring what is said in Holy Writ against those who pry into sacred mysteries, to the hidden things of nature, which are barred by no prohibition. Others with more subtlety surmise and reflect that if second causes are unknown everything can more readily be referred to the divine hand and rod, a point in which they think religion greatly concerned — which is in fact nothing else but to seek to gratify God with a lie. Others fear from past example that movements and changes in philosophy will end in assaults on religion. And others again appear apprehensive that in the investigation of nature something may be found to subvert or, at least shake the authority of religion, especially with the unlearned. But these two last fears seem to me to savor utterly of carnal wisdom; as if men in the recesses and secret thought of their hearts doubted and distrusted the strength of religion and the empire of faith over the sense, and therefore feared that the investigation of truth in nature might be dangerous to them. But if the matter be truly considered, natural philosophy is, after the word of God, at once the surest medicine against superstition and the most approved nourishment for faith, and therefore she is rightly given to religion as her most faithful handmaid, since the one displays the will of God, the other his power. For he did not err who said, "Ye err in that ye know not the Scriptures and the power of God," thus coupling and blending in an indissoluble bond information concerning his will and meditation concerning his power. Meanwhile it is not surprising if the growth of natural philosophy is checked when religion, the thing which has most power over men's minds, has by the simpleness and incautious zeal of certain persons been drawn to take part against her.

Again, in the customs and institutions of schools, academics, colleges, and similar bodies destined for the abode of learned men and the cultivation of learning, everything is found adverse to the progress of science. For the lectures and exercises there are so ordered that to think or speculate on anything out of the common way can hardly occur to any man. And if one or two have the boldness to use any liberty of judgment, they must undertake the task all by themselves; they can have no advantage from the company of others. And if they can endure this also, they will find their industry and largeness of mind no slight hindrance to their fortune. For the studies of men in these places are confined and as it were imprisoned in the writings of certain authors, from whom if any man dissent he is straightway arraigned as a turbulent person and an innovator. But surely there is a great distinction between matters of state and the arts; for the danger from new motion and new light is not the same. In matters of state a change even for the better is distrusted, because it unsettles what is established; these things resting on authority, consent, fame and opinion, not on demonstration. But arts and sciences should be like mines, where the noise of new works and further advances is heard on every side. But though the matter be so according to right reason, it is not so acted on in practice; and the points above mentioned in the administration and government of learning put a severe restraint upon the advancement of the sciences.

Nay, even if that jealousy were to cease, still it is enough to check the growth of science that efforts and labors in this field go unrewarded. For it does not rest with the same persons to cultivate sciences and to reward them. The growth of them comes from great wits; the prizes and rewards of them are in the hands of the people, or of great persons, who are but in very few cases even moderately learned. Moreover, this kind of progress is not only unrewarded with prizes and substantial benefits; it has not even the advantage of popular applause. For it is a greater matter than the generality of
men can take in, and is apt to be overwhelmed and extinguished by the gales of popular opinions. And it is nothing strange if a thing not held in honor does not prosper.

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. If therefore anyone believes or promises more, they think this comes of an uncontrolled and unripened mind, and that such attempts have prosperous beginnings, become difficult as they go on, and end in confusion. Now since these are thoughts which naturally present themselves to men grave and of great judgment, we must take good heed that we be not led away by our love for a most fair and excellent object to relax or diminish the severity of our judgment. We must observe diligently what encouragement dawns upon us and from what quarter, and, putting aside the lighter breezes of hope, we must thoroughly sift and examine those which promise greater steadiness and constancy. Nay, and we must take state prudence too into our counsels, whose rule is to distrust, and to take the less favorable view of human affairs. I am now therefore to speak touching hope, especially as I am not a dealer in promises, and wish neither to force nor to ensnare men's judgments, but to lead them by the hand with their good will. And though the strongest means of inspiring hope will be to bring men to particulars, especially to particulars digested and arranged in my Tables of Discovery (the subject partly of the second, but much more of the fourth part of my Instauration), since this is not merely the promise of the thing but the thing itself; nevertheless, that everything may be done with gentleness, I will proceed with my plan of preparing men's minds, of which preparation to give hope is no unimportant part. For without it the rest tends rather to make men sad (by giving them a worse and meaner opinion of things as they are than they now have, and making them more fully to feel and know the unhappiness of their own condition) than to induce any alacrity or to whet their industry in making trial. And therefore it is fit that I publish and set forth those conjectures of mine which make hope in this matter reasonable, just as Columbus did, before that wonderful voyage of his across the Atlantic, when he gave the reasons for his conviction that new lands and continents might be discovered besides those which were known before; which reasons, though rejected at first, were afterwards made good by experience, and were the causes and beginnings of great events.

The beginning is from God: for the business which is in hand, having the character of good so strongly impressed upon it, appears manifestly to proceed from God, who is the author of good, and the Father of Lights. Now in divine operations even the smallest beginnings lead of a certainty to their end. And as it was said of spiritual things, "The kingdom of God cometh not with observation," so is it in all the greater works of Divine Providence; everything glides on smoothly and noiselessly, and the work is fairly going on before men are aware that it has begun. Nor should the prophecy of Daniel be forgotten touching the last ages of the world: "Many shall go to and fro, and knowledge shall be increased"; clearly intimating that the thorough passage of the world (which now by so many distant voyages seems to be accomplished, or in course of accomplishment), and the advancement of the sciences, are destined by fate, that is, by Divine Providence, to meet in the same age.

Next comes a consideration of the greatest importance as an argument of hope; I mean that drawn from the errors of past time, and of the ways hitherto trodden. For most excellent was the censure once passed upon a government that had been unwisely administered. "That which is the worst thing in reference to the past, ought to be regarded as best for the future. For if you had done all that your duty demanded, and yet your affairs were no better, you would not have even a hope left you that further improvement is possible. But now, when your misfortunes are owing, not to the force of circumstances, but to your own errors, you may hope that by dismissing or correcting these errors, a great change may be
made for the better." In like manner, if during so long a course of years men had kept the true road for discovering and cultivating sciences, and had yet been unable to make further progress therein, bold doubtless and rash would be the opinion that further progress is possible. But if the road itself has been mistaken, and men's labor spent on unfit objects, it follows that the difficulty has its rise not in things themselves, which are not in our power, but in the human understanding, and the use and application thereof, which admits of remedy and medicine. It will be of great use therefore to set forth what these errors are. For as many impediments as there have been in times past from this cause, so many arguments are there of hope for the time to come. And although they have been partly touched before, I think fit here also, in plain and simple words, to represent them.

XCV

Those who have handled sciences have been either men of experiment or men of dogmas. The men of experiment are like the ant, they only collect and use; the reasoners resemble spiders, who make cobwebs out of their own substance. But the bee takes a middle course: it gathers its material from the flowers of the garden and of the field, but transforms and digests it by a power of its own. Not unlike this is the true business of philosophy; for it neither relies solely or chiefly on the powers of the mind, nor does it take the matter which it gathers from natural history and mechanical experiments and lay it up in the memory whole, as it finds it, but lays it up in the understanding altered and digested. Therefore from a closer and purer league between these two faculties, the experimental and the rational (such as has never yet been made), much may be hoped.

XCVI

We have as yet no natural philosophy that is pure; all is tainted and corrupted: in Aristotle's school by logic; in Plato's by natural theology; in the second school of Platonists, such as Proclus and others, by mathematics, which ought only to give definiteness to natural philosophy, not to generate or give it birth. From a natural philosophy pure and unmixed, better things are to be expected.

XCVII

No one has yet been found so firm of mind and purpose as resolutely to compel himself to sweep away all theories and common notions, and to apply the understanding, thus made fair and even, to a fresh examination of particulars. Thus it happens that human knowledge, as we have it, is a mere medley and ill-digested mass, made up of much credulity and much accident, and also of the childish, notions which we at first imbibed.

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. In which point I promise to myself a like fortune to that of Alexander the Great, and let no man tax me with vanity till he have heard the end; for the thing which I mean tends to the putting off of all vanity. For of Alexander and his deeds Aeschines spoke thus: "Assuredly we do not live the life of mortal men; but to this end were we born, that in after ages wonders might be told of us," as if what Alexander had done seemed to him miraculous. But in the next age Titus Livius took a better and a deeper view of the matter, saying in effect that Alexander "had done no more than take courage to despise vain apprehensions." And a like judgment I suppose may be passed on myself in future ages: that I did no great things, but simply made less account of things that were accounted great. In the meanwhile, as I have already said, there 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.

XCVIII

Now for grounds of experience — since to experience we must come — we have as yet had either none or very weak ones; no search has been made to collect a store of particular observations sufficient either in number, or in kind, or in certainty, to inform the understanding, or in any way adequate. On the contrary, men of learning, but easy withal and idle, have taken for the construction or for the confirmation of their philosophy certain rumors and vague fames or airs of experience, and allowed to these the weight of lawful evidence. And just as if some kingdom or state were to direct its counsels and affairs not by letters and reports from ambassadors and trustworthy messengers, but by the gossip of the
streets; such exactly is the system of management introduced into philosophy with relation to experience. Nothing duly investigated, nothing verified, nothing counted, weighed, or measured, is to be found in natural history; and what in observation is loose and vague, is in information deceptive and treacherous. And if anyone thinks that this is a strange thing to say, and something like an unjust complaint, seeing that Aristotle, himself so great a man, and supported by the wealth of so great a king, has composed so accurate a history of animals; and that others with greater diligence, though less pretense, have made many additions; while others, again, have compiled copious histories and descriptions of metals, plants, and fossils; it seems that he does not rightly apprehend what it is that we are now about. For a natural history which is composed for its own sake is not like one that is collected to supply the understanding with information for the building up of philosophy. They differ in many ways, but especially in this: that the former contains the variety of natural species only, and not experiments of the mechanical arts. For even as in the business of life a man's disposition and the secret workings of his mind and affections are better discovered when he is in trouble than at other times, so likewise the secrets of nature reveal themselves more readily under the vexations of art than when they go their own way. Good hopes may therefore be conceived of natural philosophy, when natural history, which is the basis and foundation of it, has been drawn up on a better plan; but not till then.

Again, even in the great plenty of mechanical experiments, there is yet a great scarcity of those which are of most use for the information of the understanding. For the mechanic, not troubling himself with the investigation of truth, confines his attention to those things which bear upon his particular work, and will not either raise his mind or stretch out his hand for anything else. 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.

CIII

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.

CIV

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. For the lowest axioms differ but slightly from bare experience, while the highest and most general (which we now have) are notional and abstract and without solidity. But the middle are the true and solid and living axioms, on which depend the affairs and fortunes of men; and above them again, last of all, those which are indeed the most general; such, I mean, as are not abstract, but of which those intermediate axioms are really limitations.

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.

CV

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, save only by Plato, who does indeed employ this form of induction to a certain extent for the purpose of discussing definitions and ideas. But in order to furnish this induction or demonstration well and duly for its work, very many things are to be provided which no mortal has yet thought of; insomuch that greater labor will have to be spent in it than has hitherto been spent on the syllogism. 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.

CVI
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.

CVII

And here also should be remembered what was said above concerning the extending of the range of natural philosophy to take in the particular sciences, and the referring or bringing back of the particular sciences to natural philosophy, that the branches of knowledge may not be severed and cut off from the stem. For without this the hope of progress will not be so good.

CVIII

So much then for the removing of despair and the raising of hope through the dismissal or rectification of the errors of past time. We must now see what else there is to ground hope upon. And this consideration occurs at once — that if many useful discoveries have been made by accident or upon occasion, when men were not seeking for them but were busy about other things, no one can doubt but that when they apply themselves to seek and make this their business, and that too by method and in order and not by desultory impulses, they will discover far more. For although it may happen once or twice that a man shall stumble on a thing by accident which, when taking great pains to search for it, he could not find, yet upon the whole it unquestionably falls out the other way. And therefore far better things, and more of them, and at shorter intervals, are to be expected from man's reason and industry and direction and fixed application than from accident and animal instinct and the like, in which inventions have hitherto had their origin.

CIX

Another argument of hope may be drawn from this — that some of the inventions already known are such as before they were discovered it could hardly have entered any man's head to think of; they would have been simply set aside as impossible. For in conjecturing what may be men set before them the example of what has been, and divine of the new with an imagination preoccupied and colored by the old; which way of forming opinions is very fallacious, for streams that are drawn from the springheads of nature do not always run in the old channels.

If, for instance, before the invention of ordnance, a man had described the thing by its effects, and said that there was a new invention by means of which the strongest towers and walls could be shaken and thrown down at a great distance, men would doubtless have begun to think over all the ways of multiplying the force of catapults and mechanical engines by weights and wheels and such machinery for ramming and projecting; but the notion of a fiery blast suddenly and violently expanding and exploding would hardly have entered into any man's imagination or fancy, being a thing to which nothing immediately analogous had been seen, except perhaps in an earthquake or in lightning, which as magnalia or marvels of nature, and by man not imitable, would have been immediately rejected.

In the same way, if, before the discovery of silk, anyone had said that there was a kind of thread discovered for the purposes of dress and furniture which far surpassed the thread of linen or of wool in fineness and at the same time in strength, and also in beauty and softness, men would have begun immediately to think of some silky kind of vegetable, or of the finer hair of some animal, or of the feathers and down of birds; but a web woven by a tiny worm, and that in such abundance, and renewing itself yearly, they would assuredly never have thought. Nay, if anyone had said anything about a worm, he would no doubt have been laughed at as dreaming of a new kind of cobwebs.

So again, if, before the discovery of the magnet, anyone had said that a certain instrument had been invented by means of which the quarters and points of the heavens could be taken and distinguished with exactness, men would have been carried by their imagination to a variety of conjectures concerning the more exquisite construction of astronomical instruments; but that anything could be discovered agreeing so well in its movements with the heavenly bodies, and yet not a heavenly body itself, but simply a substance of metal or stone, would have been judged altogether incredible. Yet these things and others like them lay for so many ages of the world concealed from men, nor was it by philosophy or the
rational arts that they were found out at last, but by accident and occasion, being indeed, as I said, altogether different in kind and as remote as possible from anything that was known before; so that no preconceived notion could possibly have led to the discovery of them.

There is therefore much ground for hoping that there are still laid up in the womb of nature many secrets of excellent use, having no affinity or parallelism with anything that is now known, but lying entirely out of the beat of the imagination, which have not yet been found out. They too no doubt will some time or other, in the course and revolution of many ages, come to light of themselves, just as the others did; only by the method of which we are now treating they can be speedily and suddenly and simultaneously presented and anticipated.

CX

But we have also discoveries to show of another kind, which prove that noble inventions may be lying at our very feet, and yet mankind may step over without seeing them. For however the discovery of gunpowder; of silk, of the magnet, of sugar, of paper, or the, like, may seem to depend on certain properties of things themselves and nature, there is at any rate nothing in the art of printing which is not plain and obvious. Nevertheless for want of observing that although it is more difficult to arrange types of letters than to write letters by the motion of the hand, there is yet this difference between the two, that types once arranged serve for innumerable impressions, but letters written with the hand for a single copy only; or perhaps again for want of observing that ink can be so thickened as to color without running (particularly when the letters face upwards and the impression is made from above) — for want, I say, of observing these things, men went for so many ages without this most beautiful discovery, which is of so much service in the propagation of knowledge.

But such is the infelicity and unhappy disposition of the human mind in this course of invention, that it first distrusts and then despises itself: first will not believe that any such thing can be found out; and when it is found out, cannot understand how the world should have missed it so long. And this very thing may be justly taken as an argument of hope, namely, that there is a great mass of inventions still remaining which not only by means of operations that are yet to be discovered, but also through the transferring, comparing, and applying of those already known, by the help of that learned experience of which I spoke, may be deduced and brought to light.

CXI

There is another ground of hope that must not be omitted. Let men but think over their infinite expenditure of understanding, time, and means on matters and pursuits of far less use and value; whereof, if but a small part were directed to sound and solid studies, there is no difficulty that might not be overcome. This I thought good to add; because I plainly confess that a collection of history natural and experimental, such as I conceive it and as it ought to be, is a great, I may say a royal work, and of much labor and expense.

CXII

Meantime, let no man be alarmed at the multitude of particulars, but let this rather encourage him to hope. For the particular phenomena of art and nature are but a handful to the inventions of the wit, when disjoined and separated from the evidence of things. Moreover, this road has an issue in the open ground and not far off; the other has no issue at all, but endless entanglement. For men hitherto have made but short stay with experience, but passing her lightly by, have wasted an infinity of time on meditations and glosses of the wit. But if someone were by that could answer our questions and tell us in each case what the fact in nature is, the discovery of all causes and sciences would be but the work of a few years.

CXIII

Moreover, I think that men may take some hope from my own example. And this I say not by way of boasting, but because it is useful to say it. If there be any that despond, let them look at me, that being of all men of my time the most busied in affairs of state, and a man of health not very strong (whereby much time is lost), and in this course altogether a pioneer, following in no man's track nor sharing these counsels with anyone, have nevertheless by resolutely
entering on the true road, and submitting my mind to Things, advanced these matters, as I suppose, some little way. And then let them consider what may be expected (after the way has been thus indicated) from men abounding in leisure, and from association of labors, and from successions of ages — the rather because it is not a way over which only one man can pass at a time (as is the case with that of reasoning), but one in which the labors and industries of men (especially as regards the collecting of experience) may with the best effect be first distributed and then combined. For then only will men begin to know their strength when instead of great numbers doing all the same things, one shall take charge of one thing and another of another.

CXIV

Lastly, even if the breath of hope which blows on us from that New Continent were fainter than it is and harder to perceive, yet the trial (if we would not bear a spirit altogether abject) must by all means be made. For there is no comparison between that which we may lose by not trying and by not succeeding, since by not trying we throw away the chance of an immense good; by not succeeding we only incur the loss of a little human labor. But as it is, it appears to me from what has been said, and also from what has been left unsaid, that there is hope enough and to spare, not only to make a bold man try, but also to make a sober-minded and wise man believe.

CXV

Concerning the grounds then for putting away despair, which has been one of the most powerful causes of delay and hindrance to the progress of knowledge, I have now spoken. And this also concludes what I had to say touching the signs and causes of the errors, sluggishness, and ignorance which have prevailed; especially since the more subtle causes, which do not fall under popular judgment and observation, must be referred to what has been said on the Idols of the human mind.

And here likewise should close that part of my Instauration which is devoted to pulling down, which part is performed by three refutations: first, by the refutation of the natural human reason, left to itself; secondly, by the refutation of the demonstrations; and thirdly, by the refutation of the theories, or the received systems of philosophy and doctrine. And the refutation of these has been such as alone it could be: that is to say, by signs and the evidence of causes, since no other kind of confutation was open to me, differing as I do from the others both on first principles and on rules of demonstration.

It is time therefore to proceed to the art itself and rule of interpreting nature. Still, however, there remains something to be premised. For whereas in this first book of aphorisms I proposed to prepare men's minds as well for understanding as for receiving what is to follow, now that I have purged and swept and leveled the floor of the mind, it remains that I place the mind in a good position and as it were in a favorable aspect toward what I have to lay before it. For in a new matter it is not only the strong preoccupation of some old opinion that tends to create a prejudice, but also a false preconception or prefiguration of the new thing which is presented. I will endeavor therefore to impart sound and true opinions as to the things I propose, although they are to serve only for the time, and by way of interest (so to speak), till the thing itself, which is the principal, be fully known.

CXVI

First, then, I must request men not to suppose that after the fashion of ancient Greeks, and of certain moderns, as Telesius, Patricius, Severinus, I wish to found a new sect in philosophy. For this is not what I am about, nor do I think that it matters much to the fortunes of men what abstract notions one may entertain concerning nature and the principles of things. And no doubt many old theories of this kind can be revived and many new ones introduced, just as many theories of the heavens may be supposed which agree well enough with the phenomena and yet differ with each other.

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. And although on some special subjects and in an incomplete form I am in possession of results which I take to be far more true and more certain and withal more fruitful than those now received (and these I have collected into the fifth part of my Instauration), yet I have no entire or universal theory to propound. For it does not seem that the time is come for such an attempt. Neither can I hope to live to complete the sixth part of the Instauration.
(which is destined for the philosophy discovered by the legitimate interpretation of nature), but hold it enough if in the intermediate business I bear myself soberly and profitably, sowing in the meantime for future ages the seeds of a purer truth, and performing my part toward the commencement of the great undertaking.

CXVII

And as I do not seek to found a school, so neither do I hold out offers or promises of particular works. It may be thought, indeed, that I who make such frequent mention of works and refer everything to that end, should produce some myself by way of earnest. But my course and method, as I have often clearly stated and would wish to state again, is this— not to extract works from works or experiments from experiments (as an empiric), but from works and experiments to extract causes and axioms, and again from those causes and axioms new works and experiments, as a legitimate interpreter of nature. And although in my tables of discovery (which compose the fourth part of the Instauration), and also in the examples of particulars (which I have adduced in the second part), and moreover in my observations on the history (which I have drawn out in the third part), any reader of even moderate sagacity and intelligence will everywhere observe indications and outlines of many noble works; still I candidly confess that the natural history which I now have, whether collected from books or from my own investigations, is neither sufficiently copious nor verified with sufficient accuracy to serve the purposes of legitimate interpretation.

Accordingly, if there be anyone more apt and better prepared for mechanical pursuits, and sagacious in hunting out works by the mere dealing with experiment, let him by all means use his industry to gather from my history and tables many things by the way, and apply them to the production of works, which may serve as interest until the principal be forthcoming. But for myself, aiming as I do at greater things, I condemn all unseasonable and premature tarrying over such things as these, being (as I often say) like Atalanta's balls. For I do not run off like a child after golden apples, but stake all on the victory of art over nature in the race. Nor do I make haste to mow down the moss or the corn in blade, but wait for the harvest in its due season.

CXVIII

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. It is only like the occurrence in a written or printed page of a letter or two mistaken or misplaced, which does not much hinder the reader, because such errors are easily corrected by the sense. So likewise may there occur in my natural history many experiments which are mistaken and falsely set down, and yet they will presently, by the discovery of causes and axioms, be easily expunged and rejected. It is nevertheless true that if the mistakes in natural history and experiments are important, frequent, and continual, they cannot possibly be corrected or amended by any felicity of wit or art. And therefore, if in my natural history, which has been collected and tested with so much diligence, severity and I may say religious care, there still lurk at intervals certain falsities or errors in the particulars, what is to be said of common natural history, which in comparison with mine is so negligent and inexact? And what of the philosophy and sciences built on such a sand (or rather quicksand)? Let no man therefore trouble himself for this.

CXIX

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, liquidity, 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—things which (as Pliny says) must be introduced with an apology—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. Moreover, as from certain putrid substances—musk, for instance, and civet—the sweetest odors are sometimes generated, so, too, from mean and sordid instances there sometimes emanates excellent light and information. But enough and more than enough of this, such fastidiousness being merely childish and effeminate.

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, as I have often said, the example of the divine creation which on the first day produced light only, and assigned to it alone one entire day, nor mixed up with it on that day any material work.

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. So also the letters of the alphabet in themselves and apart have no use or meaning, yet they are the subject matter for the composition and apparatus of all discourse. So again the seeds of things are of much latent virtue, and yet of no use except in their development. And the scattered rays of light itself, until they are made to converge, can impart none of their benefit. But if objection be taken to speculative subtleties, what is to be said of the schoolmen, who have indulged in subtleties to such excess—in subtleties, too, that were spent on words, or at any rate on popular notions (which is much the same thing), not on facts or nature; and such as were useless not only in their origin but also in their consequences; and not like those I speak of, useless indeed for the present, but promising in finite utility hereafter. But let men be assured of this, that all subtlety of disputation and discourse, if not applied till after axioms are discovered, is out of season and preposterous, and that the true and proper or at any rate the chief time for subtlety is in weighing experience and in founding axioms thereon. For that other subtlety, though it grasps and snatches at nature, yet can never take hold of her. Certainly what is said of opportunity or fortune is most true of nature: she has a lock in front, but is bald behind.

Lastly, concerning the disdain to receive into natural history things either common, or mean, or oversubtle and in their original condition useless, the answer of the poor woman to the haughty prince who had rejected her petition as an unworthy thing and beneath his dignity, may be taken for an oracle: "Then leave off being king." For most certain it is that be who will not attend to things like these as being too paltry and minute, can neither win the kingdom of nature nor govern it.
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 before the Greeks (when natural science was perhaps more flourishing, though it
made less noise, not having yet passed into the pipes and trumpets of the Greeks), or even, in part at least, to some of the
Greeks themselves; and so gained for them both support and honor, as men of no family devise for themselves by the
good help of genealogies the nobility of a descent from some ancient stock. But for my part, relying on the evidence and
truth of things, I reject all forms of fiction and imposture; nor do I think that it matters any more to the business in hand
whether the discoveries that shall now be made were long ago known to the ancients, and have their settings and their
risings according to the vicissitude of things and course of ages, than it matters to mankind whether the new world be that
island of Atlantis with which the ancients were acquainted, or now discovered for the first time. For new discoveries must
be sought from the light of nature, not fetched back out of the darkness of antiquity.

And as for the universality of the censure, certainly if the matter be truly considered such a censure is not only
more probable but more modest, too, than a partial one would be. For if the errors had not been rooted in primary notions,
there must have been some true discoveries to correct the false. But the errors being fundamental, and not so much of
false judgment as of inattention and oversight, it is no wonder that men have not obtained what they have not tried for,
nor reached a mark which they never set up, nor finished a course which they never entered on or kept.

And as for the presumption implied in it, certainly if a man undertakes by steadiness of hand and power of eye to
describe a straighter line or more perfect circle than anyone else, he challenges a comparison of abilities; but if he only
says that he with the help of a rule or a pair of compasses can draw a straighter line or a more perfect circle than anyone
else can by eye and hand alone, he makes no great boast. And this remark, be it observed, applies not merely to this first
and inceptive attempt of mine, but to all that shall take the work in hand hereafter. For my way of discovering sciences
goes far to level men's wit and leaves but little to individual excellence, because it performs everything by the surest rules
and demonstrations. And therefore I attribute my part in all this, as I have often said, rather to good luck than to ability,
and acc count it a birth of time rather than of wit. For certainly chance has something to do with men's thoughts, as well
as with their works and deeds.

\[CXXIII\]

I may say then of myself that which one said in jest (since it marks the distinction so truly), "It cannot be that we
should think alike, when one drinks water and the other drinks wine." Now other men, as well in ancient as in modern
times, have in the matter of sciences drunk a crude liquor like water, either flowing spontaneously from the
understanding, or drawn up by logic, as by wheels from a well. Whereas I pledge mankind in a liquor strained from
countless grapes, from grapes ripe and fully seasoned, collected in clusters, and gathered, and then squeezed in the press,
and finally purified and clarified in the vat. And therefore it is no wonder if they and I do not think alike.

\[CXXIV\]

Again, it will be thought, no doubt, that the goal and mark of knowledge which I myself set up (the very point
which I object to in others) is not the true or the best, for that the contemplation of truth is a thing worthier and loftier
than all utility and magnitude of works; and that this long and anxious dwelling with experience and matter and the
fluctuations of individual things, drags down the mind to earth, or rather sinks it to a very Tartarus of turmoil and
confusion, removing and withdrawing it from the serene tranquility of abstract wisdom, a condition far more heavenly.
Now to this I readily assent, and indeed this which they point at as so much to be preferred is the very thing of all others
which I am about. For I am building in the human understanding a true model of the world, such as it is in fact, not such
as a man's own reason would have it to be; a thing which cannot be done without a very diligent dissection and anatomy
of the world. But I say that those foolish and apish images of worlds which the fancies of men have created in
philosophical systems must be utterly scattered to the winds. Be it known then how vast a difference there is (as I said
above) between the idols of the human mind and the ideas of the divine. The former are nothing more than arbitrary
abstractions; the latter are the Creator's own stamp upon creation, impressed and defined in matter by true and exquisite
lines. Truth, therefore, and utility are here the very same things; and works themselves are of greater value as pledges of truth than as contributing to the comforts of life.

CXXV

It may be thought again that I am but doing what has been done before; that the ancients themselves took the same course which I am now taking; and that it is likely therefore that I too, after all this stir and striving, shall come at last to some one of those systems which prevailed in ancient times. For the ancients, too, it will be said, provided at the outset of their speculations a great store and abundance of examples and particulars, digested the same into notebooks under heads and titles, from them completed their systems and arts, and afterward, when they understood the matter, published them to the world; adding a few examples here and there for proof and illustration; but thought it superfluous and inconvenient to publish their notes and minutes and digests of particulars, and therefore did as builders do: after the house was built they removed the scaffolding and ladders out of sight. And so no doubt they did. But this objection (or scruple rather) will be easily answered by anyone who has not quite forgotten what I have said above. For the form of inquiry and discovery that was in use among the ancients is by themselves professed and appears on the very face of their writings. And that form was simply this. From a few examples and particulars (with the addition of common notions and perhaps of some portion he received opinions which have been most popular) they flew at once to the most general conclusions, or first principles of science. Taking the truth of these as fixed and immovable, they proceeded by means of intermediate propositions to educe and prove from them the inferior conclusions; and out of these they framed the art. After that, if any new particulars and examples repugnant to their dogmas were mooted and adduced, either they subtly molded them into their system by distinctions or explanations of their rules, or else coarsely got rid of them by exceptions; while to such particulars as were not repugnant they labored to assign causes in conformity with those of their principles. But this was not the natural history and experience that was wanted; far from it. And besides, that flying off to the highest generalities ruined all.

CXXVI

It will also be thought that by forbidding men to pronounce and to set down principles as established until they have duly arrived through the intermediate steps at the highest generalities, I maintain a sort of suspension of the judgment, and bring it to what the Greeks call Acatalepsia — a denial of the capacity of the mind to comprehend truth. But in reality that which I meditate and propound is not Acatalepsia, but Eucatakpsia; not denial of the capacity to understand, but provision for understanding truly. For I do not take away authority from the senses, but supply them with helps; I do not slight the understanding, but govern it. And better surely it is that we should know all we need to know, and yet think our knowledge imperfect, than that we should think our knowledge perfect, and yet not know anything we need to know.

CXXVII

It may also be asked (in the way of doubt rather than objection) whether I speak of natural philosophy only, or whether I mean that the other sciences, logic, ethics, and politics, should be carried on by this method. Now I certainly mean what I have said to, be understood of them all; and as the common logic, which governs by the syllogism, extends not only to natural but to all sciences, so does mine also, which proceeds by induction, embrace everything. For I form a history and table of discovery for anger, fear, shame, and the like; for matters political; and again for the mental operations of memory, composition and division, judgment, and the rest; not less than for heat and cold, or light, or vegetation, or the like. But, nevertheless, since my method of interpretation, after the history has been prepared and duly arranged, regards not the working and discourse of the mind only (as the common logic does) but the nature of things also, I supply the mind such rules and guidance that it may in every case apply itself aptly to the nature of things. And therefore I deliver many and diverse precepts in the doctrine of interpretation, which in some measure modify the method of invention according to the quality and condition of the subject of the inquiry.

2 Ipsissimæ res. I think this must have been Bacon's meaning, though not a meaning which the word can properly bear.—J. S.
On one point not even a doubt ought to be entertained, namely, whether I desire to pull down and destroy the philosophy and arts and sciences which are at present in use. So far from that, I am most glad to see them used, cultivated, and honored. There is no reason why the arts which are now in fashion should not continue to supply matter for disputation and ornaments for discourse, to be employed for the convenience of professors and men of business, to be, in short, like current coin, which passes among men by consent. Nay, I frankly declare that what I am introducing will be but little fitted for such purposes as these, since it cannot be brought down to common apprehension save by effects and works only. But how sincere I am in my professions of affection and good will toward the received sciences, my published writings, especially the books on the advancement of learning, sufficiently show; and therefore I will not attempt to prove it further by words. Meanwhile I give constant and distinct warning that by the methods now in use neither can any great progress be made in the doctrines and contemplative part of sciences, nor can they be carried out to any magnitude of works.

It remains for me to say a few words touching the excellency of the end in view. Had they been uttered earlier, they might have seemed like idle wishes, but now that hopes have been raised and unfair prejudices removed, they may perhaps have greater weight. Also if I had finished all myself, and had no occasion to call in others to help and take part in the work, I should even now have abstained from such language lest it might be taken as a proclamation of my own deserts. But since I want to quicken the industry and rouse and kindle the zeal of others, it is fitting that I put men in mind of some things.

In the first place, then, the introduction of famous discoveries appears to hold by far the first place among human actions; and this was the judgment of the former ages. For to the authors of inventions they awarded divine honors, while to those who did good service in the state (such as founders of cities and empires, legislators, saviors of their country from long endured evils, quellers of tyrannies, and the like) they decreed no higher honors than heroic. And certainly if a man rightly compare the two, he will find that this judgment of antiquity was just. For the benefits of discoveries may extend to the whole race of man, civil benefits only to particular places; the latter last not beyond a few ages, the former through all time. Moreover, the reformation of a state in civil matters is seldom brought in without violence and confusion; but discoveries carry blessings with them, and confer benefits without causing harm or sorrow to any.

Again, discoveries are as it were new creations, and imitations of God's works, as the poet well sang:

To man's frail race great Athens long ago  
First gave the seed whence waving harvests grow,  
And re-created all our life below.

And it appears worthy of remark in Solomon that, though mighty in empire and in gold, in the magnificence of his works, his court, his household, and his fleet, in the luster of his name and the worship of mankind, yet he took none of these to glory in, but pronounced that "The glory of God is to conceal a thing; the glory of the king to search it out."

Again, let a man only consider what a difference there is between the life of men in the most civilized province of Europe, and in the wildest and most barbarous districts of New India; he will feel it be great enough to justify the saying that "man is a god to man," not only in regard to aid and benefit, but also by a comparison of condition. And this difference comes not from soil, not from climate, not from race, but from the arts.

Again, it is well to observe the force and virtue and consequences of discoveries, and these are to be seen nowhere more conspicuously than in those three which were unknown to the ancients, and of which the origin, though recent, is obscure and inglorious; namely, printing, gunpowder, and the magnet. For these three have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes, insomuch that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries.

Further, it will not be amiss to distinguish the three kinds and, as it were, grades of ambition in mankind. The first is of those who desire to extend their own power in their native country, a vulgar and degenerate kind. The second is
of those who labor to extend the power and dominion of their country among men. This certainly has more dignity, though not less covetousness. But if a man endeavor to establish and extend the power and dominion of the human race itself over the universe, his ambition (if ambition it can be called) is without doubt both a more wholesome and a more noble thing than the other two. Now the empire of man over thing depends wholly on the arts and sciences. For we cannot command nature except by obeying her.

Again, if men have thought so much of some one particular discovery as to regard him as more than man who has been able by some benefit to make the whole human race his debtor, how much higher a thing to discover that by means of which all things else shall be discovered with ease! And yet (to speak the whole truth), as the uses of light are infinite in enabling us to walk, to ply our arts, to read, to recognize one another — and nevertheless the very beholding of the light is itself a more excellent and a fairer thing than all the uses of it — so assuredly the very contemplation of things as they are, without superstition or imposture, error or confusion, is in itself more worthy than all the fruit of inventions.

Lastly, if the debasement of arts and sciences to purposes of wickedness, luxury, and the like, be made a ground of objection, let no one be moved thereby. For the same may be said of all earthly goods: of wit, courage, strength, beauty, wealth, light itself, and the rest. Only let the human race recover that right over nature which belongs to it by divine bequest, and let power be given it; the exercise thereof will be governed by sound reason and true religion.

CXXX

And now it is time for me to propound the art itself of interpreting nature, in which, although I conceive that I have given true and most useful precepts, yet I do not say either that it is absolutely necessary (as if nothing could be done without it) or that it is perfect. For I am of the opinion that if men had ready at hand a just history of nature and experience, and labored diligently thereon, and if they could bind themselves to two rules — the first, to lay aside received opinions and notions; and the second, to refrain the mind for a time from the highest generalizations, and those next to them — they would be able by the native and genuine force of the mind, without any other art, to fall into my form of interpretation. For interpretation is the true and natural work of the mind when freed from impediments. It is true, however, that by my precepts everything will be in more readiness, and much more sure.

Nor again do I mean to say that no improvement can be made upon these. On the contrary, I regard the mind, not only in its faculties, but in its connection with things, must needs hold that the art of discovery may advance as discoveries advance.
APPENDIX


XXI

After the Tables of first presentation, after rejection or exclusion, and after making the first harvest on the basis of them, we must proceed to the other aids to the intellect in the interpretation of nature and in true and complete induction. In setting them out we shall continue to use heat and cold when we need tables, but where we want just a few examples, we shall make use of any other examples, so that we may give a wider scope to our teaching without confusing the inquiry.

We shall speak then in the first place of privileged instances; secondly of supports for induction; third of the refinement of investigation; fourth of the adaptation of the investigation to the nature of the subject; fifth of natures which are privileged so far as investigation is concerned, or of which inquiries we should make first and which ones later; sixth of the limits of investigation, or of a summary of all natures universally; seventh of deductions to practice, or of how it relates to man; eighth of preparations for investigation; and finally of the ascending and descending scale of axioms.

[...]

XXXVI

In the fourteenth place among privileged instances we place crucial instances:

- We take the term from the signposts which are erected at forks in the road to indicate and mark where the different roads go.
- We have also chosen to call them decisive instances and instances of verdicts, and in some cases oracular and commanding instances. This is how they work. Sometimes in the search for a nature the intellect is poised in equilibrium and cannot decide to which of two or (occasionally) more natures it should attribute or assign the cause of the nature under investigation, because many natures habitually occur close together; in these circumstances crucial instances reveal that the fellowship of one of the natures with the nature under investigation is constant and indissoluble, while that of the other is fitful and occasional. This ends the search as the former nature is taken as the cause and the other dismissed and rejected. Thus instances of this kind give the greatest light and the greatest authority; so that a course of interpretation sometimes ends in them and is completed through them. Sometimes crucial instances simply occur, being found among instances long familiar, but for the most part they are new and deliberately and specifically devised and applied; it takes keen and constant diligence to unearth them.
- For example, suppose the nature under investigation is the ebb and flow of the sea, repeated twice a day, six hours for each incoming and outgoing tide, with some difference which corresponds to the motions of the moon. The fork of the road in this nature is as follows.

This motion has to be caused either by a forward-and-backward movement of the waters, like water sloshing back and forth in a basin, which leaves one side of the basin when it covers the other, or by the waters rising and subsiding from the depths, like water boiling up and then subsiding. But one is in doubt to which of the two causes to attribute the ebb and flow. If the first account is accepted, then when there is a high tide in the sea on one side, there has to be a low tide in the sea at the same time elsewhere. And so this is the form the investigation will take. And yet Acosta and many others have observed (after careful investigation) that there are high tides at the same time on the shores of Florida and on the opposite shores of Spain and Africa, and likewise low tides at the same times, and not the contrary, that when it is high tide on the shores of Florida, it is low tide on the shores of Spain and Africa. However, if one looks at it still more carefully, this does not prove a rising motion and refute a forward motion. For it can happen that waters move forward, while flooding both shores of a stretch of water at the same time, i.e. if those waters are subjected to force and pressure from another direction, as happens in rivers, where the ebb and flow on both shores occurs at the same time, even though the motion is clearly motion forward, the motion of waters entering the river mouth from the sea. And so it may be similarly that waters coming in a great mass from the East Indian Ocean are driven and thrust into the basin of the Atlantic Sea, and thus flood both sides at the same time. We must therefore ask whether there is another basin through which the waters can at the same time ebb and flow back. And there is, the Southern Sea, which is not smaller than the Atlantic, but rather wider and vaster, and would be adequate for this purpose.

And so we have reached the crucial instance on this subject. Here it is: if it is found for certain that when it is high tide on the opposing shores of both Florida and Spain in the Atlantic Sea, there is at the same time high tide on the shores of Peru and near the mainland of China in the Southern Sea; then by this decisive instance we must certainly reject the assertion that the ebb and flow of the sea (the subject of the inquiry) occurs by a forward motion; there is no other sea or place remaining where there could be a retreat or ebb at the same time. This could most conveniently be known if inquiry were made of the inhabitants of Panama and Lima (where the two Oceans, the Atlantic and the Southern, are separated by a small Isthmus) whether the ebb and flow of the sea on the two sides

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3 *Instantiae crucis*
4 ‘Crucial’ is derived from *cruX*, ‘cross’.
5 Jose de Acosta (c. 1539-1600), Spanish Jesuit missionary to Peru. Published *The Natural and Moral History of the Indies* (1590; translated into English 1604).
of the Isthmus occur at the same time or not. Now this verdict or definitive rejection seems certain if we posit that the earth is unmoving. However, if the earth rotates, it may perhaps be that the earth and the waters of the sea rotate unequally (unequal in speed or force), the consequence of which would be violent pressure forcing the waters up into a heap, which is the high tide, and a subsequent dropping of the waters (when they can no longer stay heaped up), which is the ebb. This needs separate inquiry. But on this supposition also it remains equally true that there has to be an ebb of the sea somewhere at the same time as there are high tides elsewhere.

Likewise suppose the nature under investigation is the latter of the two motions which we first assumed, viz. arising and subsiding motion of the sea if, after careful examination, we do in fact reject the other motion we mentioned, the forward motion. There will then be a three-way fork in the road: the motion by which waters rise and fall in their ebbs and flows, without the addition of other waters flowing into them, has to occur in one of three ways. It may be because a great mass of water wells up from the interior of the earth and then sinks back into it; or because there is not a larger amount of water, but the same waters (with no increase of quantity) are stretch or thinned out so that they occupy a greater space and dimension, and then contract; or because the quantity and extension are no greater, but the same waters (same both in quantity and density and rarity) rise and fall through some magnetic force above which attracts and draws them up, through agreement. Let us leave aside the first two motions and narrow the inquiry (if you please) to this last possibility; and let inquiry be made whether there is any such raising by agreement or magnetic force. And first it is evident that all the waters, as they lie in the trench or bed of the sea, cannot be raised together at the same time, because there would be nothing to take their place at the bottom; hence if the waters had any such tendency to rise, it would be broken and restrained by the bonds of nature, or (as they commonly say) to prevent the occurrence of a vacuum. The only explanation left is that the waters rise in one place and, for that reason, fall and recede in another place. In fact, it will necessarily follow that since the magnetic force cannot operate over the whole, it operates most intensely over the centre, so that it lifts the waters in the middle, and when they are raised, they move away [sic, from] the sides and leave them bare and uncovered.

And thus at last we have reached the crucial instance on this subject. It is this: if it is found that in the ebbs of the sea the surface of the waters in the sea is more arched and rounded as the waters rise in the middle of the sea and fall away at the edges, which are the shores; and in the flows the same surface is planer and flatter when the waters return to their former position; then by this decisive instance we can certainly accept raising by magnetic force; otherwise it has to be totally rejected. And this is not difficult to find out by making use of sounding lines in straits; i.e. to find out whether towards the centre of the sea the water is higher or deeper in ebbs than in flows. And we must note that if this is so, the fact (contrary to belief) is that the waters rise in ebbs, and fall only in flows, so as to cover and flood the beaches.

[Other illustrations of crucial instances are not part of the selections.]