

# NOVUM ORGANUM

BY  
LORD BACON

EDITED BY JOSEPH DEVEY, M.A.



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S C I E N C E



# NOVUM ORGANUM

OR

## TRUE SUGGESTIONS FOR THE INTERPRETATION OF NATURE

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### P R E F A C E

THEY who have presumed to dogmatize on nature, as on some well investigated subject, either from self-conceit or arrogance, and in the professorial style, have inflicted the greatest injury on philosophy and learning. For they have tended to stifle and interrupt inquiry exactly in proportion as they have prevailed in bringing others to their opinion: and their own activity has not counterbalanced the mischief they have occasioned by corrupting and destroying that of others. They again who have entered upon a contrary course, and asserted that nothing whatever can be known, whether they have fallen into this opinion from their hatred of the ancient sophists, or from the hesitation of their minds, or from an exuberance of learning, have certainly adduced reasons for it which are by no means contemptible. They have not, however, derived their opinion from true sources, and, hurried on by their zeal and some affectation, have certainly exceeded due moderation. But the more ancient Greeks (whose writings have perished), held a more prudent mean, between the arrogance of dogmatism, and the despair of scepticism; and though too frequently intermingling complaints and indig-

nation at the difficulty of inquiry, and the obscurity of things, and champing, as it were, the bit, have still persisted in pressing their point, and pursuing their intercourse with nature; thinking, as it seems, that the better method was not to dispute upon the very point of the possibility of anything being known, but to put it to the test of experience. Yet they themselves, by only employing the power of the understanding, have not adopted a fixed rule, but have laid their whole stress upon intense meditation, and a continual exercise and perpetual agitation of the mind.

Our method, though difficult in its operation, is easily explained. It consists in determining the degrees of certainty, while we, as it were, restore the senses to their former rank, but generally reject that operation of the mind which follows close upon the senses, and open and establish a new and certain course for the mind from the first actual perceptions of the senses themselves. This, no doubt, was the view taken by those who have assigned so much to logic; showing clearly thereby that they sought some support for the mind, and suspected its natural and spontaneous mode of action. But this is now employed too late as a remedy, when all is clearly lost, and after the mind, by the daily habit and intercourse of life, has come prepossessed with corrupted doctrines, and filled with the vainest idols. The art of logic therefore being (as we have mentioned), too late a precaution,<sup>1</sup> and in no way remedy.

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<sup>1</sup> Because it was idle to draw a logical conclusion from false principles, error being propagated as much by false premises, which logic does not pretend to examine, as by illegitimate inference. Hence, as Bacon says further on, men being easily led to confound legitimate inference with truth, were confirmed in their errors by the very subtlety of their genius.—*Ed.*

ing the matter, has tended more to confirm errors, than to disclose truth. Our only remaining hope and salvation is to begin the whole labor of the mind again; not leaving it to itself, but directing it perpetually from the very first, and attaining our end as it were by mechanical aid. If men, for instance, had attempted mechanical labors with their hands alone, and without the power and aid of instruments, as they have not hesitated to carry on the labors of their understanding with the unaided efforts of their mind, they would have been able to move and overcome but little, though they had exerted their utmost and united powers. And just to pause awhile on this comparison, and look into it as a mirror; let us ask, if any obelisk of a remarkable size were perchance required to be moved, for the purpose of gracing a triumph or any similar pageant, and men were to attempt it with their bare hands, would not any sober spectator avow it to be an act of the greatest madness? And if they should increase the number of workmen, and imagine that they could thus succeed, would he not think so still more? But if they chose to make a selection, and to remove the weak, and only employ the strong and vigorous, thinking by this means, at any rate, to achieve their object, would he not say that they were more fondly deranged? Nay, if not content with this, they were to determine on consulting the athletic art, and were to give orders for all to appear with their hands, arms, and muscles regularly oiled and prepared, would he not exclaim that they were taking pains to rave by method and design? Yet men are hurried on with the same senseless energy and useless combination in intellectual matters, as long as they expect great results either from the number and agreement, or the excellence and acuteness of their wits; or even

strengthen their minds with logic, which may be considered as an athletic preparation, but yet do not desist (if we rightly consider the matter) from applying their own understandings merely with all this zeal and effort. While nothing is more clear, than that in every great work executed by the hand of man without machines or implements, it is impossible for the strength of individuals to be increased, or for that of the multitude to combine.

Having premised so much, we lay down two points on which we would admonish mankind, lest they should fail to see or to observe them. The first of these is, that it is our good fortune (as we consider it), for the sake of extinguishing and removing contradiction and irritation of mind, to leave the honor and reverence due to the ancients untouched and undiminished, so that we can perform our intended work, and yet enjoy the benefit of our respectful moderation. For if we should profess to offer something better than the ancients, and yet should pursue the same course as they have done, we could never, by any artifice, contrive to avoid the imputation of having engaged in a contest or rivalry as to our respective wits, excellences, or talents; which, though neither inadmissible nor new (for why should we not blame and point out anything that is imperfectly discovered or laid down by them, of our own right, a right common to all?), yet however just and allowable, would perhaps be scarcely an equal match, on account of the disproportion of our strength. But since our present plan leads up to open an entirely different course to the understanding, and one unattempted and unknown to them, the case is altered. There is an end to party zeal, and we only take upon ourselves the character of a guide, which requires a moderate share of authority and good fortune,

rather than talents and excellence. The first admonition relates to persons, the next to things.

We make no attempt to disturb the system of philosophy that now prevails, or any other which may or will exist, either more correct or more complete. For we deny not that the received system of philosophy, and others of a similar nature, encourage discussion, embellish harangues, are employed, and are of service in the duties of the professor, and the affairs of civil life. Nay, we openly express and declare that the philosophy we offer will not be very useful in such respects. It is not obvious, nor to be understood in a cursory view, nor does it flatter the mind in its preconceived notions, nor will it descend to the level of the generality of mankind unless by its advantages and effects.

Let there exist then (and may it be of advantage to both), two sources, and two distributions of learning, and in like manner two tribes, and as it were kindred families of contemplators or philosophers, without any hostility or alienation between them; but rather allied and united by mutual assistance. Let there be in short one method of cultivating the sciences, and another of discovering them. And as for those who prefer and more readily receive the former, on account of their haste or from motives arising from their ordinary life, or because they are unable from weakness of mind to comprehend and embrace the other (which must necessarily be the case with by far the greater number), let us wish that they may prosper as they desire in their undertaking, and attain what they pursue. But if any individual desire, and is anxious not merely to adhere to, and make use of present discoveries, but to penetrate still further, and not to overcome his adversaries in disputes, but nature by labor, not in short to give elegant

and specious opinions, but to know to a certainty and demonstration, let him, as a true son of science (if such be his wish), join with us; that when he has left the antechambers of nature trodden by the multitude, an entrance may at last be discovered to her inner apartments. And in order to be better understood, and to render our meaning more familiar by assigning determinate names, we have accustomed ourselves to call the one method the anticipation of the mind, and the other the interpretation of nature.

We have still one request left. We have at least reflected and taken pains in order to render our propositions not only true, but of easy and familiar access to men's minds, however wonderfully prepossessed and limited. Yet it is but just that we should obtain this favor from mankind (especially in so great a restoration of learning and the sciences), that whosoever may be desirous of forming any determination upon an opinion of this our work either from his own perceptions, or the crowd of authorities, or the forms of demonstrations, he will not expect to be able to do so in a cursory manner, and while attending to other matters; but in order to have a thorough knowledge of the subject, will himself by degrees attempt the course which we describe and maintain; will be accustomed to the subtlety of things which is manifested by experience; and will correct the depraved and deeply rooted habits of his mind by a seasonable, and, as it were, just hesitation: and then, finally (if he will), use his judgment when he has begun to be master of himself.

## APHORISMS—BOOK I

### ON THE INTERPRETATION OF NATURE AND THE EMPIRE OF MAN

I. MAN, as the minister and interpreter of nature, does and understands as much as his observations on the order of nature, either with regard to things or the mind, permit him, and neither knows nor is capable of more.

II. The unassisted hand and the understanding left to itself possess but little power. Effects are produced by the means of instruments and helps, which the understanding requires no less than the hand; and as instruments either promote or regulate the motion of the hand, so those that are applied to the mind prompt or protect the understanding.

III. Knowledge and human power are synonymous, since the ignorance of the cause frustrates the effect; for nature is only subdued by submission, and that which in contemplative philosophy corresponds with the cause in practical science becomes the rule.

IV. Man while operating can only apply or withdraw natural bodies; nature internally performs the rest.

V. Those who become practically versed in nature are, the mechanic, the mathematician, the physician, the alchemist, and the *magician*,<sup>1</sup> but all (as matters now stand) with faint efforts and meagre success.

<sup>1</sup> Bacon uses the term in its ancient sense, and means one who, knowing the occult properties of bodies, is able to startle the ignorant by drawing out of them wonderful and unforeseen changes. See the 85th aphorism of this book, and the 5th cap. book iii. of the *De Augmentis Scientiarum*, where he speaks more clearly—*Ed.*

VI. It would be madness and inconsistency to suppose that things which have never yet been performed can be performed without employing some hitherto untried means.

VII. The creations of the mind and hand appear very numerous, if we judge by books and manufactures; but all that variety consists of an excessive refinement, and of deductions from a few well known matters—*not of a number of axioms*.<sup>2</sup>

VIII. Even the effects already discovered are due to chance and experiment rather than to the sciences; for our present sciences are nothing more than peculiar arrangements of matters already discovered, and not methods for discovery or plans for new operations.

IX. The sole cause and root of almost every defect in the sciences is this, that while we falsely admire and extol the powers of the human mind, we do not search for its real helps.

X. The subtlety of nature is far beyond that of sense or of the understanding: so that the specious meditations, speculations, and theories of mankind are but a kind of insanity, only there is no one to stand by and observe it.

XI. As the present sciences are useless for the discovery of effects, so the present system of logic<sup>3</sup> is useless for the discovery of the sciences.

<sup>2</sup> By this term axiomata, Bacon here speaks of general principles, or universal laws. In the 19th aphorism he employs the term to express any proposition collected from facts by induction, and thus fitted to become the starting-point of deductive reasoning. In the last and more rigorous sense of the term, Bacon held they arose from experience. See Whewell's "Philosophy of the Inductive Sciences," vol. i. p. 74; and Mill's "Logie," vol. i. p. 311; and the June "Quarterly," 1841, for the modern phase of the discussion.—*Ed.*

<sup>3</sup> Bacon here attributes to the Aristotelian logic the erroneous consequences which sprung out of its abuse. The demonstrative forms it exhibits, whether verbally or mathematically expressed, are necessary to the support, verification,

XII. The present system of logic rather assists in confirming and rendering inveterate the errors founded on vulgar notions than in searching after truth, and is therefore more hurtful than useful.

XIII. The syllogism is not applied to the principles of the sciences, and is of no avail in intermediate axioms,<sup>4</sup> as

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and extension of induction, and when the propositions they embrace are founded on an accurate and close observation of facts, the conclusions to which they lead, even in moral science, may be regarded as certain as the facts wrested out of nature by direct experiment. In physics such forms are absolutely required to generalize the results of experience, and to connect intermediate axioms with laws still more general, as is sufficiently attested by the fact, that no science since Bacon's day has ceased to be experimental by the mere method of induction, and that all become exact only so far as they rise above experience, and connect their isolated phenomena with general laws by the principles of deductive reasoning. So far, then, are these forms from being useless, that they are absolutely essential to the advancement of the sciences, and in no case can be looked on as detrimental, except when obtruded in the place of direct experiment, or employed as a means of deducing conclusions about nature from imaginary hypotheses and abstract conceptions. This had been unfortunately the practice of the Greeks. From the rapid development geometry received in their hands, they imagined the same method would lead to results equally brilliant in natural science, and snatching up some abstract principle, which they carefully removed from the test of experiment, imagined they could reason out from it all the laws and external appearances of the universe. The scholastics were impelled along the same path, not only by precedent, but by profession. Theology was the only science which received from them a consistent development, and the *d priori* grounds on which it rested prevented them from employing any other method in the pursuit of natural phenomena. Thus, forms of demonstration, in themselves accurate, and of momentous value in their proper sphere, became confounded with fable, and led men into the idea they were exploring truth when they were only accurately deducing error from error. One principle ever so slightly deflected, like a false quantity in an equation, could be sufficient to infect the whole series of conclusions of which it was the base; and though the philosopher might subsequently deduce a thousand consecutive inferences with the utmost accuracy or precision, he would only succeed in drawing out very methodically nine hundred and ninety-nine errors.—*Ed.*

<sup>4</sup> It would appear from this and the two preceding aphorisms, that Bacon fell into the error of denying the utility of the syllogism in the very part of inductive science where it is essentially required. Logic, like mathematics, is

being very unequal to the subtlety of nature. It forces assent, therefore, and not things.

XIV. The syllogism consists of propositions; propositions of words; words are the signs of notions. If, therefore, the notions (which form the basis of the whole) be confused and carelessly abstracted from things, there is no solidity in the superstructure. Our only hope, then, is in genuine induction.

XV. We have no sound notions either in logic or physics; substance, quality, action, passion, and existence are not clear notions; much less weight, levity, density, tenuity, moisture, dryness, generation, corruption, attraction,

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purely a formal process, and must, as the scaffolding to the building, be employed to arrange facts in the structure of a science, and not to form any portion of its groundwork, or to supply the materials of which the system is to be composed. The word syllogism, like most other psychological terms, has no fixed or original signification, but is sometimes employed, as it was by the Greeks, to denote general reasoning, and at others to point out the formal method of deducing a particular inference from two or more general propositions. Bacon does not confine the term within the boundaries of express definition, but leaves us to infer that he took it in the latter sense, from his custom of associating the term with the wranglings of the schools. The scholastics, it is true, abused the deductive syllogism, by employing it in its naked, skeleton-like form, and confounding it with the whole breadth of logical theory; but their errors are not to be visited on Aristotle, who never dreamed of playing with formal syllogisms, and, least of all, mistook the descending for the ascending series of inference. In our mind we are of accord with the Stagyrite, who propounds, as far as we can interpret him, two modes of investigating truth—the one by which we ascend from particular and singular facts to general laws and axioms, and the other by which we descend from universal propositions to the individual cases which they virtually include. Logic, therefore, must equally vindicate the formal purity of the synthetic illation by which it ascends to the whole, as the analytic process by which it descends to the parts. The deductive and inductive syllogism are of equal significance in building up any body of truth, and whoever restricts logic to either process, mistakes one-half of its province for the whole; and if he acts upon his error, will paralyze his methods, and strike the noblest part of science with sterility.—*Ed.*

repulsion, element, matter, form, and the like. They are all fantastical and ill-defined.

XVI. The notions of less abstract natures, as man, dog, dove, and the immediate perceptions of sense, as heat, cold, white, black, do not deceive us materially, yet even these are sometimes confused by the mutability of matter and the intermixture of things. All the rest which men have hitherto employed are errors, and improperly abstracted and deduced from things.

XVII. There is the same degree of licentiousness and error in forming axioms as in abstracting notions, and that in the first principles, which depend on common induction; still more is this the case in axioms and inferior propositions derived from syllogisms.

XVIII. The present discoveries in science are such as lie immediately beneath the surface of common notions. It is necessary, however, to penetrate the more secret and remote parts of nature, in order to abstract both notions and axioms from things by a more certain and guarded method.

XIX. There are and can exist but two ways of investigating and discovering truth. The one hurries on rapidly from the senses and particulars to the most general axioms, and from them, as principles and their supposed indisputable truth, derives and discovers the intermediate axioms. This is the way now in use. The other constructs its axioms from the senses and particulars, by ascending continually and gradually, till it finally arrives at the most general axioms, which is the true but unattempted way.

XX. The understanding when left to itself proceeds by the same way as that which it would have adopted under the guidance of logic, namely, the first; for the mind is fond of starting off to generalities, that it may avoid labor, and

after dwelling a little on a subject is fatigued by experiment. But those evils are augmented by logic, for the sake of the ostentation of dispute.

XXI. The understanding, when left to itself in a man of a steady, patient, and reflecting disposition (especially when unimpeded by received doctrines), makes some attempt in the right way, but with little effect, since the understanding, undirected and unassisted, is unequal to and unfit for the task of vanquishing the obscurity of things.

XXII. Each of these two ways begins from the senses and particulars, and ends in the greatest generalities. But they are immeasurably different; for the one merely touches cursorily the limits of experiment and particulars, while the other runs duly and regularly through them—the one from the very outset lays down some abstract and useless generalities, the other gradually rises to those principles which are really the most common in nature.<sup>5</sup>

XXIII. There is no small difference between the idols of the human mind and the ideas of the Divine mind—that is to say, between certain idle dogmas and the real stamp and impression of created objects, as they are found in nature.

XXIV. Axioms determined upon in argument can never assist in the discovery of new effects; for the subtlety of nature is vastly superior to that of argument. But axioms properly and regularly abstracted from particulars easily

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<sup>5</sup> The Latin is, *ad ea que revera sunt naturae notiora*. This expression, *nature notiora*, *nature notior*, is so frequently employed by Bacon, that we may conclude it to point to some distinguishing feature in the Baconian physics. It properly refers to the most evident principles and laws of nature, and springs from that system which regards the material universe as endowed with intelligence, and acting according to rules either fashioned or clearly understood by itself.—*Ed.*

point out and define new particulars, and therefore impart activity to the sciences.

XXV. The axioms now in use are derived from a scanty handful, as it were, of experience, and a few particulars of frequent occurrence, whence they are of much the same dimensions or extent as their origin. And if any neglected or unknown instance occurs, the axiom is saved by some frivolous distinction, when it would be more consistent with truth to amend it.

XXVI. We are wont, for the sake of distinction, to call that human reasoning which we apply to nature the anticipation of nature (as being rash and premature), and that which is properly deduced from things the interpretation of nature.

XXVII. Anticipations are sufficiently powerful in producing unanimity, for if men were all to become even uniformly mad, they might agree tolerably well with each other.

XXVIII. Anticipations again, will be assented to much more readily than interpretations, because being deduced from a few instances, and these principally of familiar occurrence, they immediately hit the understanding and satisfy the imagination; while, on the contrary, interpretations, being deduced from various subjects, and these widely dispersed, cannot suddenly strike the understanding, so that in common estimation they must appear difficult and discordant, and almost like the mysteries of faith.

XXIX. In sciences founded on opinions and dogmas, it is right to make use of anticipations and logic if you wish to force assent rather than things.

XXX. If all the capacities of all ages should unite and combine and transmit their labors, no great progress will be

made in learning by anticipations, because the radical errors, and those which occur in the first process of the mind, are not cured by the excellence of subsequent means and remedies.

XXXI. It is in vain to expect any great progress in the sciences by the superinducing or ingrafting new matters upon old. An instauration must be made from the very foundations, if we do not wish to revolve forever in a circle, making only some slight and contemptible progress.

XXXII. The ancient authors and all others are left in undisputed possession of their honors; for we enter into no comparison of capacity or talent, but of method, and assume the part of a guide rather than of a critic.

XXXIII. To speak plainly, no correct judgment can be formed either of our method or its discoveries by those anticipations which are now in common use; for it is not to be required of us to submit ourselves to the judgment of the very method we ourselves arraign.

XXXIV. Nor is it an easy matter to deliver and explain our sentiments; for those things which are in themselves new can yet be only understood from some analogy to what is old.

XXXV. Alexander Borgia<sup>6</sup> said of the expedition of the French into Italy that they came with chalk in their hands to mark up their lodgings, and not with weapons to force their passage. Even so do we wish our philosophy to make its way quietly into those minds that are fit for it, and of good capacity; for we have no need of contention where we

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<sup>6</sup> This Borgia was Alexander VI., and the expedition alluded to that in which Charles VIII. overran the Italian peninsula in five months. Bacon uses the same illustration in concluding his survey of natural philosophy, in the second book of the "De Augmentis."—*Ed.*

differ in first principles, and in our very notions, and even in our forms of demonstration.

XXXVI. We have but one simple method of delivering our sentiments, namely, we must bring men to particulars and their regular series and order, and they must for a while renounce their notions, and begin to form an acquaintance with things.

→ XXXVII. Our method and that of the sceptics<sup>7</sup> agree in some respects at first setting out, but differ most widely, and are completely opposed to each other in their conclusion; for they roundly assert that nothing can be known; we, that but a small part of nature can be known, by the present method; their next step, however, is to destroy the authority of the senses and understanding, while we invent and supply them with assistance.

XXXVIII. The idols and false notions which have already preoccupied the human understanding, and are deeply rooted in it, not only so beset men's minds that they become difficult of access, but even when access is obtained will again meet and trouble us in the instauration of the sciences, unless mankind when forewarned guard themselves with all possible care against them.

XXXIX. Four species of idols beset the human mind,<sup>8</sup>

<sup>7</sup> *Ratio eorum qui acatalepsiam tenuerunt.* Bacon alludes to the members of the later academy, who held the ἀκατάληψια, or the impossibility of comprehending anything. His translator, however, makes him refer to the sceptics, who neither dogmatized about the known or the unknown, but simply held, that as all knowledge was relative, πρὸς πάντα τί, man could never arrive at absolute truth, and therefore could not with certainty affirm or deny anything.—*Ed.*

<sup>8</sup> It is argued by Hallam, with some appearance of truth, that idols is not the correct translation of εἴδωλα, from which the original idola is manifestly derived; but that Bacon used it in the literal sense attached to it by the Greeks, as a species of illusion, or false appearance, and not as a species of divinity be-

to which (for distinction's sake) we have assigned names, calling the first Idols of the Tribe, the second Idols of the Den, the third Idols of the Market, the fourth Idols of the Theatre.

XL. The formation of notions and axioms on the foundation of true induction is the only fitting remedy by which we can ward off and expel these idols. It is, however, of great service to point them out; for the doctrine of idols bears the same relation to the interpretation of nature as that of the confutation of sophisms does to common logic.<sup>9</sup>

XLI. The idols of the tribe are inherent in human nature and the very tribe or race of man; for man's sense is falsely asserted to be the standard of things; on the contrary, all the perceptions both of the senses and the mind bear reference to man and not to the universe, and the human mind resembles those uneven mirrors which impart their own

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fore which the mind bows down. If Hallam be right, Bacon is saved from the odium of an analogy which his foreign commentators are not far wrong in denouncing as barbarous; but this service is rendered at the expense of the men who have attached an opposite meaning to the word, among whom are Brown, Playfair and Dugald Stewart.—*Ed.*

<sup>9</sup> We cannot see how these idols have less to do with sophistical paralogisms than with natural philosophy. The process of scientific induction involves only the first elements of reasoning, and presents such a clear and tangible surface, as to allow no lurking-place for prejudice; while questions of politics and morals, to which the deductive method, or common logic, as Bacon calls it, is peculiarly applicable, are ever liable to be swayed or perverted by the prejudices he enumerates. After mathematics, physical science is the least amenable to the illusions of feeling; each portion having been already tested by experiment and observation, is fitted into its place in the system, with all the rigor of the geometrical method; affection or prejudice cannot, as in matters of taste, history or religion, select fragmentary pieces, and form a system of their own. The whole must be admitted, or the structure of authoritative reason razed to the ground. It is needless to say that the idols enumerated present only another interpretation of the substance of logical fallacies.—*Ed.*

properties to different objects, from which rays are emitted and distort and disfigure them.<sup>10</sup>

XLII. The idols of the den are those of each individual; for everybody (in addition to the errors common to the race of man) has his own individual den or cavern, which intercepts and corrupts the light of nature, either from his own peculiar and singular disposition, or from his education and intercourse with others, or from his reading, and the authority acquired by those whom he reverences and admires, or from the different impressions produced on the mind, as it happens to be preoccupied and predisposed, or equable and tranquil, and the like; so that the spirit of man (according to its several dispositions), is variable, confused, and as it were actuated by chance; and Heraclitus said well that men search for knowledge in lesser worlds, and not in the greater or common world.

XLIII. There are also idols formed by the reciprocal intercourse and society of man with man, which we call idols of the market, from the commerce and association of men with each other; for men converse by means of language, but words are formed at the will of the generality, and there arises from a bad and unapt formation of words a wonderful obstruction to the mind. Nor can the definitions and explanations with which learned men are wont to guard and protect themselves in some instances afford a complete remedy—words still manifestly force the understanding, throw everything into confusion, and lead mankind into vain and innumerable controversies and fallacies.

XLIV. Lastly, there are idols which have crept into

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<sup>10</sup> The propensity to this illusion may be viewed in the spirit of system, or hasty generalization, which is still one of the chief obstacles in the path of modern science.—*Ed.*

men's minds from the various dogmas of peculiar systems of philosophy, and also from the perverted rules of demonstration, and these we denominate idols of the theatre: for we regard all the systems of philosophy hitherto received or imagined, as so many plays brought out and performed, creating fictitious and theatrical worlds. Nor do we speak only of the present systems, or of the philosophy and sects of the ancients, since numerous other plays of a similar nature can be still composed and made to agree with each other, the causes of the most opposite errors being generally the same. Nor, again, do we allude merely to general systems, but also to many elements and axioms of sciences which have become inveterate by tradition, implicit credence, and neglect. We must, however, discuss each species of idols more fully and distinctly in order to guard the human understanding against them.

XLV. The human understanding, from its peculiar nature, easily supposes a greater degree of order and equality in things than it really finds; and although many things in nature be *sui generis* and most irregular, will yet invent parallels and conjugates and relatives, where no such thing is. Hence the fiction, that all celestial bodies move in perfect circles, thus rejecting entirely spiral and serpentine lines (except as explanatory terms).<sup>11</sup> Hence also the ele-

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<sup>11</sup> Though Kepler had, when Bacon wrote this, already demonstrated his three great laws concerning the elliptical path of the planets, neither Bacon nor Descartes seems to have known or assented to his discoveries. Our author deemed the startling astronomical announcements of his time to be mere theoretic solutions of the phenomena of the heavens, not so perfect as those advanced by antiquity, but still deserving a praise for the ingenuity displayed in their contrivance. Bacon believed a hundred such systems might exist, and though true in their explanation of phenomena, yet might all more or less differ, according to the preconceived notions which their framers brought to the survey of the heavens. He even thought he might put in his claim to the

ment of fire is introduced with its peculiar orbit,<sup>12</sup> to keep square with those other three which are objects of our senses. The relative rarity of the elements (as they are called) is arbitrarily made to vary in tenfold progression, with many other dreams of the like nature.<sup>13</sup> Nor is this folly confined to theories, but it is to be met with even in simple notions.

XLVI. The human understanding, when any proposition has been once laid down (either from general admission and belief, or from the pleasure it affords), forces everything else to add fresh support and confirmation; and although most cogent and abundant instances may exist to the contrary, yet either does not observe or despises them, or gets rid of and rejects them by some distinction, with violent and injurious prejudice, rather than sacrifice the authority of its first conclusions. It was well answered by him<sup>14</sup> who was

notice of posterity for his astronomical ingenuity, and, as Ptolemy had labored by means of epicycles and eccentricities, and Kepler with ellipses, to explain the laws of planetary motion, Bacon thought the mystery would unfold itself quite as philosophically through spiral labyrinths and serpentine lines. What the details of his system were, we are left to conjecture, and that from a very meagre but naïve account of one of his inventions which he has left in his Miscellany MSS.—*Ed.*

<sup>12</sup> *Hinc elementum ignis cum orbe suo introductum est.* Bacon saw in fire the mere result of a certain combination of action, and was consequently led to deny its elementary character. The ancient physicists attributed an orbit to each of the four elements, into which they resolved the universe, and supposed their spheres to involve each other. The orbit of the earth was in the centre, that of fire at the circumference. For Bacon's inquisition into the nature of heat, and its complete failure, see the commencement of the second book of the *Novum Organum*.—*Ed.*

<sup>13</sup> Robert Fludd is the theorist alluded to, who had supposed the gravity of the earth to be ten times heavier than water, that of water ten times heavier than air, and that of air ten times heavier than fire.—*Ed.*

<sup>14</sup> Diagoras. The same allusion occurs in the second part of the *Advancement of Learning*, where Bacon treats of the idols of the mind.

shown in a temple the votive tablets suspended by such as had escaped the peril of shipwreck, and was pressed as to whether he would then recognize the power of the gods, by an inquiry, But where are the portraits of those who have perished in spite of their vows? All superstition is much the same, whether it be that of astrology, dreams, omens, retributive judgment, or the like, in all of which the deluded believers observe events which are fulfilled, but neglect and pass over their failure, though it be much more common. But this evil insinuates itself still more craftily in philosophy and the sciences, in which a settled maxim vitiates and governs every other circumstance, though the latter be much more worthy of confidence. Besides, even in the absence of that eagerness and want of thought (which we have mentioned), it is the peculiar and perpetual error of the human understanding to be more moved and excited by affirmatives than negatives, whereas it ought duly and regularly to be impartial; nay, in establishing any true axiom the negative instance is the most powerful.

XLVII. The human understanding is most excited by that which strikes and enters the mind at once and suddenly, and by which the imagination is immediately filled and inflated. It then begins almost imperceptibly to conceive and suppose that everything is similar to the few objects which have taken possession of the mind, while it is very slow and unfit for the transition to the remote and heterogeneous instances by which axioms are tried as by fire, unless the office be imposed upon it by severe regulations and a powerful authority.

XLVIII. The human understanding is active and cannot halt or rest, but even, though without effect, still presses forward. Thus we cannot conceive of any end or external

boundary of the world, and it seems necessarily to occur to us that there must be something beyond. Nor can we imagine how eternity has flowed on down to the present day, since the usually received distinction of an infinity, *a parte ante* and *a parte post*,<sup>15</sup> cannot hold good; for it would thence follow that one infinity is greater than another, and also that infinity is wasting away and tending to an end. There is the same difficulty in considering the infinite divisibility of lines, arising from the weakness of our minds, which weakness interferes to still greater disadvantage with the discovery of causes; for although the greatest generalities in nature must be positive, just as they are found, and in fact not causable, yet the human understanding, incapable of resting, seeks for something more intelligible. Thus, however, while aiming at further progress, it falls back to what is actually less advanced, namely, final causes; for they are clearly more allied to man's own nature, than the system of the universe, and from this source they have wonderfully corrupted philosophy. But he would be an unskilful and shallow philosopher who should seek for causes in the greatest generalities,

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<sup>15</sup> A scholastic term, to signify the two eternities of past and future duration, that stretch out on both sides of the narrow isthmus (time) occupied by man. It must be remembered that Bacon lived before the doctrine of limits gave rise to the higher calculus, and therefore could have no conception of different denominations of infinities: on the other hand he would have thought the man insane who should have talked to him about lines infinitely great, inclosing angles infinitely little; that a right line, which is a right line so long as it is finite, by changing infinitely little its direction, becomes an infinite curve, and that a curve may become infinitely less than another curve; that there are infinite squares and infinite cubes, and infinites of infinites, all greater than one another, and the last but one of which is nothing in comparison with the last. Yet half a century sufficed from Bacon's time, to make this nomenclature, which would have appeared to him the excess of frenzy, not only reasonable but necessary, to grasp the higher demonstrations of physical science.—*Ed.*

and not be anxious to discover them in subordinate objects.

XLIX. The human understanding resembles not a dry light, but admits a tincture of the will<sup>16</sup> and passions, which generate their own system accordingly; for man always believes more readily that which he prefers. He, therefore, rejects difficulties for want of patience in investigation; sobriety, because it limits his hope; the depths of nature, from superstition; the light of experiment, from arrogance and pride, lest his mind should appear to be occupied with common and varying objects; paradoxes, from a fear of the opinion of the vulgar; in short, his feelings imbue and corrupt his understanding in innumerable and sometimes imperceptible ways.

L. But by far the greatest impediment and aberration of the human understanding proceeds from the dulness, incompetence, and errors of the senses; since whatever strikes the senses preponderates over everything, however superior, which does not immediately strike them. Hence contemplation mostly ceases with sight, and a very scanty, or perhaps no regard is paid to invisible objects. The entire operation, therefore, of spirits inclosed in tangible bodies<sup>17</sup> is concealed, and escapes us. All that more delicate change of formation in the parts of coarser substances (vulgarly

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<sup>16</sup> Spinoza, in his letter to Oldenberg (Op. Posth. p. 398), considers this aphorism based on a wrong conception of the origin of error, and, believing it to be fundamental, was led to reject Bacon's method altogether. Spinoza refused to acknowledge in man any such thing as a will, and resolved all his volitions into particular acts, which he considered to be as fatally determined by a chain of physical causes as any effects in nature.—*Ed.*

<sup>17</sup> *Operatio spirituum in corporibus tangibiliibus.* Bacon distinguished with the schools the gross and tangible parts of bodies, from such as were volatile and intangible. These, in conformity with the scholastic language, he terms spirits, and frequently returns to their operations in the 2d book.—*Ed.*

called alteration, but in fact a change of position in the smallest particles) is equally unknown; and yet, unless the two matters we have mentioned be explored and brought to light, no great effect can be produced in nature. Again, the very nature of common air, and all bodies of less density (of which there are many) is almost unknown; for the senses are weak and erring, nor can instruments be of great use in extending their sphere or acuteness—all the better interpretations of nature are worked out by instances, and fit and apt experiments, where the senses only judge of the experiment, the experiment of nature and the thing itself.

LI. The human understanding is, by its own nature, prone to abstraction, and supposes that which is fluctuating to be fixed. But it is better to dissect than abstract nature: such was the method employed by the school of Democritus,<sup>18</sup> which made greater progress in penetrating nature than the rest. It is best to consider matter, its conformation, and the changes of that conformation, its own action,<sup>19</sup> and the law of this action or motion; for forms are a mere fiction of the human mind, unless you will call the laws of action by that name.<sup>20</sup>

<sup>18</sup> Democritus, of Abdera, a disciple of Leucippus, born B.C. 470, died 360; all his works are destroyed. He is said to be the author of the doctrine of atoms: he denied the immortality of the soul, and first taught that the milky way was occasioned by a confused light from a multitude of stars. He may be considered as the parent of experimental philosophy, in the prosecution of which he was so ardent as to declare that he would prefer the discovery of one of the causes of natural phenomena, to the possession of the diadem of Persia. Democritus imposed on the blind credulity of his contemporaries, and, like Roger Bacon, astonished them by his inventions.—*Ed.*

<sup>19</sup> The Latin is *actus purus*, another scholastic expression to denote the action of the substance, which composes the essence of the body apart from its accidental qualities. For an exposition of the various kinds of motions he contemplates, the reader may refer to the 48th aphorism of the 2d book.—*Ed.*

<sup>20</sup> The scholastics after Aristotle distinguished in a subject three modes of SCIENCE—Vol. 22—2

LII. Such are the idols of the tribe, which arise either from the uniformity of the constitution of man's spirit, or its prejudices, or its limited faculties or restless agitation, or from the interference of the passions, or the incompetence of the senses, or the mode of their impressions.

LIII. The idols of the den derive their origin from the peculiar nature of each individual's mind and body, and also from education, habit, and accident; and although they be various and manifold, yet we will treat of some that require the greatest caution, and exert the greatest power in polluting the understanding.

LIV. Some men become attached to particular sciences and contemplations, either from supposing themselves the authors and inventors of them, or from having bestowed the greatest pains upon such subjects, and thus become most habituated to them.<sup>21</sup> If men of this description apply themselves to philosophy and contemplations of a universal

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beings: viz., the power or faculty, the act, and the habitude, or in other words that which is able to exist, what exists actually, and what continues to exist. Bacon means that is necessary to fix our attention not on that which can or ought to be, but on that which actually is; not on the right, but on the fact.—*Ed.*

<sup>21</sup> The inference to be drawn from this is to suspect that kind of evidence which is most consonant to our inclinations, and not to admit any notion as real except we can base it firmly upon that kind of demonstration which is peculiar to the subject, not to our impression. Sometimes the mode of proof may be consonant to our inclinations, and to the subject at the same time, as in the case of Pythagoras, when he applied his beloved numbers to the solution of astronomical phenomena; or in that of Descartes, when he reasoned geometrically concerning the nature of the soul. Such examples cannot be censured with justice, inasmuch as the methods pursued were adapted to the end of the inquiry. The remark in the text can only apply to those philosophers who attempt to build up a moral or theological system by the instruments of induction alone, or who rush, with the geometrical axiom, and the *a priori* syllogism, to the investigation of nature. The means in such cases are totally inadequate to the object in view.—*Ed.*

nature, they wrest and corrupt them by their preconceived fancies, of which Aristotle affords us a single instance, who made his natural philosophy completely subservient to his logic, and thus rendered it little more than useless and disputations. The chemists, again, have formed a fanciful philosophy with the most confined views, from a few experiments of the furnace. Gilbert,<sup>22</sup> too, having employed himself most assiduously in the consideration of the magnet, immediately established a system of philosophy to coincide with his favorite pursuit.

LV. The greatest and, perhaps, radical distinction between different men's dispositions for philosophy and the sciences is this, that some are more vigorous and active in observing the differences of things, others in observing their resemblances; for a steady and acute disposition can fix its thoughts, and dwell upon and adhere to a point, through all the refinements of differences, but those that are sublime and discursive recognize and compare even the most delicate and general resemblances; each of them readily falls into excess, by catching either at nice distinctions or shadows of resemblance.

LVI. Some dispositions evince an unbounded admiration of antiquity, others eagerly embrace novelty, and but few can preserve the just medium, so as neither to tear up

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<sup>22</sup> Gilbert lived toward the close of the sixteenth century, and was court physician to both Elizabeth and James. In his work alluded to in the text he continually asserts the advantages of the experimental over the *a priori* method in physical inquiry, and succeeded when his censor failed in giving a practical example of the utility of his precepts. His "De Magnete" contains all the fundamental parts of the science, and these so perfectly treated, that we have nothing to add to them at the present day.

Gilbert adopted the Copernican system, and even spoke of the contrary theory as utterly absurd, grounding his argument on the vast velocities which such a supposition requires us to ascribe to the heavenly bodies.—*Ed.*

what the ancients have correctly laid down, nor to despise the just innovations of the moderns. But this is very prejudicial to the sciences and philosophy, and instead of a correct judgment we have but the fictions of the ancients and moderns. Truth is not to be sought in the good fortune of any particular conjuncture of time, which is uncertain, but in the light of nature and experience, which is eternal. Such fictions, therefore, are to be abjured, and the understanding must not allow them to hurry it on to assent.

LVII. The contemplation of nature and of bodies in their individual form distracts and weakens the understanding; but the contemplation of nature and of bodies in their general composition and formation stupefies and relaxes it. We have a good instance of this in the school of Leucippus and Democritus compared with others, for they applied themselves so much to particulars as almost to neglect the general structure of things, while the others were so astounded while gazing on the structure that they did not penetrate the simplicity of nature. These two species of contemplation must, therefore, be interchanged, and each employed in its turn, in order to render the understanding at once penetrating and capacious, and to avoid the inconveniences we have mentioned, and the idols that result from them.

LVIII. Let such, therefore, be our precautions in contemplation, that we may ward off and expel the idols of the den, which mostly owe their birth either to some predominant pursuit, or, secondly, to an excess in synthesis and analysis, or, thirdly, to a party zeal in favor of certain ages, or, fourthly, to the extent or narrowness of the subject. In general, he who contemplates nature should suspect whatever particularly takes and fixes his understand-

ing, and should use so much the more caution to preserve it equitable and unprejudiced.

LIX. The idols of the market are the most troublesome of all, those namely which have entwined themselves round the understanding from the associations of words and names.

For men imagine that their reason governs words, while, in fact, words react upon the understanding; and this has rendered philosophy and the sciences sophistical and inactive. Words are generally formed in a popular sense, and define things by those broad lines which are most obvious to the vulgar mind; but when a more acute understanding or more diligent observation is anxious to vary those lines, and to adapt them more accurately to nature, words oppose it. Hence the great and solemn disputes of learned men often terminate in controversies about words and names, in regard to which it would be better (imitating the caution of mathematicians) to proceed more advisedly in the first instance, and to bring such disputes to a regular issue by definitions. Such definitions, however, cannot remedy the evil in natural and material objects, because they consist themselves of words, and these words produce others;<sup>23</sup> so that we must necessarily have recourse to particular instances, and their regular series and arrangement, as we

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<sup>23</sup> The Latin text adds "without end"; but Bacon is scarcely right in supposing that the descent from complex ideas and propositions to those of simple nature, involve the analyst in a series of continuous and interminable definitions. For in the gradual and analytical scale, there is a bar beyond which we cannot go, as there is a summit bounded by the limited variations of our conceptions. Logical definitions, to fulfil their conditions, or indeed to be of any avail, must be given in simpler terms than the object which is sought to be defined; now this, in the case of primordial notions and objects of sense, is impossible; therefore we are obliged to rest satisfied with the mere names of our perceptions.—*Ed.*

shall mention when we come to the mode and scheme of determining notions and axioms.

LX. The idols imposed upon the understanding by words are of two kinds. They are either the names of things which have no existence (for as some objects are from inattention left without a name, so names are formed by fanciful imaginations which are without an object), or they are the names of actual objects, but confused, badly defined, and hastily and irregularly abstracted from things. Fortune, the *pri-mum mobile*, the planetary orbits,<sup>24</sup> the element of fire, and the like fictions, which owe their birth to futile and false theories, are instances of the first kind. And this species of idols is removed with greater facility, because it can be exterminated by the constant refutation or the desuetude of the theories themselves. The others, which are created by vicious and unskilful abstraction, are intricate and deeply rooted. Take some word, for instance, as moist, and let us examine how far the different significations of this word are consistent. It will be found that the word moist is nothing but a confused sign of different actions admitted of no settled and defined uniformity. For it means that which easily diffuses itself over another body; that which is indeterminate and cannot be brought to a consistency; that which

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<sup>24</sup> The ancients supposed the planets to describe an exact circle round the sunth. As observations increased and facts were disclosed, which were irreconcileable with this supposition, the earth was removed from the centre to some other point in the circle, and the planets were supposed to revolve in a smaller eircle (epicycle) round an imaginary point, which in its turn described a circle of which the earth was the centre. In proportion as observation elicited fresh facts, contradictory to these representations, other epicycles and eccentrics were added, involving additional confusion. Though Kepler had swept away all these complicated theories in the preceding century, by the demonstration of his three laws, which established the elliptical course of the planets, Bacon regarded him and Copernicus in the same light as Ptolemy and Xenophanes.—Ed.

yields easily in every direction; that which is easily divided and dispersed; that which is easily united and collected; that which easily flows and is put in motion; that which easily adheres to, and wets another body; that which is easily reduced to a liquid state though previously solid. When, therefore, you come to predicate or impose this name, in one sense flame is moist, in another air is not moist, in another fine powder is moist, in another glass is moist; so that it is quite clear that this notion is hastily abstracted from water only, and common ordinary liquors, without any due verification of it.

There are, however, different degrees of distortion and mistake in words. One of the least faulty classes is that of the names of substances, particularly of the less abstract and more defined species (those then of chalk and mud are good, of earth bad); words signifying actions are more faulty, as to generate, to corrupt, to change; but the most faulty are those denoting qualities (except the immediate objects of sense), as heavy, light, rare, dense. Yet in all of these there must be some notions a little better than others, in proportion as a greater or less number of things come before the senses.

LXI. The idols of the theatre are not innate, nor do they introduce themselves secretly into the understanding, but they are manifestly instilled and cherished by the fictions of theories and depraved rules of demonstration. To attempt, however, or undertake their confutation would not be consistent with our declarations. For since we neither agree in our principles nor our demonstrations, all argument is out of the question. And it is fortunate that the ancients are left in possession of their honors. We detract nothing from them, seeing our whole doctrine relates only to the

path to be pursued. The lame (as they say) in the path outstrip the swift who wander from it, and it is clear that the very skill and swiftness of him who runs not in the right direction must increase his aberration.

Our method of discovering the sciences is such as to leave little to the acuteness and strength of wit, and indeed rather to level wit and intellect. For as in the drawing of a straight line, or accurate circle by the hand, much depends on its steadiness and practice, but if a ruler or compass be employed there is little occasion for either; so it is with our method. Although, however, we enter into no individual confutations, yet a little must be said, first, of the sects and general divisions of these species of theories; secondly, something further to show that there are external signs of their weakness; and, lastly, we must consider the causes of so great a misfortune, and so long and general a unanimity in error, that we may thus render the access to truth less difficult, and that the human understanding may the more readily be purified, and brought to dismiss its idols.

LXII. The idols of the theatre, or of theories, are numerous, and may, and perhaps will, be still more so. For unless men's minds had been now occupied for many ages in religious and theological considerations, and civil governments (especially monarchies), had been averse to novelties of that nature even in theory (so that men must apply to them with some risk and injury to their own fortunes, and not only without reward, but subject to contumely and envy), there is no doubt that many other sects of philosophers and theorists would have been introduced, like those which formerly flourished in such diversified abundance among the Greeks. For as many imaginary theories of the heavens can be deduced from the phenomena of the sky, so

it is even more easy to found many dogmas upon the phenomena of philosophy—and the plot of this our theatre resembles those of the poetical, where the plots which are invented for the stage are more consistent, elegant, and pleasurable than those taken from real history.

In general, men take for the groundwork of their philosophy either too much from a few topics, or too little from many; in either case their philosophy is founded on too narrow a basis of experiment and natural history, and decides on too scanty grounds. For the theoretic philosopher seizes various common circumstances by experiment, without reducing them to certainty or examining and frequently considering them, and relies for the rest upon meditation and the activity of his wit.

There are other philosophers who have diligently and accurately attended to a few experiments, and have thence presumed to deduce and invent systems of philosophy, forming everything to conformity with them.

A third set, from their faith and religious veneration, introduce theology and traditions; the absurdity of some among them having proceeded so far as to seek and derive the sciences from spirits and genii. There are, therefore, three sources of error and three species of false philosophy; the sophistic, empiric, and superstitious.

LXIII. Aristotle affords the most eminent instance of the first; for he corrupted natural philosophy by logic—thus he formed the world of categories, assigned to the human soul, the noblest of substances, a genus determined by words of secondary operation, treated of density and rarity (by which bodies occupy a greater or lesser space), by the frigid distinctions of action and power, asserted that there was a peculiar and proper motion in all bodies, and

that if they shared in any other motion, it was owing to an external moving cause, and imposed innumerable arbitrary distinctions upon the nature of things; being everywhere more anxious as to definitions in teaching and the accuracy of the wording of his propositions, than the internal truth of things. And this is best shown by a comparison of his philosophy with the others of greatest repute among the Greeks. For the similar parts of Anaxagoras, the atoms of Leucippus and Democritus, the heaven and earth of Parmenides, the discord and concord of Empedocles,<sup>25</sup> the resolution of bodies into the common nature of fire, and their condensation according to Heraclitus, exhibit some sprinkling of natural philosophy, the nature of things, and experiment; while Aristotle's physics are mere logical terms, and he remodelled the same subject in his metaphysics under a more imposing title, and more as a realist than a nominalist. Nor is much stress to be laid on his frequent recourse to experiment in his books on animals, his problems, and other treatises; for he had already decided, without having properly consulted experience as the basis of his decisions and axioms, and after having so decided, he drags experiment along as a captive constrained to accommodate herself to his decisions: so that he is even more to be blamed than his modern followers (of the scholastic school) who have deserted her altogether.

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<sup>25</sup> Empedocles, of Agrigentum, flourished 414 B.C. He was the disciple of Telanges the Pythagorean, and warmly adopted the doctrine of transmigration. He resolved the universe into the four ordinary elements, the principles of whose composition were life and happiness, or concord and amity, but whose decomposition brought forth death and evil, or discord and hatred. Heraclitus held matter to be indifferent to any peculiar form, but as it became rarer or more dense, it took the appearance of fire, air, earth and water. Fire, however, he believed to be the elementary principle out of which the others were evolved. This was also the belief of Lucretius. See book i. 783, etc.

LXIV. The empiric school produces dogmas of a more deformed and monstrous nature than the sophistic or theoretic school; not being founded in the light of common notions (which, however poor and superstitious, is yet in a manner universal, and of a general tendency), but in the confined obscurity of a few experiments. Hence this species of philosophy appears probable, and almost certain to those who are daily practiced in such experiments, and have thus corrupted their imagination, but incredible and futile to others. We have a strong instance of this in the alchemists and their dogmas; it would be difficult to find another in this age, unless perhaps in the philosophy of Gilbert.<sup>26</sup> We could not, however, neglect to caution others against this school, because we already foresee and augur, that if men be hereafter induced by our exhortations to apply seriously to experiments (bidding farewell to the sophistic doctrines), there will then be imminent danger from empirics, owing to the premature and forward haste of the understanding, and its jumping or flying to generalities and the principles of things. We ought, therefore, already to meet the evil.

LXV. The corruption of philosophy by the mixing of it up with superstition and theology, is of a much wider extent, and is most injurious to it both as a whole and in parts. For the human understanding is no less exposed to the impressions of fancy, than to those of vulgar notions. The disputatious and sophistic school entraps the understanding, while the fanciful, bombastic, and, as it were, poetical school, rather flatters it. There is a clear example of this

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<sup>26</sup> It is thus the Vulcanists and Neptunians have framed their opposite theories in geology. Phrenology is a modern instance of hasty generalization.—*Ed.*

among the Greeks, especially in Pythagoras, where, however, the superstition is coarse and overcharged, but it is more dangerous and refined in Plato and his school. This evil is found also in some branches of other systems of philosophy, where it introduces abstracted forms, final and first causes, omitting frequently the intermediate and the like. Against it we must use the greatest caution; for the apotheosis of error is the greatest evil of all, and when folly is worshipped, it is, as it were, a plague spot upon the understanding. Yet some of the moderns have indulged this folly with such consummate inconsiderateness, that they have endeavored to build a system of natural philosophy on the first chapter of Genesis, the book of Job, and other parts of Scripture; seeking thus the dead among the living.<sup>27</sup> And this folly is the more to be prevented and restrained, because not only fantastical philosophy, but heretical religion springing from the absurd mixture of matters divine and human. It is therefore most wise soberly to render unto faith the things that are faith's.

LXVI. Having spoken of the vicious authority of the systems founded either on vulgar notions, or on a few experiments, or on superstition, we must now consider the faulty subjects for contemplation, especially in natural philosophy. The human understanding is perverted by observing the power of mechanical arts, in which bodies are very materially changed by composition or separation, and is induced to suppose that something similar takes place in the universal nature of things. Hence the fiction of elements,

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<sup>27</sup> In Scripturo everything which concerns the passing interests of the body is called dead; the only living knowledge having regard to the eternal interest of the soul.—*Ed.*

and their co-operation in forming natural bodies.<sup>28</sup> Again, when man reflects upon the entire liberty of nature, he meets with particular species of things, as animals, plants, minerals, and is thence easily led to imagine that there exist in nature certain primary forms which she strives to produce, and that all variation from them arises from some impediment or error which she is exposed to in completing her work, or from the collision or metamorphosis of different species. The first hypothesis has produced the doctrine of elementary properties, the second that of occult properties and specific powers; and both lead to trifling courses of reflection, in which the mind acquiesces, and is thus diverted from more important subjects. But physicians exercise a much more useful labor in the consideration of the secondary qualities of things, and the operations of attraction, repulsion, attenuation, inspissation, dilatation, astringency, separation, maturation, and the like; and would do still more if they would not corrupt these proper observations by the two systems I have alluded to, of elementary qualities and specific powers, by which they either reduce the secondary to first qualities, and their subtle and immeas-

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<sup>28</sup> In mechanics and the general sciences, causes compound their effects, or in other words, it is generally possible to deduce *à priori* the consequence of introducing complex agencies into any experiment, by allowing for the effect of each of the simple causes which enter into their composition. In chemistry and physiology a contrary law holds; the causes which they embody generally uniting to form distinct substances, and to introduce unforeseen laws and combinations. The deductive method here is consequently inapplicable, and we are forced back upon experiment.

Bacon in the text is hardly consistent with himself, as he admits in the second book the doctrine, to which modern discovery points, of the reciprocal transmutation of the elements. What seemed poetic fiction in the theories of Pythagoras and Seneca, assumes the appearance of scientific fact in the hands of Baron Caynard.—*Ed.*

urable composition, or at any rate neglect to advance by greater and more diligent observation to the third and fourth qualities, thus terminating their contemplation prematurely. Nor are these powers (or the like) to be investigated only among the medicines for the human body, but also in all changes of other natural bodies.

A greater evil arises from the contemplation and investigation rather of the stationary principles of things from which, than of the active by which things themselves are created. For the former only serve for discussion, the latter for practice. Nor is any value to be set on those common differences of motion which are observed in the received system of natural philosophy, as generation, corruption, augmentation, diminution, alteration, and translation. For this is their meaning: if a body, unchanged in other respects, is moved from its place, this is translation; if the place and species be given, but the quantity changed, it is alteration; but if, from such a change, the mass and quantity of the body do not continue the same, this is the motion of augmentation and diminution; if the change be continued so as to vary the species and substance, and transfuse them to others, this is generation and corruption. All this is merely popular, and by no means penetrates into nature; and these are but the measures and bounds of motion, and not different species of it; they merely suggest how far, and not how or whence. For they exhibit neither the affections of bodies nor the process of their parts, but merely establish a division of that motion, which coarsely exhibits to the senses matter in its varied form. Even when they wish to point out something relative to the causes of motion, and to establish a division of them, they most absurdly introduce natural and violent motion, which is also a popular notion,

since every violent motion is also in fact natural, that is to say, the external efficient puts nature in action in a different manner to that which she had previously employed.

But if, neglecting these, any one were, for instance, to observe that there is in bodies a tendency of adhesion, so as not to suffer the unity of nature to be completely separated or broken, and a *vacuum*<sup>29</sup> to be formed, or that they have a tendency to return to their natural dimensions or tension, so that, if compressed or extended within or beyond it, they immediately strive to recover themselves, and resume their former volume and extent; or that they have a tendency to congregate into masses with similar bodies—the dense, for instance, toward the circumference of the earth, the thin and rare toward that of the heavens. These and the like are true physical genera of motions, but the others are clearly logical and scholastic, as appears plainly from a comparison of the two.

Another considerable evil is, that men in their systems and contemplations bestow their labor upon the investigation and discussion of the principles of things and the extreme limits of nature, although all utility and means of action consist in the intermediate objects. Hence men cease not to abstract nature till they arrive at potential and shapeless matter,<sup>30</sup> and still persist in their dissection, till

<sup>29</sup> Galileo had recently adopted the notion that nature abhorred a vacuum for an axiomatic principle, and it was not till Torricelli, his disciple, had given practical proof of the utility of Bacon's method, by the discovery of the barometer (1643) that this error, as also that expressed below, and believed by Bacon, concerning the homœopathic tendencies of bodies, was destroyed.—*Ed.*

<sup>30</sup> *Donec ad materiam potentialem et informem ventum fuerit.* Nearly all the ancient philosophers admitted the existence of a certain primitive and shapeless matter as the substratum of things which the creative power had reduced to fixed proportions, and resolved into specific substances. The ex-

they arrive at atoms; and yet were all this true, it would be of little use to advance man's estate.

LXVII. The understanding must also be cautioned against the intemperance of systems, so far as regards its giving or withholding its assent; for such intemperance appears to fix and perpetuate idols, so as to leave no means of removing them.

These excesses are of two kinds. The first is seen in those who decide hastily, and render the sciences positive and dictatorial. The other in those who have introduced scepticism, and vague unbounded inquiry. The former subdues, the latter enervates the understanding. The Aristotelian philosophy, after destroying other systems (as the Ottomans<sup>31</sup> do their brethren) by its disputatious confutations, decided upon everything, and Aristotle himself then raises up questions at will, in order to settle them; so that everything should be certain and decided, a method now in use among his successors.

The school of Plato introduced scepticism, first, as it were in joke and irony, from their dislike to Protagoras, Hippias,<sup>32</sup> and others, who were ashamed of appearing not

pression potential matter refers to that substance forming the basis of the Peripatetic system, which virtually contained all the forms that it was in the power of the efficient cause to draw out of it.—*Ed.*

<sup>31</sup> An allusion to the humanity of the *Sultans*, who, in their earlier histories are represented as signalizing their accession to the throne by the destruction of their family, to remove the danger of rivalry and the terrors of civil war.—*Ed.*

<sup>32</sup> The text is “in odium veterum sophistarum, Protagoræ, Hippie, et reliquorum.” Those were called sophists, who, *ostentationis aut questus causa philosophabantur*. (*Acad. Prior.* ii. 22.) They had corrupted and degraded philosophy before Socrates. Protagoras of Abdera (*Ἄβδηρα*), the most celebrated, taught that man is the measure of all things, by which he meant not only that all which can be known is known only as it related to our faculties, but also that apart from our faculties nothing can be known. The sceptics

to doubt upon any subject. But the new academy dogmatized in their scepticism, and held it as their tenet. Although this method be more honest than arbitrary decision (for its followers allege that they by no means confound all inquiry, like Pyrrho and his disciples, but hold doctrines which they can follow as probable, though they cannot maintain them to be true), yet when the human mind has once despaired of discovering truth, everything begins to languish. Hence men turn aside into pleasant controversies and discussions, and into a sort of wandering over subjects rather than sustain any rigorous investigation. But as we observed at first, we are not to deny the authority of the human senses and understanding, although weak, but rather to furnish them with assistance.

LXVIII. We have now treated of each kind of idols, and their qualities, all of which must be abjured and renounced with firm and solemn resolution, and the understanding must be completely freed and cleared of them, so that the access to the kingdom of man, which is founded on the sciences, may resemble that to the kingdom of heaven, where no admission is conceded except to children.

LXIX. Vicious demonstrations are the muniments and support of idols, and those which we possess in logic, merely subject and enslave the world to human thoughts, and thoughts to words. But demonstrations are in some manner themselves systems of philosophy and science; for such as they are, and accordingly as they are regularly or im-

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equally held that knowledge was probable only as it related to our faculties, but they stopped there, and did not, like the sophist, dogmatize about the unknown. The works of Protagoras were condemned for their impiety, and publicly burned by the ædiles of Athens, who appear to have discharged the office of common hangmen to the literary blasphemers of their day.—*Ed.*

properly established, such will be the resulting systems of philosophy and contemplation. But those which we employ in the whole process leading from the senses and things to axioms and conclusions, are fallacious and incompetent. This process is fourfold, and the errors are in equal number. In the first place the impressions of the senses are erroneous, for they fail and deceive us. We must supply defects by substitutions, and fallacies by their correction. Secondly, notions are improperly abstracted from the senses, and indeterminate and confused when they ought to be the reverse. Thirdly, the induction that is employed is improper, for it determines the principles of sciences by simple enumeration,<sup>33</sup> without adopting exclusions and resolutions, or just separations of nature. Lastly, The usual method of discovery and proof, by first establishing the most general propositions, then applying and proving the intermediate axioms according to them, is the parent of error and the calamity of every science. But we will treat more fully

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<sup>33</sup> Bacon is hardly correct in implying that the *enumerationem per simplicem* was the only light in which the ancients looked upon induction, as they appear to have regarded it as only one, and that the least important, of its species. Aristotle expressly considers induction in a perfect or dialectic sense, and in an imperfect or rhetorical sense. Thus if a genus (g), contains four species (a, b, c, d), the syllogism would lead us to infer, that what is true of g, is true of any one of the four. But perfect induction would reason, that what we can prove of a, b, c, d, separately, we may properly state as true of g, the whole genus. This is evidently a formal argument as demonstrative as the syllogism. In necessary matters, however, legitimate induction may claim a wider province, and infer of the whole genus what is only apparent in a part of the species. Such are those inductive inferences which concern the laws of nature, the immutability of forms, by which Bacon strove to erect his new system of philosophy. The Stagyrite, however, looked upon *enumerationem per simplicem*, without any regard to the nature of the matter, or to the completeness of the species, with as much reprehensive caution as Bacon, and guarded his readers against it as the source of innumerable errors.—*Ed.*

of that which we now slightly touch upon, when we come to lay down the true way of interpreting nature, after having gone through the above expiatory process and purification of the mind.

LXX. But experience is by far the best demonstration, provided it adhere to the experiment actually made, for if that experiment be transferred to other subjects apparently similar, unless with proper and methodical caution it becomes fallacious. The present method of experiment is blind and stupid; hence men wandering and roaming without any determined course, and consulting mere chance, are hurried about to various points, and advance but little—at one time they are happy, at another their attention is distracted, and they always find that they want something further. Men generally make their experiments carelessly, and as it were in sport, making some little variation in a known experiment, and then if they fail they become disgusted and give up the attempt; nay, if they set to work more seriously, steadily, and assiduously, yet they waste all their time on probing some solitary matter, as Gilbert on the magnet, and the alchemists on gold. But such conduct shows their method to be no less unskilful than mean; for nobody can successfully investigate the nature of any object by considering that object alone; the inquiry must be more generally extended.

Even when men build any science and theory upon experiment, yet they almost always turn with premature and hasty zeal to practice, not merely on account of the advantage and benefit to be derived from it, but in order to seize upon some security in a new undertaking of their not employing the remainder of their labor unprofitably, and by making themselves conspicuous, to acquire a greater name

for their pursuit. Hence, like Atalanta, they leave the course to pick up the golden apple, interrupting their speed, and giving up the victory. But in the true course of experiment, and in extending it to new effects, we should imitate the Divine foresight and order; for God on the first day only created light, and assigned a whole day to that work without creating any material substance thereon. In like manner we must first, by every kind of experiment, elicit the discovery of causes and true axioms, and seek for experiments which may afford light rather than profit. Axioms, when rightly investigated and established, prepare us not for a limited but abundant practice, and bring in their train whole troops of effects. But we will treat hereafter of the ways of experience, which are not less beset and interrupted than those of judgment; having spoken at present of common experience only as a bad species of demonstration, the order of our subject now requires some mention of those external signs of the weakness in practice of the received systems of philosophy and contemplation<sup>34</sup> which we referred to above, and of the causes of a circumstance at first sight so wonderful and incredible. For the knowledge of these external signs prepares the way for assent, and the explanation of the causes removes the wonder; and these two circumstances are of material use in extirpating more easily and gently the idols from the understanding.

LXXI. The sciences we possess have been principally derived from the Greeks; for the addition of the Roman, Arabic, or more modern writers, are but few and of small importance, and such as they are, are founded on the basis

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<sup>34</sup> See Ax. lxi. toward the end. This subject extends to Ax. lxxviii.

of Greek invention. But the wisdom of the Greeks was professional and disputatious, and thus most adverse to the investigation of truth. The name, therefore, of sophists, which the contemptuous spirit of those who deemed themselves philosophers, rejected and transferred to the rhetoricians—Gorgias,<sup>35</sup> Protagoras, Hippias, Polus—might well suit the whole tribe, such as Plato, Aristotle, Zeno, Epicurus, Theophrastus, and their successors—Chrysippus, Carneades, and the rest. There was only this difference between them—the former were mercenary vagabonds, travelling about to different states, making a show of their wisdom, and requiring pay; the latter more dignified and noble, in possession of fixed habitations, opening schools, and teaching philosophy gratuitously. Both, however (though differing in other respects), were professorial, and reduced every subject to controversy, establishing and defending certain sects and dogmas of philosophy, so that their doctrines were nearly (what Dionysius not unaptly objected to Plato) the talk of idle old men to ignorant youths. But the more ancient Greeks, as Empedocles, Anaxagoras, Leucippus, Democritus, Parmenides, Heraclitus, Xenophanes, Philolaus, and the rest<sup>36</sup> (for I omit Pythagoras as being superstitious),

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<sup>35</sup> Gorgias of Leontium went to Athens in 424 B.C. He and Polus were disciples of Empedocles, whom we have already noticed (Aphorism 63), where he sustained the three famous propositions, that nothing exists, that nothing can be known, and that it is out of the power of man to transmit or communicate intelligence. He is reckoned one of the earliest writers on the art of rhetoric, and for that reason, Plato called his elegant dialogue on that subject after his name.

<sup>36</sup> Chrysippus, a stoic philosopher of Soli in Cilicia, Campestris, born in 280, died in the 143d Olympiad, 208 B.C. He was equally distinguished for natural abilities and industry, seldom suffering a day to lapse without writing 500 lines. He wrote several hundred volumes, of which three hundred were on logical subjects; but in all, borrowed largely from others. He was very fond of the *sorites* in argument, which is hence called by Persius the heap of Chry-

did not (that we are aware) open schools, but betook themselves to the investigation of truth with greater silence and with more severity and simplicity, that is, with less affectation and ostentation. Hence in our opinion they acted more advisedly, however their works may have been eclipsed in course of time by those lighter productions which better correspond with and please the apprehensions and passions of the vulgar; for time, like a river,<sup>37</sup> bears down to us that

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sippus. He was called the Column of the Portico, a name given to the Stoical School from Zeno, its founder, who had given his lessons under the portico.

Carneades, born about 215, died in 130. He attached himself to Chrysippus, and sustained with *éclat* the scepticism of the academy. The Athenians sent him with Critolaus and Diogenes as ambassador to Rome, where he attracted the attention of his new auditory by the subtlety of his reasoning, and the fluency and vehemence of his language. Before Galba and Cato the Censor, he harangued with great variety of thought and copiousness of diction in praise of justice. The next day, to establish his doctrine of the uncertainty of human knowledge, he undertook to refute all his arguments. He maintained with the New Academy, that the senses, the imagination, and the understanding frequently deceive us, and therefore cannot be infallible judges of truth, but that from the impressions produced on the mind by means of the senses, we infer appearances of truth or probabilities. Nevertheless, with respect to the conduct of life, Carneades held that probable opinions are a sufficient guide.

Xenophanes, a Greek philosopher, of Colophon, born in 556, the founder of the Eleatic school, which owes its fame principally to Parmenides. Wild in his opinions about astronomy, he supposed that the stars were extinguished every morning, and rekindled at night; that eclipses were occasioned by the temporary extinction of the sun, and that there were several suns for the convenience of the different climates of the earth. Yet this man held the chair of philosophy at Athens for seventy years.

Philolaus, a Pythagorean philosopher of Crotona, B.C. 374. He first supported the diurnal motion of the earth round its axis, and its annual motion round the sun. Cicero (Acad. iv. 39) has ascribed this opinion to the Syrian philosopher Nicias, and likewise to Plato. From this passage, it is most probable that Copernicus got the idea of the system he afterward established. Bacon, in the Advancement of Human Learning, charges Gilbert with restoring the doctrines of Philolaus, because he ventured to support the Copernican theory.—*Ed.*

<sup>37</sup> Bacon is equally conspicuous for the use and abuse of analogical illustrations. The levity, as Stuart Mill very properly observes, by which substances

which is light and inflated, and sinks that which is heavy and solid. Nor were even these more ancient philosophers free from the national defect, but inclined too much to the ambition and vanity of forming a sect, and captivating public opinion, and we must despair of any inquiry after truth when it condescends to such trifles. Nor must we omit the opinion, or rather prophecy, of an Egyptian priest with regard to the Greeks, that they would forever remain children, without any antiquity of knowledge or knowledge of antiquity; for they certainly have this in common with children, that they are prone to talking, and incapable of generation, their wisdom being loquacious and unproductive of effects. Hence the external signs derived from the origin and birthplace of our present philosophy are not favorable.

LXXII. Nor are those much better which can be deduced from the character of the time and age, than the former from that of the country and nation; for in that age the knowledge both of time and of the world was confined and meagre, which is one of the worst evils for those who rely entirely on experience—they had not a thousand years of history worthy of that name, but mere fables and ancient traditions; they were acquainted with but a small portion of the regions and countries of the world, for they indiscriminately called all nations situated far toward the north Seythians, all those to the west Celts; they knew nothing of Africa but the nearest part of Ethiopia, or of Asia be-

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float on a stream, and the levity which is synonymous with worthlessness, have nothing beside the name in common; and to show how little value there is in the figure, we need only change the word into buoyancy, to turn the semblance of Bacon's argument against himself—*Ed.*

yond the **Ganges**, and had not even heard any sure and clear tradition of the regions of the New World. Besides, a vast number of climates and zones, in which innumerable nations live and breathe, were pronounced by them to be uninhabitable; nay, the travels of Democritus, Plato, and Pythagoras, which were not extensive, but rather mere excursions from home, were considered as something vast. But in our times many parts of the New World, and every extremity of the Old, are well known, and the mass of experiments has been infinitely increased; wherefore, if external signs were to be taken from the time of the nativity or procreation (as in astrology), nothing extraordinary could be predicted of these early systems of philosophy.

LXXIII. Of all signs there is none more certain or worthy than that of the fruits produced, for the fruits and effects are the sureties and vouchers, as it were, for the truth of philosophy. Now, from the systems of the Greeks, and their subordinate divisions in particular branches of the sciences during so long a period, scarcely one single experiment can be culled that has a tendency to elevate or assist mankind, and can be fairly set down to the speculations and doctrines of their philosophy. Celsus candidly and wisely confesses as much, when he observes that experiments were first discovered in medicine, and that men afterward built their philosophical systems upon them, and searched for and assigned causes, instead of the inverse method of discovering and deriving experiments from philosophy and the knowledge of causes; it is not, therefore, wonderful that the Egyptians (who bestowed divinity and sacred honors on the authors of new inventions) should have consecrated more images of brutes than of men, for the brutes by their natural instinct made many discoveries,

while men derived but few from discussion and the conclusions of reason.

The industry of the alchemists has produced some effect, by chance, however, and casualty, or from varying their experiments (as mechanics also do), and not from any regular art or theory, the theory they have imagined rather tending to disturb than to assist experiment. Those, too, who have occupied themselves with natural magic (as they term it) have made but few discoveries, and those of small import, and bordering on imposture; for which reason, in the same manner as we are cautioned by religion to show our faith by our works, we may very properly apply the principle to philosophy, and judge of it by its works, accounting that to be futile which is unproductive, and still more so if, instead of grapes and olives, it yield but the thistle and thorns of dispute and contention.

LXXIV. Other signs may be selected from the increase and progress of particular systems of philosophy and the sciences; for those which are founded on nature grow and increase, while those which are founded on opinion change and increase not. If, therefore, the theories we have mentioned were not like plants, torn up by the roots, but grew in the womb of nature, and were nourished by her, that which for the last two thousand years has taken place would never have happened, namely, that the sciences still continue in their beaten track, and nearly stationary, without having received any important increase, nay, having, on the contrary, rather bloomed under the hands of their first author, and then faded away. But we see that the case is reversed in the mechanical arts, which are founded on nature and the light of experience, for they (as long as they are popular) seem full of life, and uninterruptedly thrive and

grow, being at first rude, then convenient, lastly polished, and perpetually improved.

LXXV. There is yet another sign (if such it may be termed, being rather an evidence, and one of the strongest nature), namely, the actual confession of those very authorities whom men now follow; for even they who decide on things so daringly, yet at times, when they reflect, betake themselves to complaints about the subtlety of nature, the obscurity of things, and the weakness of man's wit. If they would merely do this, they might perhaps deter those who are of a timid disposition from further inquiry, but would excite and stimulate those of a more active and confident turn to further advances. They are not, however, satisfied with confessing so much of themselves, but consider everything which has been either unknown or unattempted by themselves or their teachers, as beyond the limits of possibility, and thus, with most consummate pride and envy, convert the defects of their own discoveries into a calumny on nature and a source of despair to every one else. Hence arose the New Academy, which openly professed scepticism,<sup>38</sup> and consigned mankind to eternal darkness; hence the notion that forms, or the true differences of things (which are in fact the laws of simple action), are beyond man's

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<sup>38</sup> We have before observed, that the New Academy did not profess skepticism, but the ἀκατάληψις, or incomprehensibility of the absolute essences of things. Even modern physicists are not wanting, to assert with this school that the utmost knowledge we can obtain is relative, and necessarily short of absolute certainty. It is not without an appearance of truth that these philosophers maintain that our ideas and perceptions do not express the nature of the things which they represent, but only the effects of the peculiar organs by which they are conveyed to the understanding, so that were these organs changed, we should have different conceptions of their nature. That constitution of air which is dark to man is luminous to bats and owls.

reach, and cannot possibly be discovered; hence those notions in the active and operative branches, that the heat of the sun and of fire are totally different, so as to prevent men from supposing that they can elicit or form, by means of fire, anything similar to the operations of nature; and again, that composition only is the work of man and mixture of nature, so as to prevent men from expecting the generation or transformation of natural bodies by art. Men will, therefore, easily allow themselves to be persuaded by this sign not to engage their fortunes and labor in speculations, which are not only desperate, but actually devoted to desperation.

LXXVI. Nor should we omit the sign afforded by the great dissension formerly prevalent among philosophers, and the variety of schools, which sufficiently show that the way was not well prepared that leads from the senses to the understanding, since the same groundwork of philosophy (namely, the nature of things), was torn and divided into such widely differing and multifarious errors. And although in these days the dissensions and differences of opinions with regard to first principles and entire systems are nearly extinct,<sup>39</sup> yet there remain innumerable questions and controversies with regard to particular branches of philosophy. So that it is manifest that there is nothing sure or sound either in the systems themselves or in the methods of demonstration.<sup>40</sup>

LXXVII. With regard to the supposition that there is a general unanimity as to the philosophy of Aristotle, because

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<sup>39</sup> Owing to the universal prevalence of Aristotelism.

<sup>40</sup> It must be remembered, that when Bacon wrote, algebra was in its infancy, and the doctrine of units and infinitesimals undiscovered.

the other systems of the ancients ceased and became obsolete on its promulgation, and nothing better has been since discovered; whence it appears that it is so well determined and founded, as to have united the suffrages of both ages; we will observe—1st. That the notion of other ancient systems having ceased after the publication of the works of Aristotle is false, for the works of the ancient philosophers subsisted long after that event, even to the time of Cicero, and the subsequent ages. But at a later period, when human learning had, as it were, been wrecked in the inundation of barbarians into the Roman empire, then the systems of Aristotle and Plato were preserved in the waves of ages, like planks of a lighter and less solid nature. 2d. The notion of unanimity, on a clear inspection, is found to be fallacious. For true unanimity is that which proceeds from a free judgment, arriving at the same conclusion, after an investigation of the fact. Now, by far the greater number of those who have assented to the philosophy of Aristotle, have bound themselves down to it from prejudice and the authority of others, so that it is rather obsequiousness and concurrence than unanimity. But even if it were real and extensive unanimity, so far from being esteemed a true and solid confirmation, it should even lead to a violent presumption to the contrary. For there is no worse augury in intellectual matters than that derived from unanimity, with the exception of divinity and polities, where suffrages are allowed to decide. For nothing pleases the multitude, unless it strike the imagination or bind down the understanding, as we have observed above, with the shackles of vulgar notions. Hence we may well transfer Phocion's remark from morals to the intellect: "That men should immediately examine what error or fault they have committed, when the

multitude concurs with, and applauds them."<sup>41</sup> This then is one of the most unfavorable signs. All the signs, therefore, of the truth and soundness of the received systems of philosophy and the sciences are unpropitious, whether taken from their origin, their fruits, their progress, the confessions of their authors, or from unanimity.

LXXVIII. We now come to the causes of errors,<sup>42</sup> and of such perseverance in them for ages. These are sufficiently numerous and powerful to remove all wonder, that what we now offer should have so long been concealed from, and have escaped the notice of mankind, and to render it more worthy of astonishment, that it should even now have entered any one's mind, or become the subject of his thoughts; and that it should have done so, we consider rather the gift of fortune than of any extraordinary talent, and as the offspring of time rather than wit. But, in the first place, the number of ages is reduced to very narrow limits, on a proper consideration of the matter. For out of twenty-five<sup>43</sup> centuries, with which the memory and learn-

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<sup>41</sup> Because the vulgar make up the overwhelming majority in such decisions, and generally allow their judgments to be swayed by passion or prejudice.

<sup>42</sup> See end of Axiom xi. The subject extends to Axiom xc.

<sup>43</sup> If we adopt the statement of Herodotus, who places the Homeric era 400 years back from his time, Homer lived about 900 years before Christ. On adding this number to the sixteen centuries of the Christian era which had elapsed up to Bacon's time, we get the twenty-five centuries he mentions. The Homeric epoch is the furthest point in antiquity from which Bacon could reckon with any degree of certainty. Hesiod, if he were not contemporary, immediately preceded him.

The epoch of Greek philosophy may be included between Thales and Plato, that is, from the 35th to the 88th Olympiad; that of the Roman, between Terence and Pliny. The modern revolution, in which Bacon is one of the central figures, took its rise from the time of Dante and Petrarch, who lived at the commencement of the fourteenth century; and to which, on account of the invention of printing, and the universal spread of literature, which has ren-

ing of man are conversant, scarcely six can be set apart and selected as fertile in science and favorable to its progress. For there are deserts and wastes in times as in countries, and we can only reckon up three revolutions and epochs of philosophy. 1. The Greek. 2. The Roman. 3. Our own, that is the philosophy of the western nations of Europe: and scarcely two centuries can with justice be assigned to each. The intermediate ages of the world were unfortunate both in the quantity and richness of the sciences produced. Nor need we mention the Arabs, or the scholastic philosophy, which, in those ages, ground down the sciences by their numerous treatises, more than they increased their weight. The first cause, then, of such insignificant progress in the sciences, is rightly referred to the small proportion of time which has been favorable thereto.

LXXIX. A second cause offers itself, which is certainly of the greatest importance; namely, that in those very ages in which men's wit and literature flourished considerably, or even moderately, but a small part of their industry was bestowed on natural philosophy, the great mother of the sciences. For every art and science torn from this root may, perhaps, be polished, and put into a serviceable shape, but can admit of little growth. It is well known, that after the Christian religion had been acknowledged, and arrived at maturity, by far the best wits were busied upon theology, where the highest rewards offered themselves, and every species of assistance was abundantly supplied, and the study of which was the principal occupation of the western European nations during the third epoch; the rather because

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dered a second destruction of learning impossible, it is difficult to foresee any other end than the extinction of the race of man.—*Ed.*

literature flourished about the very time when controversies concerning religion first began to bud forth. 2. In the preceding ages, during the second epoch (that of the Romans), philosophical meditation and labor was chiefly occupied and wasted in moral philosophy (the theology of the heathens): besides, the greatest minds in these times applied themselves to civil affairs, on account of the magnitude of the Roman empire, which required the labor of many. 3. The age during which natural philosophy appeared principally to flourish among the Greeks, was but a short period, since in the more ancient times the seven sages (with the exception of Thales), applied themselves to moral philosophy and politics, and at a later period, after Socrates had brought down philosophy from heaven to earth, moral philosophy became more prevalent, and diverted men's attention from natural. Nay, the very period during which physical inquiries flourished, was corrupted and rendered useless by contradictions, and the ambition of new opinions. Since, therefore, during these three epochs, natural philosophy has been materially neglected or impeded, it is not at all surprising that men should have made but little progress in it, seeing they were attending to an entirely different matter.

LXXX. Add to this that natural philosophy, especially of late, has seldom gained exclusive possession of an individual free from all other pursuits, even among those who have applied themselves to it, unless there may be an example or two of some monk studying in his cell, or some nobleman in his villa.<sup>44</sup> She has rather been made a passage and bridge to other pursuits.

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<sup>44</sup> The allusion is evidently to Roger Bacon and Réné Descartes.—*Ed.*

Thus has this great mother of the sciences been degraded most unworthily to the situation of a handmaid, and made to wait upon medicine or mathematical operations, and to wash the immature minds of youth, and imbue them with a first dye, that they may afterward be more ready to receive and retain another. In the meantime, let no one expect any great progress in the sciences (especially their operative part), unless natural philosophy be applied to particular sciences, and particular sciences again referred back to natural philosophy. For want of this, astronomy, optics, music, many mechanical arts, medicine itself, and (what perhaps is more wonderful), moral and political philosophy, and the logical sciences have no depth, but only glide over the surface and variety of things; because these sciences, when they have been once partitioned out and established, are no longer nourished by natural philosophy, which would have imparted fresh vigor and growth to them from the sources and genuine contemplation of motion, rays, sounds, texture, and conformation of bodies, and the affections and capacity of the understanding. But we can little wonder that the sciences grow not when separated from their roots.

LXXXI. There is another powerful and great cause of the little advancement of the sciences, which is this; it is impossible to advance properly in the course when the goal is not properly fixed. But the real and legitimate goal of the sciences is the endowment of human life with new inventions and riches. The great crowd of teachers know nothing of this, but consist of dictatorial hirelings; unless it so happen that some artisan of an acute genius, and ambitious of fame, gives up his time to a new discovery, which is generally attended with a loss of property. The majority, so far from proposing to themselves the augmentation

of the mass of arts and sciences, make no other use of an inquiry into the mass already before them, than is afforded by the conversion of it to some use in their lectures, or to gain, or to the acquirement of a name, and the like. But if one out of the multitude be found, who courts science from real zeal, and on his own account, even he will be seen rather to follow contemplation, and the variety of theories, than a severe and strict investigation of truth. Again, if there even be an unusually strict investigator of truth, yet will he propose to himself, as the test of truth, the satisfaction of his mind and understanding, as to the causes of things long since known, and not such a test as to lead to some new earnest of effects, and a new light in axioms. If, therefore, no one have laid down the real end of science, we cannot wonder that there should be error in points subordinate to that end.

LXXXII. But, in like manner, as the end and goal of science is ill defined, so, even were the case otherwise, men have chosen an erroneous and impassable direction. For it is sufficient to astonish any reflecting mind, that nobody should have cared or wished to open and complete a way for the understanding, setting off from the senses, and regular, well-conducted experiment; but that everything has been abandoned either to the mists of tradition, the whirl and confusion of argument, or the waves and mazes of chance, and desultory, ill-combined experiment. Now, let any one but consider soberly and diligently the nature of the path men have been accustomed to pursue in the investigation and discovery of any matter, and he will doubtless first observe the rude and inartificial manner of discovery most familiar to mankind: which is no other than this. When any one prepares himself for discovery, he first inquires and obtains

a full account of all that has been said on the subject by others, then adds his own reflections, and stirs up and, as it were, invokes his own spirit, after much mental labor, to disclose its oracles. All which is a method without foundation, and merely turns on opinion.

Another, perhaps, calls in logic to assist him in discovery, which bears only a nominal relation to his purpose. For the discoveries of logic are not discoveries of principles and leading axioms, but only of what appears to accord with them.<sup>45</sup> And when men become curious and importunate, and give trouble, interrupting her about her proofs, and the discovery of principles or first axioms, she puts them off with her usual answer, referring them to faith, and ordering them to swear allegiance to each art in its own department.

There remains but mere experience, which, when it offers itself, is called chance; when it is sought after, experiment.<sup>46</sup> But this kind of experience is nothing but a loose fagot; and mere groping in the dark, as men at night try all means of discovering the right road, while it would be better and more prudent either to wait for day, or procure a light, and then proceed. On the contrary, the real order of experience begins by setting up a light, and then shows the road by it, commencing with a regulated and digested, not a misplaced and vague course of experiment, and thence deducing axioms, and from those axioms new experiments: for not even the Divine Word proceeded to operate on the general mass of things without due order.

Let men, therefore, cease to wonder if the whole course

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<sup>45</sup> From the abuse of the scholastics, who mistook the *a priori* method, the deductive syllogism, for the entire province of logic.—*Ed.*

<sup>46</sup> See Aphorism xcv.

of science be not run, when all have wandered from the path; quitting it entirely, and deserting experience, or involving themselves in its mazes, and wandering about, while a regularly combined system would lead them in a sure track through its wilds to the open day of axioms.

LXXXIII. The evil, however, has been wonderfully increased by an opinion, or inveterate conceit, which is both vainglorious and prejudicial, namely, that the dignity of the human mind is lowered by long and frequent intercourse with experiments and particulars, which are the objects of sense, and confined to matter; especially since such matters generally require labor in investigation, are mean subjects for meditation, harsh in discourse, unproductive in practice, infinite in number, and delicate in their subtlety. Hence we have seen the true path not only deserted, but intercepted and blocked up, experience being rejected with disgust, and not merely neglected or improperly applied.

LXXXIV. Again, the reverence for antiquity,<sup>47</sup> and the authority of men who have been esteemed great in philosophy, and general unanimity, have retarded men from advancing in science, and almost enchanted them. As to unanimity, we have spoken of it above.

The opinion which men cherish of antiquity is altogether idle, and scarcely accords with the term. For the old age and increasing years of the world should in reality be considered as antiquity, and this is rather the character of our own times than of the less advanced age of the world in those of the ancients; for the latter, with respect to our-

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<sup>47</sup> The incongruity to which Bacon alludes appears to spring from confounding two things, which are not only distinct, but affect human knowledge in inverse proportion, viz., the experience which terminates with life, with that experience which one century transmits to another.—*Ed.*

**selves, are ancient** and elder, with respect to the world **modern** and younger. And as we expect a greater knowledge of human affairs, and more mature judgment from an old man than from a youth, on account of his experience, and the variety and number of things he has seen, heard, and meditated upon, so we have reason to expect much greater things of our own age (if it knew but its strength and would essay and exert it) than from antiquity, since the world has grown older, and its stock has been increased and accumulated with an infinite number of experiments and observations.

We must also take into our consideration that many objects in nature fit to throw light upon philosophy have been exposed to our view, and discovered by means of long voyages and travels, in which our times have abounded. It would, indeed, be dishonorable to mankind, if the regions of the material globe, the earth, the sea, and stars, should be so prodigiously developed and illustrated in our age, and yet the boundaries of the intellectual globe should be confined to the narrow discoveries of the ancients.

With regard to authority, it is the greatest weakness to attribute infinite credit to particular authors, and to refuse his own prerogative to time, the author of all authors, and, therefore, of all authority. For truth is rightly named the daughter of time, not of authority. It is not wonderful, therefore, if the bonds of antiquity, authority, and unanimity, have so enchained the power of man, that he is unable (as if bewitched) to become familiar with things themselves.

LXXXV. Nor is it only the admiration of antiquity, authority, and unanimity, that has forced man's industry to rest satisfied with present discoveries, but, also, the admiration of the effects already placed within his power. For

whoever passes in review the variety of subjects, and the beautiful apparatus collected and introduced by the mechanical arts for the service of mankind, will certainly be rather inclined to admire our wealth than to perceive our poverty: not considering that the observations of man and operations of nature (which are the souls and first movers of that variety) are few, and not of deep research; the rest must be attributed merely to man's patience, and the delicate and well-regulated motion of the hand or of instruments. To take an instance, the manufacture of clocks is delicate and accurate, and appears to imitate the heavenly bodies in its wheels, and the pulse of animals in its regular oscillation, yet it only depends upon one or two axioms of nature.

Again, if one consider the refinement of the liberal arts, or even that exhibited in the preparation of natural bodies in mechanical arts and the like, as the discovery of the heavenly motions in astronomy, of harmony in music, of the letters of the alphabet<sup>48</sup> (still unadopted by the Chinese) in grammar; or, again, in mechanical operations, the productions of Bacchus and Ceres, that is, the preparation of wine and beer, the making of bread, or even the luxuries of the table, distillation, and the like; if one reflect also, and consider for how long a period of ages (for all the above, except distillation, are ancient) these things have been brought to their present state of perfection, and (as we instanced in clocks) to how few observations and axioms of nature they may be referred, and how easily, and as it were, by obvious chance or contemplation, they might be discovered, one

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<sup>48</sup> The Chinese characters resemble, in many respects, the hieroglyphics of the Egyptians, being adapted to represent ideas, not sounds.

would soon cease to admire and rather pity the human lot on account of its vast want and dearth of things and discoveries for so many ages. Yet even the discoveries we have mentioned were more ancient than philosophy and the intellectual arts; so that (to say the truth) when contemplation and doctrinal science began, the discovery of useful works ceased.

But if any one turn from the manufactories to libraries, and be inclined to admire the immense variety of books offered to our view, let him but examine and diligently inspect the matter and contents of these books, and his astonishment will certainly change its object: for when he finds no end of repetitions, and how much men do and speak the same thing over again, he will pass from admiration of this variety to astonishment at the poverty and scarcity of matter, which has hitherto possessed and filled men's minds.

But if any one should condescend to consider such sciences as are deemed rather curious than sound, and take a full view of the operations of the alchemists or magii, he will perhaps hesitate whether he ought rather to laugh or to weep. For the alchemist cherishes eternal hope, and when his labors succeed not, accuses his own mistakes, deeming, in his self-accusation, that he has not properly understood the words of art or of his authors; upon which he listens to tradition and vague whispers, or imagines there is some slight unsteadiness in the minute details of his practice, and then has recourse to an endless repetition of experiments: and in the meantime, when, in his casual experiments, he falls upon something in appearance new, or of some degree of utility, he consoles himself with such an earnest, and ostentatiously publishes them, keeping up his hope of the final result. Nor can it be denied that the alche-

mists have made several discoveries, and presented mankind with useful inventions. But we may well apply to them the fable of the old man, who bequeathed to his sons some gold buried in his garden, pretending not to know the exact spot, whereupon they worked diligently in digging the vineyard, and though they found no gold, the vintage was rendered more abundant by their labor.

The followers of natural magic, who explain everything by sympathy and antipathy, have assigned false powers and marvellous operations to things by gratuitous and idle conjectures: and if they have ever produced any effects, they are rather wonderful and novel than of any real benefit or utility.

In superstitious magic (if we say anything at all about it) we must chiefly observe, that there are only some peculiar and definite objects with which the curious and superstitious arts have, in every nation and age, and even under every religion, been able to exercise and amuse themselves. Let us, therefore, pass them over. In the meantime we cannot wonder that the false notion of plenty should have occasioned want.

LXXXVI. The admiration of mankind with regard to the arts and sciences, which is of itself sufficiently simple and almost puerile, has been increased by the craft and artifices of those who have treated the sciences, and delivered them down to posterity. For they propose and produce them to our view so fashioned, and as it were masked, as to make them pass for perfect and complete. For if you consider their method and divisions, they appear to embrace and comprise everything which can relate to the subject. And although this frame be badly filled up and resemble an empty bladder, yet it presents to the vul-

gar understanding the form and appearance of a perfect science.

The first and most ancient investigators of truth were wont, on the contrary, with more honesty and success, to throw all the knowledge they wished to gather from contemplation, and to lay up for use, into aphorisms, or short scattered sentences unconnected by any method, and without pretending or professing to comprehend any entire art. But according to the present system, we cannot wonder that men seek nothing beyond that which is handed down to them as perfect, and already extended to its full complement.

LXXXVII. The ancient theories have received additional support and credit from the absurdity and levity of those who have promoted the new, especially in the active and practical part of natural philosophy. For there have been many silly and fantastical fellows who, from credulity or imposture, have loaded mankind with promises, announcing and boasting of the prolongation of life, the retarding of old age, the alleviation of pains, the remedying of natural defects, the deception of the senses, the restraint and excitement of the passions, the illumination and exaltation of the intellectual faculties, the transmutation of substances, the unlimited intensity and multiplication of motion, the impressions and changes of the air, the bringing into our power the management of celestial influences, the divination of future events, the representation of distant objects, the revelation of hidden objects, and the like. One would not be very wrong in observing with regard to such pretenders, that there is as much difference in philosophy, between their absurdity and real science, as there is in history between the exploits of Cæsar or Alexander, and those

of Amadis de Gaul and Arthur of Britain. For those illustrious generals are found to have actually performed greater exploits than such fictitious heroes are even pretended to have accomplished, by the means, however, of real action, and not by any fabulous and portentous power. Yet it is not right to suffer our belief in true history to be diminished, because it is sometimes injured and violated by fables. In the meantime we cannot wonder that great prejudice has been excited against any new propositions (especially when coupled with any mention of effects to be produced), by the conduct of impostors who have made a similar attempt; for their extreme absurdity, and the disgust occasioned by it, has even to this day overpowered every spirited attempt of the kind.

LXXXVIII. Want of energy, and the littleness and futility of the tasks that human industry has undertaken, have produced much greater injury to the sciences: and yet (to make it still worse) that very want of energy manifests itself in conjunction with arrogance and disdain.

For, in the first place, one excuse, now from its repetition become familiar, is to be observed in every art, namely, that its promoters convert the weakness of the art itself into a calumny upon nature: and whatever it in their hands fails to effect, they pronounce to be physically impossible. But how can the art ever be condemned while it acts as judge in its own cause? Even the present system of philosophy cherishes in its bosom certain positions or dogmas, which (it will be found on diligent inquiry) are calculated to produce a full conviction that no difficult, commanding, and powerful operation upon nature ought to be anticipated through the means of art; we instanced<sup>49</sup> above the alleged different

<sup>49</sup> See Axiom 75.

quality of heat in the sun and fire, and composition and mixture. Upon an accurate observation the whole tendency of such positions is wilfully to circumscribe man's power, and to produce a despair of the means of invention and contrivance, which would not only confound the promises of hope, but cut the very springs and sinews of industry, and throw aside even the chances of experience. The only object of such philosophers is to acquire the reputation of perfection for their own art, and they are anxious to obtain the most silly and abandoned renown, by causing a belief that whatever has not yet been invented and understood can never be so hereafter. But if any one attempt to give himself up to things, and to discover something new; yet he will only propose and destine for his object the investigation and discovery of some one invention, and nothing more; as the nature of the magnet, the tides, the heavenly system, and the like, which appear enveloped in some degree of mystery, and have hitherto been treated with but little success. Now it is the greatest proof of want of skill, to investigate the nature of any object in itself alone; for that same nature, which seems concealed and hidden in some instances, is manifest and almost palpable in others, and excites wonder in the former, while it hardly attracts attention in the latter.<sup>50</sup> Thus the nature of consistency is scarcely observed in wood or stone, but passed over by the term solid without any further inquiry about the repulsion of separation or the

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<sup>50</sup> The methods by which Newton carried the rule and compass to the boundaries of creation is a sufficient comment on the sagacity of the text. The same cause which globulizes a bubble, has rounded the earth, and the same law which draws a stone to its surface, keeps the moon in her orbit. It was by calculating and ascertaining these principles upon substances entirely at his disposal that this great philosopher was enabled to give us a key to unlock the mysteries of the universe.—*Ed.*

solution of continuity. But in water-bubbles the same circumstance appears matter of delicate and ingenious research, for they form themselves into thin pellicles, curiously shaped into hemispheres, so as for an instant to avoid the solution of continuity.

In general those very things which are considered as secret are manifest and common in other objects, but will never be clearly seen if the experiments and contemplation of man be directed to themselves only. Yet it commonly happens, that if, in the mechanical arts, any one bring old discoveries to a finer polish, or more elegant height of ornament, or unite and compound them, or apply them more readily to practice, or exhibit them on a less heavy and voluminous scale, and the like, they will pass off as new.

We cannot, therefore, wonder that no magnificent discoveries, worthy of mankind, have been brought to light, while men are satisfied and delighted with such scanty and puerile tasks, nay, even think that they have pursued or attained some great object in their accomplishment.

LXXXIX. Nor should we neglect to observe that natural philosophy has, in every age, met with a troublesome and difficult opponent: I mean superstition, and a blind and immoderate zeal for religion. For we see that, among the Greeks, those who first disclosed the natural causes of thunder and storms to the yet untrained ears of man were condemned as guilty of impiety toward the gods.<sup>61</sup> Nor did some of the old fathers of Christianity treat those much better who showed by the most positive proofs (such as no

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<sup>61</sup> See the "Clouds" of Aristophanes, where Socrates is represented as chasing Jupiter out of the sky, by resolving thunderstorms into aerial concussions and whirlwinds.—*Ed.*

one now disputes) that the earth is spherical, and thence asserted that there were antipodes.<sup>52</sup>

Even in the present state of things the condition of discussions on natural philosophy is rendered more difficult and dangerous by the summaries and methods of divines, who, after reducing divinity into such order as they could, and brought it into a scientific form, have proceeded to mingle an undue proportion of the contentious and thorny philosophy of Aristotle with the substance of religion.<sup>53</sup>

The fictions of those who have not feared to deduce and confirm the truth of the Christian religion by the principles and authority of philosophers, tend to the same end, though in a different manner.<sup>54</sup> They celebrate the union of faith and the senses as though it were legitimate, with great pomp and solemnity, and gratify men's pleasing minds with a variety, but in the meantime confound most improperly things divine and human. Moreover, in these mixtures of divinity and philosophy the received doctrines of the latter are alone included, and any novelty, even though it

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<sup>52</sup> Robespierre was the latest victim of this bigotry. In his younger days he attempted to introduce Franklin's lightning conductor into France, but was persecuted by those whose lives he sought to protect, as one audaciously striving to avert the designs of Providence.—*Ed.*

<sup>53</sup> We can hardly agree with the text. The scholastics, in building up a system of divinity, certainly had recourse to the deductive syllogism, because the inductive was totally inapplicable, except as a corroborative process. With regard to the technical form in which they marshalled their arguments, which is what our author aims at in his censure, they owed nothing at all to Aristotle, the conducting a dispute in naked syllogistic fashion having originated entirely with themselves.—*Ed.*

<sup>54</sup> Bacon cannot be supposed to allude to those divines who have attempted to show that the progress of physical science is confirmatory of revelation, but only to such as have built up a system of faith out of their own refinements on nature and revelation, as Patricius and Emanuel Swedenborg.—*Ed.*

be an improvement, scarcely escapes banishment and extermination.

In short, you may find all access to any species of philosophy, however pure, intercepted by the ignorance of divines. Some in their simplicity are apprehensive that a too deep inquiry into nature may penetrate beyond the proper bounds of decorum, transferring and absurdly applying what is said of sacred mysteries in Holy Writ against those who pry into divine secrets, to the mysteries of nature, which are not forbidden by any prohibition. Others with more cunning imagine and consider, that if secondary causes be unknown, everything may more easily be referred to the Divine hand and wand, a matter, as they think, of the greatest consequence to religion, but which can only really mean that God wishes to be gratified by means of falsehood. Others fear, from past example, lest motion and change in philosophy should terminate in an attack upon religion. Lastly, there are others who appear anxious lest there should be something discovered in the investigation of nature to overthrow, or at least shake, religion, particularly among the unlearned. The last two apprehensions appear to resemble animal instinct, as if men were diffident, in the bottom of their minds and secret meditations, of the strength of religion and the empire of faith over the senses, and therefore feared that some danger awaited them from an inquiry into nature. But any one who properly considers the subject will find natural philosophy to be, after the Word of God, the surest remedy against superstition, and the most approved support of faith. She is, therefore, rightly bestowed upon religion as a most faithful attendant, for the one exhibits the will and the other the power of God. Nor was he wrong who observed, "Ye err, not knowing the

Scriptures and the power of God," thus uniting in one bond the revelation of his will and the contemplation of his power. In the meanwhile, it is not wonderful that the progress of natural philosophy has been restrained, since religion, which has so much influence on men's minds, has been led and hurried to oppose her through the ignorance of some and the imprudent zeal of others.

XC. Again, in the habits and regulations of schools, universities, and the like assemblies, destined for the abode of learned men and the improvement of learning, everything is found to be opposed to the progress of the sciences; for the lectures and exercises are so ordered, that anything out of the common track can scarcely enter the thoughts and contemplations of the mind. If, however, one or two have perhaps dared to use their liberty, they can only impose the labor on themselves, without deriving any advantage from the association of others; and if they put up with this, they will find their industry and spirit of no slight disadvantage to them in making their fortune; for the pursuits of men in such situations are, as it were, chained down to the writings of particular authors, and if any one dare to dissent from them he is immediately attacked as a turbulent and revolutionary spirit. Yet how great is the difference between civil matters and the arts, for there is not the same danger from new activity and new light. In civil matters even a change for the better is suspected on account of the commotion it occasions, for civil government is supported by authority, unanimity, fame, and public opinion, and not by demonstration. In the arts and sciences, on the contrary, every department should resound, as in mines, with new works and advances. And this is the rational, though not the actual view of the case, for that administration and

government of science we have spoken of is wont too rigorously to repress its growth.

XCI. And even should the odium I have alluded to be avoided, yet it is sufficient to repress the increase of science that such attempts and industry pass unrewarded; for the cultivation of science and its reward belong not to the same individual. The advancement of science is the work of a powerful genius, the prize and reward belong to the vulgar or to princes, who (with a few exceptions) are scarcely moderately well informed. Nay, such progress is not only deprived of the rewards and beneficence of individuals, but even of popular praise; for it is above the reach of the generality, and easily overwhelmed and extinguished by the winds of common opinions. It is not wonderful, therefore, that little success has attended that which has been little honored.

XCII. But by far the greatest obstacle to the advancement of the sciences, and the undertaking of any new attempt or department, is to be found in men's despair and the idea of impossibility; for men of a prudent and exact turn of thought are altogether diffident in matters of this nature, considering the obscurity of nature, the shortness of life, the deception of the senses, and weakness of the judgment. They think, therefore, that in the revolutions of ages and of the world there are certain floods and ebbs of the sciences, and that they grow and flourish at one time, and wither and fall off at another, that when they have attained a certain degree and condition they can proceed no further.

If, therefore, any one believe or promise greater things, they impute it to an uncurbed and immature mind, and imagine that such efforts begin pleasantly, then become

laborious, and end in confusion. And since such thoughts easily enter the minds of men of dignity and excellent judgment, we must really take heed lest we should be captivated by our affection for an excellent and most beautiful object, and relax or diminish the severity of our judgment; and we must diligently examine what gleam of hope shines upon us, and in what direction it manifests itself, so that, banishing her lighter dreams, we may discuss and weigh whatever appears of more sound importance. We must consult the prudence of ordinary life, too, which is diffident upon principle, and in all human matters augurs the worst. Let us, then, speak of hope, especially as we are not vain promisers, nor are willing to enforce or insnare men's judgment, but would rather lead them willingly forward. And although we shall employ the most cogent means of enforcing hope when we bring them to particulars, and especially those which are digested and arranged in our Tables of Invention (the subject partly of the second, but principally of the fourth part of the Instauration), which are, indeed, rather the very object of our hopes than hope itself; yet to proceed more leniently we must treat of the preparation of men's minds, of which the manifestation of hope forms no slight part; for without it all that we have said tends rather to produce a gloom than to encourage activity or quicken the industry of experiment, by causing them to have a worse and more contemptuous opinion of things as they are than they now entertain, and to perceive and feel more thoroughly their unfortunate condition. We must, therefore, disclose and prefix our reasons for not thinking the hope of success improbable, as Columbus, before his wonderful voyage over the Atlantic, gave the reasons of his conviction that new lands and continents might be discovered besides those

already known; and these reasons, though at first rejected, were yet proved by subsequent experience, and were the causes and beginnings of the greatest events.

XCIII. Let us begin from God, and show that our pursuit from its exceeding goodness clearly proceeds from him, the author of good and father of light. Now, in all divine works the smallest beginnings lead assuredly to some result, and the remark in spiritual matters that "the kingdom of God cometh without observation," is also found to be true in every great work of Divine Providence, so that everything glides quietly on without confusion or noise, and the matter is achieved before men either think or perceive that it is commenced. Nor should we neglect to mention the prophecy of Daniel, of the last days of the world, "Many shall run to and fro, and knowledge shall be increased,"<sup>65</sup> thus plainly hinting and suggesting that fate (which is Providence) would cause the complete circuit of the globe (now accomplished, or at least going forward by means of so many distant voyages), and the increase of learning to happen at the same epoch.

XCIV. We will next give a most potent reason for hope deduced from the errors of the past, and the ways still unattempted; for well was an ill-governed state thus reprobred, "That which is worst with regard to the past should appear most consolatory for the future; for if you had done all that your duty commanded, and your affairs proceeded no better, you could not even hope for their improvement; but since their present unhappy situation is not owing to the force of circumstances, but to your own errors, you have reason to hope that by banishing or correcting the latter

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<sup>65</sup> Daniel xii. 4.

you can produce a great change for the better in the former." So if men had, during the many years that have elapsed, adhered to the right way of discovering and cultivating the sciences without being able to advance, it would be assuredly bold and presumptuous to imagine it possible to improve; but if they have mistaken the way and wasted their labor on improper objects, it follows that the difficulty does not arise from things themselves, which are not in our power, but from the human understanding, its practice and application, which is susceptible of remedy and correction. Our best plan, therefore, is to expose these errors; for in proportion as they impeded the past, so do they afford reason to hope for the future. And although we have touched upon them above, yet we think it right to give a brief, bare, and simple enumeration of them in this place.

XCV. Those who have treated of the sciences have been either empirics or dogmatical.<sup>56</sup> The former like ants only heap up and use their store, the latter like spiders spin out their own webs. The bee, a mean between both, extracts matter from the flowers of the garden and the field, but works and fashions it by its own efforts. The true labor of philosophy resembles hers, for it neither relies entirely or principally on the powers of the mind, nor yet lays up in the memory the matter afforded by the experiments of natural history and mechanics in its raw state, but changes and works it in the understanding. We have good reason,

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<sup>56</sup> Bacon, in this Aphorism, appears to have entertained a fair idea of the use of the inductive and deductive methods in scientific inquiry, though his want of geometrical knowledge must have hindered him from accurately determining the precise functions of each, as it certainly led him in other parts of the Organon (V. Aph. 82), to undervalue the deductive, and, as he calls it, the dogmatic method, and to rely too much upon empiricism.—*Ed.*

therefore, to derive hope from a closer and purer alliance of these faculties (the experimental and rational) than has yet been attempted.

XCVI. Natural philosophy is not yet to be found unadulterated, but is impure and corrupted—by logic in the school of Aristotle, by natural theology in that of Plato,<sup>57</sup> by mathematics in the second school of Plato (that of Proclus and others)<sup>58</sup> which ought rather to terminate natural philosophy than to generate or create it. We may, therefore, hope for better results from pure and unmixed natural philosophy.

XCVII. No one has yet been found possessed of sufficient firmness and severity to resolve upon and undertake the task of entirely abolishing common theories and notions, and applying the mind afresh, when thus cleared and levelled, to particular researches; hence our human reasoning is a mere farrago and crude mass made up of a great deal of credulity and accident, and the puerile notions it originally contracted.

<sup>57</sup> The reader may consult the note of the 23d Aphorism for the fault which Bacon censures, and, if he wish to pursue the subject further, may read Plato's *Timaeus*, where that philosopher explains his system in detail. Bacon, however, is hardly consistent in one part of his censure, for he also talks about the spirit and appetites of inanimate substances, and that so frequently, as to preclude the supposition that he is employing metaphor.—*Ed.*

<sup>58</sup> Proclus flourished about the beginning of the fifth century, and was the successor of Plotinus, Porphyry and Iamblicus, who, in the two preceding centuries, had revived the doctrines of Plato, and assailed the Christian religion. The allusion in the text must be assigned to Iamblicus, who, in the fourth century, had republished the Pythagorean theology of numbers, and endeavored to construct the world out of arithmetic, thinking everything could be solved by the aid of proportions and geometry. Bacon must not be understood in the text to censure the use but the abuse of mathematics and physical investigations, as in the "De Augmentis" (lib. iv. c. 6), he enumerates the multiplicity of demonstration scientific facts admit of, from this source.—*Ed.*

But if a man of mature age, unprejudiced senses, and clear mind, would betake himself anew to experience and particulars, we might hope much more from such a one; in which respect we promise ourselves the fortune of Alexander the Great, and let none accuse us of vanity till they have heard the tale, which is intended to check vanity.

For Æschines spoke thus of Alexander and his exploits: "We live not the life of mortals, but are born at such a period that posterity will relate and declare our prodigies"; as if he considered the exploits of Alexander to be miraculous.

But in succeeding ages<sup>59</sup> Livy took a better view of the fact, and has made some such observation as this upon Alexander: "That he did no more than dare to despise insignificance." So in our opinion posterity will judge of us, that we have achieved no great matters, but only set less account upon what is considered important; for the meantime (as we have before observed) our only hope is in the regeneration of the sciences, by regularly raising them on the foundation of experience and building them anew, which I think none can venture to affirm to have been already done or even thought of.

XCVIII. The foundations of experience (our sole resource) have hitherto failed completely or have been very weak; nor has a store and collection of particular facts, capable of informing the mind or in any way satisfactory, been either sought after or amassed. On the contrary, learned, but idle and indolent, men have received some

<sup>59</sup> See Livy. lib. x. c. 17, where, in a digression on the probable effect of a contest between Rome and Alexander the Great, he says: "Non cum Dario rem esse dixisset: quem mulierum ac spadonum agmen trahentem inter purpuram atque aurum, oneratum fortunæ apparatibus, priedam verius quam hostem, nihil aliud quam ausus vana contemnere, incurvatus devicit."

mere reports of experience, traditions as it were of dreams, as establishing or confirming their philosophy, and have not hesitated to allow them the weight of legitimate evidence. So that a system has been pursued in philosophy with regard to experience resembling that of a kingdom or state which would direct its councils and affairs according to the gossip of city and street politicians, instead of the letters and reports of ambassadors and messengers worthy of credit. Nothing is rightly inquired into, or verified, noted, weighed, or measured, in natural history; indefinite and vague observation produces fallacious and uncertain information. If this appear strange, or our complaint somewhat too unjust (because Aristotle himself, so distinguished a man and supported by the wealth of so great a king, has completed an accurate history of animals, to which others with greater diligence but less noise have made considerable additions, and others again have composed copious histories and notices of plants, metals, and fossils), it will arise from a want of sufficiently attending to and comprehending our present observations; for a natural history compiled on its own account, and one collected for the mind's information as a foundation for philosophy, are two different things. They differ in several respects, but principally in this—the former contains only the varieties of natural species without the experiments of mechanical arts; for as in ordinary life every person's disposition, and the concealed feelings of the mind and passions are most drawn out when they are disturbed—so the secrets of nature betray themselves more readily when tormented by art than when left to their own course. We must begin, therefore, to entertain hopes of natural philosophy then only, when we have a better compilation of natural history, its real basis and support.

**XCIX.** Again, even in the abundance of mechanical experiments, there is a very great scarcity of those which best inform and assist the understanding. For the mechanic, little solicitous about the investigation of truth, neither directs his attention, nor applies his hand to anything that is not of service to his business. But our hope of further progress in the sciences will then only be well founded, when numerous experiments shall be received and collected into natural history, which, though of no use in themselves, assist materially in the discovery of causes and axioms; which experiments we have termed enlightening, to distinguish them from those which are profitable. They possess this wonderful property and nature, that they never deceive or fail you; for being used only to discover the natural cause of some object, whatever be the result, they equally satisfy your aim by deciding the question.

C. We must not only search for, and procure a greater number of experiments, but also introduce a completely different method, order, and progress of continuing and promoting experience. For vague and arbitrary experience is (as we have observed), mere groping in the dark, and rather astonishes than instructs. But when experience shall proceed regularly and uninterruptedly by a determined rule, we may entertain better hopes of the sciences.

CI. But after having collected and prepared an abundance and store of natural history, and of the experience required for the operations of the understanding or philosophy, still the understanding is as incapable of acting on such materials of itself, with the aid of memory alone, as any person would be of retaining and achieving, by memory, the computation of an almanac. Yet meditation has hitherto done more for discovery than writing, and no

experiments have been committed to paper. We cannot, however, approve of any mode of discovery without writing, and when that comes into more general use, we may have further hopes.

CII. Besides this, there is such a multitude and host, as it were, of particular objects, and lying so widely dispersed, as to distract and confuse the understanding; and we can, therefore, hope for no advantage from its skirmishing, and quick movements and incursions, unless we put its forces in due order and array, by means of proper and well arranged, and, as it were, living tables of discovery of these matters, which are the subject of investigation, and the mind then apply itself to the ready prepared and digested aid which such tables afford.

CIII. When we have thus properly and regularly placed before the eyes a collection of particulars, we must not immediately proceed to the investigation and discovery of new particulars or effects, or, at least, if we do so, must not rest satisfied therewith. For, though we do not deny that by transferring the experiments from one art to another (when all the experiments of each have been collected and arranged, and have been acquired by the knowledge, and subjected to the judgment of a single individual), many new experiments may be discovered tending to benefit society and mankind, by what we term literate experience; yet comparatively insignificant results are to be expected thence, while the more important are to be derived from the new light of axioms, deduced by certain method and rule from the above particulars, and pointing out and defining new particulars in their turn. Our road is not a long plain, but rises and falls, ascending to axioms, and descending to effects.

CIV. Nor can we suffer the understanding to jump and fly from particulars to remote and most general axioms (such as are termed the principles of arts and things), and thus prove and make out their intermediate axioms according to the supposed unshaken truth of the former. This, however, has always been done to the present time from the natural bent of the understanding, educated too, and accustomed to this very method, by the syllogistic mode of demonstration. But we can then only augur well for the sciences, when the assent shall proceed by a true scale and successive steps, without interruption or breach, from particulars to the lesser axioms, thence to the intermediate (rising one above the other), and lastly, to the most general. For the lowest axioms differ but little from bare experiment;<sup>60</sup> the highest and most general (as they are esteemed at present), are notional, abstract, and of no real weight. The intermediate are true, solid, full of life, and upon them depend the business and fortune of mankind; beyond these are the really general, but not abstract, axioms, which are truly limited by the intermediate.

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<sup>60</sup> The lowest axioms are such as spring from simple experience—such as in chemistry, that animal substances yield no fixed salt by calcination; in music, that concords intermixed with discords make harmony, etc. Intermediate axioms advance a step further, being the result of reflection, which, applied to our experimental knowledge, deduces laws from them, such as in optics of the first degree of generality, that the angle of incidence is equal to the angle of reflection; and in mechanics, Kepler's three laws of motion, while his general law, that all bodies attract each other with forces proportional to their masses, and inversely as the squares of their distances, may be taken as one of the highest axioms. Yet so far is this principle from being only notional or abstract, it has presented us with a key which fits into the intricate wards of the heavens, and has laid bare to our gaze the principal mechanism of the universe. But natural philosophy in Bacon's day had not advanced beyond intermediate axioms, and the term notional or abstract is applied to those general axioms then current, not founded on the solid principles of inductive inquiry, but based upon *a priori* reasoning and airy metaphysics.—*Ed.*

We must not then add wings, but rather lead and ballast to the understanding, to prevent its jumping or flying, which has not yet been done; but whenever this takes place, we may entertain greater hopes of the sciences.

CV. In forming axioms, we must invent a different form of induction from that hitherto in use; not only for the proof and discovery of principles (as they are called), but also of minor, intermediate, and, in short, every kind of axioms. The induction which proceeds by simple enumeration is puerile, leads to uncertain conclusions, and is exposed to danger from one contradictory instance, deciding generally from too small a number of facts, and those only the most obvious. But a really useful induction for the discovery and demonstration of the arts and sciences, should separate nature by proper rejections and exclusions, and then conclude for the affirmative, after collecting a sufficient number of negatives. Now this has not been done, nor even attempted, except perhaps by Plato, who certainly uses this form of induction in some measure, to sift definitions and ideas. But much of what has never yet entered the thoughts of man must necessarily be employed, in order to exhibit a good and legitimate mode of induction or demonstration, so as even to render it essential for us to bestow more pains upon it than have hitherto been bestowed on syllogisms. The assistance of induction is to serve us not only in the discovery of axioms, but also in defining our notions. Much indeed is to be hoped from such an induction as has been described.

CVI. In forming our axioms from induction, we must examine and try whether the axiom we derive be only fitted and calculated for the particular instances from which it is

deduced, or whether it be more extensive and general. If it be the latter, we must observe, whether it confirm its own extent and generality by giving surety, as it were, in pointing out new particulars, so that we may neither stop at actual discoveries, nor with a careless grasp catch at shadows and abstract forms, instead of substances of a determinate nature: and as soon as we act thus, well authorized hope may with reason be said to beam upon us.

CVII. Here, too, we may again repeat what we have said above, concerning the extending of natural philosophy and reducing particular sciences to that one, so as to prevent any schism or dismembering of the sciences; without which we cannot hope to advance.

CVIII. Such are the observations we would make in order to remove despair and excite hope, by bidding farewell to the errors of past ages, or by their correction. Let us examine whether there be other grounds for hope. And, first, if many useful discoveries have occurred to mankind by chance or opportunity, without investigation or attention on their part, it must necessarily be acknowledged that much more may be brought to light by investigation and attention, if it be regular and orderly, not hasty and interrupted. For although it may now and then happen that one falls by chance upon something that had before escaped considerable efforts and laborious inquiries, yet undoubtedly the reverse is generally the case. We may, therefore, hope for further, better, and more frequent results from man's reason, industry, method, and application, than from chance and mere animal instinct, and the like, which have hitherto been the sources of invention.

CIX. We may also derive some reason for hope from the circumstance of several actual inventions being of such a

nature, that scarcely any one could have formed a conjecture about them previously to their discovery, but would rather have ridiculed them as impossible. For men are wont to guess about new subjects from those they are already acquainted with, and the hasty and vitiated fancies they have thence formed: than which there cannot be a more fallacious mode of reasoning, because much of that which is derived from the sources of things does not flow in their usual channel.

If, for instance, before the discovery of cannon, one had described its effects in the following manner: There is a new invention by which walls and the greatest bulwarks can be shaken and overthrown from a considerable distance; men would have begun to contrive various means of multiplying the force of projectiles and machines by means of weights and wheels, and other modes of battering and projecting. But it is improbable that any imagination or fancy would have hit upon a fiery blast, expanding and developing itself so suddenly and violently, because none would have seen an instance at all resembling it, except perhaps in earthquakes or thunder, which they would have immediately rejected as the great operations of nature, not to be imitated by man.

So, if before the discovery of silk thread, any one had observed, That a species of thread had been discovered, fit for dresses and furniture, far surpassing the thread of worsted or flax in fineness, and at the same time in tenacity, beauty, and softness; men would have begun to imagine something about Chinese plants, or the fine hair of some animals, or the feathers or down of birds, but certainly would never have had an idea of its being spun by a small worm, in so copious a manner, and renewed annually. But if any one had ventured to suggest the silkworm, he would

have been laughed at as if dreaming of some new manufacture from spiders.

So again, if before the discovery of the compass, any one had said, That an instrument had been invented, by which the quarters and points of the heavens could be exactly taken and distinguished, men would have entered into disquisitions on the refinement of astronomical instruments, and the like, from the excitement of their imaginations; but the thought of anything being discovered, which, not being a celestial body, but a mere mineral or metallic substance, should yet in its motion agree with that of such bodies, would have appeared absolutely incredible. Yet were these facts, and the like (unknown for so many ages) not discovered at last either by philosophy or reasoning, but by chance and opportunity; and (as we have observed), they are of a nature most heterogeneous, and remote from what was hitherto known, so that no previous knowledge could lead to them.

We may, therefore, well hope<sup>61</sup> that many excellent and useful matters are yet treasured up in the bosom of nature, bearing no relation or analogy to our actual discoveries, but out of the common track of our imagination, and still undiscovered, and which will doubtless be brought to light in the course and lapse of years, as the others have been before them; but in the way we now point out, they may rapidly and at once be both represented and anticipated.

CX. There are, moreover, some inventions which render

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<sup>61</sup> This hope has been abundantly realized in the discovery of gravity and the decomposition of light, mainly by the inductive method. To a better philosophy we may also attribute the discovery of electricity, galvanism and their mutual connection with each other, and magnetism, the inventions of the air-pump, steam-engine and the chronometer.

it probable that men may pass and hurry over the most noble discoveries which lie immediately before them. For however the discovery of gunpowder, silk, the compass, sugar, paper, or the like, may appear to depend on peculiar properties of things and nature, printing at least involves no contrivance which is not clear and almost obvious. But from want of observing that although the arrangement of the types of letters required more trouble than writing with the hand, yet these types once arranged serve for innumerable impressions, while manuscript only affords one copy; and again, from want of observing that ink might be thickened so as to stain without running (which was necessary, seeing the letters face upward, and the impression is made from above), this most beautiful invention (which assists so materially the propagation of learning) remained unknown for so many ages.

The human mind is often so awkward and ill-regulated in the career of invention that it is at first diffident, and then despises itself. For it appears at first incredible that any such discovery should be made, and when it has been made, it appears incredible that it should so long have escaped men's research. All which affords good reason for the hope that a vast mass of inventions yet remains, which may be deduced not only from the investigation of new modes of operation, but also from transferring, comparing, and applying these already known, by the method of what we have termed literate experience.

CXI. Nor should we omit another ground of hope. Let men only consider (if they will) their infinite expenditure of talent, time, and fortune, in matters and studies of far inferior importance and value; a small portion of which applied to sound and solid learning would be sufficient to over-

come every difficulty. And we have thought right to add this observation, because we candidly own that such a collection of natural and experimental history as we have traced in our own mind, and as is really necessary, is a great and as it were royal work, requiring much labor and expense.

CXII. In the meantime let no one be alarmed at the multitude of particulars, but rather inclined to hope on that very account. For the particular phenomena of the arts and nature are in reality but as a handful, when compared with the fictions of the imagination removed and separated from the evidence of facts. The termination of our method is clear, and I had almost said near at hand; the other admits of no termination, but only of infinite confusion. For men have hitherto dwelt but little, or rather only slightly touched upon experience, while they have wasted much time on theories and the fictions of the imagination. If we had but any one who could actually answer our interrogations of nature, the invention of all causes and sciences would be the labor of but a few years.

CXIII. We think some ground of hope is afforded by our own example, which is not mentioned for the sake of boasting, but as a useful remark. Let those who distrust their own powers observe myself, one who have among my contemporaries been the most engaged in public business, who am not very strong in health (which causes a great loss of time), and am the first explorer of this course, following the guidance of none, nor even communicating my thoughts to a single individual; yet having once firmly entered in the right way, and submitting the powers of my mind to things, I have somewhat advanced (as I make bold to think) the matter I now treat of. Then let others consider what may

be hoped from men who enjoy abundant leisure, from united labors, and the succession of ages, after these suggestions on our part, especially in a course which is not confined, like theories, to individuals, but admits of the best distribution and union of labor and effect, particularly in collecting experiments. For men will then only begin to know their own power, when each performs a separate part, instead of undertaking in crowds the same work.

CXIV. Lastly, though a much more faint and uncertain breeze of hope were to spring up from our new continent, yet we consider it necessary to make the experiment, if we would not show a dastard spirit. For the risk attending want of success is not to be compared with that of neglecting the attempt; the former is attended with the loss of a little human labor, the latter with that of an immense benefit. For these and other reasons it appears to us that there is abundant ground to hope, and to induce not only those who are sanguine to make experiment, but even those who are cautious and sober to give their assent.

CXV. Such are the grounds for banishing despair, hitherto one of the most powerful causes of the delay and restraint to which the sciences have been subjected; in treating of which we have at the same time discussed the signs and causes of the errors, idleness, and ignorance that have prevailed; seeing especially that the more refined causes, which are not open to popular judgment and observation, may be referred to our remarks on the idols of the human mind.

Here, too, we should close the demolishing branch of our Instauration, which is comprised in three confutations: ① the confutation of natural human reason left to itself; ② the confutation of demonstration; ③ the confutation of theories,

or received systems of philosophy and doctrines. Our confutation has followed such a course as was open to it, namely, the exposing of the signs of error, and the producing evidence of the causes of it: for we could adopt no other, differing as we do both in first principles and demonstrations from others.

It is time for us therefore to come to the art itself, and the rule for the interpretation of nature: there is, however, still something which must not be passed over. For the intent of this first book of aphorisms being to prepare the mind for understanding, as well as admitting, what follows, we must now, after having cleansed, polished, and levelled its surface, place it in a good position, and as it were a benevolent aspect toward our propositions; seeing that prejudice in new matters may be produced not only by the strength of preconceived notions, but also by a false anticipation or expectation of the matter proposed. We shall therefore endeavor to induce good and correct opinions of what we offer, although this be only necessary for the moment, and as it were laid out at interest, until the matter itself be well understood.

CXVI. First, then, we must desire men not to suppose that we are ambitious of founding any philosophical sect, like the ancient Greeks, or some moderns, as Telesius, Patricius, and Severinus.<sup>62</sup> For neither is this our intention,

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<sup>62</sup> As Bacon very frequently cites these authors, a slight notice of their labors may not be unacceptable to the reader. Bernardinus Telesius, born at Cosenza, in 1508, combated the Aristotelian system in a work entitled "De Rerum Natura juxta propria principia," i.e., according to principles of his own. The proem of the work announces his design was to show that "the construction of the world, the magnitude and nature of the bodies contained in it, are not to be investigated by reasoning, which was done by the ancients, but are to be apprehended by the senses, and collected from the things themselves." He

nor do we think that peculiar abstract opinions on nature and the principles of things are of much importance to men's fortunes, since it were easy to revive many ancient theories, and to introduce many new ones; as, for instance, many hypotheses with regard to the heavens can be formed, differing in themselves, and yet sufficiently according with the phenomena.

We bestow not our labor on such theoretical and, at the same time, useless topics. On the contrary, our determination is that of trying, whether we can lay a firmer foundation, and extend to a greater distance the boundaries of human power and dignity. And although here and there, upon some particular points, we hold (in our own opinion) more true and certain, and I might even say, more advantageous tenets than those in general repute (which we have collected in the fifth part of our *Instauratio*), yet we offer

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had, however, no sooner laid down this principle than he departed from it in practice, and pursued the deductive method he so much condemned in his predecessors. His first step was an assumption of principles as arbitrary as any of the empirical notions of antiquity; at the outset of his book he very quietly takes it for granted that heat is the principle of motion, cold of immobility, matter being assumed as the corporeal substratum, in which these incorporeal and active agents carry on their operations. Out of these abstract and ill-defined conceptions Telesius builds up a system quite as complete, symmetrical, and imaginative as any of the structures of antiquity.

Francis Patricius, born at Cherso, in Dalmatia, about 1529, was another physicist who rose up against Aristotle, and announced the dawn of a new philosophy. In 1593 appeared his "Nova de Universis Philosophia." He lays down a string of axioms, in which scholastic notions, physical discoveries, and theological dogmas, are strangely commingled, and erects upon them a system which represents all the grotesque features of theological empiricism.

Severinus, born in Jutland, in 1529, published an attack on Aristotle's natural history, but adopted fantasies which the Stagyrite ridiculed in his own day. He was a follower of Paracelsus, a Swiss enthusiast of the fifteenth century, who ignored the ancient doctrine of the four elements for salt, sulphur and mercury, and allied chemistry and medicine with mysticism.—*Ed.*

no universal or complete theory. The time does not yet appear to us to be arrived, and we entertain no hope of our life being prolonged to the completion of the sixth part of the Instauration (which is destined for philosophy discovered by the interpretation of nature), but are content if we proceed quietly and usefully in our intermediate pursuit, scattering, in the meantime, the seeds of less adulterated truth for posterity, and, at least, commence the great work.

CXVII. And, as we pretend not to found a sect, so do we neither offer nor promise particular effects; which may occasion some to object to us, that since we so often speak of effects, and consider everything in its relation to that end, we ought also to give some earnest of producing them. Our course and method, however (as we have often said, and again repeat), is such as not to deduce effects from effects, nor experiments from experiments (as the empirics do), but in our capacity of legitimate interpreters of nature, to deduce causes and axioms from effects and experiments; and new effects and experiments from those causes and axioms.

And although any one of moderate intelligence and ability will observe the indications and sketches of many noble effects in our tables of inventions (which form the fourth part of the Instauration), and also in the examples of particular instances cited in the second part, as well as in our observations on history (which is the subject of the third part); yet we candidly confess that our present natural history, whether compiled from books or our own inquiries, is not sufficiently copious and well ascertained to satisfy, or even assist, a proper interpretation.

If, therefore, there be any one who is more disposed and prepared for mechanical art, and ingenious in discovering effects, than in the mere management of experiment, we

allow him to employ his industry in gathering many of the fruits of our history and tables in this way, and applying them to effects, receiving them as interest till he can obtain the principal. For our own part, having a greater object in view, we condemn all hasty and premature rest in such pursuits as we would Atalanta's apple (to use a common allusion of ours); for we are not childishly ambitious of golden fruit, but use all our efforts to make the course of art outstrip nature, and we hasten not to reap moss or the green blade, but wait for a ripe harvest.

CXVIII. There will be some, without doubt, who, on a perusal of our history and tables of invention, will meet with some uncertainty, or perhaps fallacy, in the experiments themselves, and will thence perhaps imagine that our discoveries are built on false foundations and principles. There is, however, really nothing in this, since it must needs happen in beginnings.<sup>63</sup> For it is the same as if in writing or printing one or two letters were wrongly turned or misplaced, which is no great inconvenience to the reader, who can easily by his own eye correct the error; let men in the same way conclude, that many experiments in natural history may be erroneously believed and admitted, which are easily expunged and rejected afterward, by the discovery of causes and axioms. It is, however, true, that if these errors in natural history and experiments become great, frequent, and continued, they cannot be corrected and amended by

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<sup>63</sup> Bacon's apology is sound, and completely answers those German and French critics, who have refused him a niche in the philosophical pantheon. One German commentator, too modest to reveal his name, accuses Bacon of ignorance of the calculus, though, in his day, Wallis had not yet stumbled upon the laws of continuous fractions; while Count de Maistre, in a coarse attack upon his genius, expresses his astonishment at finding Bacon unacquainted with discoveries which were not heard of till a century after his death.—*Ed.*

any dexterity of wit or art. If then, even in our natural history, well examined and compiled with such diligence, strictness, and (I might say) reverential scruples, there be now and then something false and erroneous in the details, what must we say of the common natural history, which is so negligent and careless when compared with ours? or of systems of philosophy and the sciences, based on such loose soil (or rather quicksand)? Let none then be alarmed by such observations.

CXIX. Again, our history and experiments will contain much that is light and common, mean and illiberal, too refined and merely speculative, and, as it were, of no use, and this perhaps may divert and alienate the attention of mankind.

With regard to what is common; let men reflect, that they have hitherto been used to do nothing but refer and adapt the causes of things of rare occurrence to those of things which more frequently happen, without any investigation of the causes of the latter, taking them for granted and admitted.

Hence, they do not inquire into the causes of gravity, the rotation of the heavenly bodies, heat, cold, light, hardness, softness, rarity, density, liquidity, solidity, animation, inanimation, similitude, difference, organic formation, but taking them to be self-evident, manifest, and admitted, they dispute and decide upon other matters of less frequent and familiar occurrence.

But we (who know that no judgment can be formed of that which is rare or remarkable, and much less anything new brought to light, without a previous regular examination and discovery of the causes of that which is common, and the causes again of those causes) are necessarily com-

elled to admit the most common objects into our history. Besides, we have observed that nothing has been so injurious to philosophy as this circumstance, namely, that familiar and frequent objects do not arrest and detain men's contemplation, but are carelessly admitted, and their causes never inquired after; so that information on unknown subjects is not more often wanted than attention to those which are known.

CXX. With regard to the meanness, or even the filthiness of particulars, for which (as Pliny observes), an apology is requisite, such subjects are no less worthy of admission into natural history than the most magnificent and costly; nor do they at all pollute natural history, for the sun enters alike the palace and the privy, and is not thereby polluted. We neither dedicate nor raise a capitol or pyramid to the pride of man, but rear a holy temple in his mind, on the model of the universe, which model therefore we imitate. For that which is deserving of existence is deserving of knowledge, the image of existence. Now the mean and splendid alike exist. Nay, as the finest odors are sometimes produced from putrid matter (such as musk and civet), so does valuable light and information emanate from mean and sordid instances. But we have already said too much, for such fastidious feelings are childish and effeminate.

CXXI. The next point requires a more accurate consideration, namely, that many parts of our history will appear to the vulgar, or even any mind accustomed to the present state of things, fantastically and uselessly refined. Hence, we have in regard to this matter said from the first, and must again repeat, that we look for experiments that shall afford light rather than profit, imitating the divine creation, which,

as we have often observed, only produced light on the first day, and assigned that whole day to its creation, without adding any material work.

If any one, then, imagine such matters to be of no use, he might equally suppose light to be of no use, because it is neither solid nor material. For, in fact, the knowledge of simple natures, when sufficiently investigated and defined, resembles light, which, though of no great use in itself, affords access to the general mysteries of effects, and with a peculiar power comprehends and draws with it whole bands and troops of effects, and the sources of the most valuable axioms. So also the elements of letters have of themselves separately no meaning, and are of no use, yet are they, as it were, the original matter in the composition and preparation of speech. The seeds of substances, whose effect is powerful, are of no use except in their growth, and the scattered rays of light itself avail not unless collected.

But if speculative subtleties give offence, what must we say of the scholastic philosophers who indulged in them to such excess? And those subtleties were wasted on words, or, at least, common notions (which is the same thing), not on things or nature, and alike unproductive of benefit in their origin and their consequences: in no way resembling ours, which are at present useless, but in their consequences of infinite benefit. Let men be assured that all subtle disputes and discursive efforts of the mind are late and preposterous, when they are introduced subsequently to the discovery of axioms, and that their true, or, at any rate, chief opportunity is, when experiment is to be weighed and axioms to be derived from it. They otherwise catch and grasp at nature, but never seize or detain her: and we may well apply to nature that which has been said of opportunity

or fortune, that she wears a lock in front, but is bald behind.

In short, we may reply decisively to those who despise any part of natural history as being vulgar, mean, or subtle, and useless in its origin, in the words of a poor woman to a haughty prince,<sup>“</sup> who had rejected her petition as unworthy, and beneath the dignity of his majesty: “Then cease to reign”; for it is quite certain that the empire of nature can neither be obtained nor administered by one who refuses to pay attention to such matters as being poor and too minute.

CXXII. Again, it may be objected to us as being singular and harsh, that we should with one stroke and assault, as it were, banish all authorities and sciences, and that too by our own efforts, without requiring the assistance and support of any of the ancients.

Now we are aware, that had we been ready to act otherwise than sincerely, it was not difficult to refer our present method to remote ages, prior to those of the Greeks (since the sciences in all probability flourished more in their natural state, though silently, than when they were paraded with the fifes and trumpets of the Greeks); or even (in parts, at least) to some of the Greeks themselves, and to derive authority and honor from thence; as men of no family labor to raise and form nobility for themselves in some ancient line, by the help of genealogies. Trusting, however, to the evidence of facts, we reject every kind of fiction and imposture; and think it of no more consequence to our subject, whether future discoveries were known to the ancients, and set or rose according to the vicissitudes of events and

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<sup>“</sup> Philip of Macedon.

lapse of ages, than it would be of importance to mankind to know whether the new world be the island of Atlantis,<sup>65</sup> and known to the ancients, or be now discovered for the first time.

With regard to the universal censure we have bestowed, it is quite clear, to any one who properly considers the matter, that it is both more probable and more modest than any partial one could have been. For if the errors had not been rooted in the primary notions, some well conducted discoveries must have corrected others that were deficient. But since the errors were fundamental, and of such a nature, that men may be said rather to have neglected or passed over things, than to have formed a wrong or false judgment of them, it is little to be wondered at, that they did not obtain what they never aimed at, nor arrive at a goal which they had not determined, nor perform a course which they had neither entered upon nor adhered to.

With regard to our presumption, we allow that if we were to assume a power of drawing a more perfect straight line or circle than any one else, by superior steadiness of hand or acuteness of eye, it would lead to a comparison of talent; but if one merely assert that he can draw a more perfect line or circle with a ruler or compasses, than another can by his unassisted hand or eye, he surely cannot be said to boast of much. Now this applies not only to our first original attempt, but also to those who shall hereafter apply themselves to the pursuit. For our method of discovering the sciences merely levels men's wits, and leaves but little to their superiority, since it achieves everything by the most certain rules and demonstrations. Whence (as we have

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<sup>65</sup> See Plato's Timæus.

often observed), our attempt is to be attributed to fortune rather than talent, and is the offspring of time rather than of wit. For a certain sort of chance has no less effect upon our thoughts than on our acts and deeds.

CXXIII. We may, therefore, apply to ourselves the joke of him who said, that water and wine drinkers could not think alike,<sup>66</sup> especially as it hits the matter so well. For others, both ancients and moderns, have in the sciences drank a crude liquor like water, either flowing of itself from the understanding, or drawn up by logic as the wheel draws up the bucket. But we drink and pledge others with a liquor made of many well-ripened grapes, collected and plucked from particular branches, squeezed in the press, and at last clarified and fermented in a vessel. It is not, therefore, wonderful that we should not agree with others.

CXXIV. Another objection will without doubt be made, namely, that we have not ourselves established a correct, or the best goal or aim of the sciences (the very defect we blame in others). For they will say that the contemplation of truth is more dignified and exalted than any utility or extent of effects; but that our dwelling so long and anxiously on experience and matter, and the fluctuating state of particulars, fastens the mind to earth, or rather casts it down into an abyss of confusion and disturbance, and separates and removes it from a much more divine state, the quiet and tranquillity of abstract wisdom. We willingly assent to their reasoning, and are most anxious to effect the very point they hint at and require. For we are founding a real model of the world in the understanding, such as it is found to be, not such as man's reason has distorted.

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<sup>66</sup> The saying of Philocrates when he differed from Demosthenes.—*Ed.*

Now this cannot be done without dissecting and anatomizing the world most diligently; but we declare it necessary to destroy completely the vain, little and, as it were, apish imitations of the world, which have been formed in various systems of philosophy by men's fancies. Let men learn (as we have said above) the difference that exists between the idols of the human mind and the ideas of the divine mind. The former are mere arbitrary abstractions; the latter the true marks of the Creator on his creatures, as they are imprinted on, and defined in matter, by true and exquisite touches. Truth, therefore, and utility, are here perfectly identical, and the effects are of more value as pledges of truth than from the benefit they confer on men.

CXXV. Others may object that we are only doing that which has already been done, and that the ancients followed the same course as ourselves. They may imagine, therefore, that, after all this stir and exertion, we shall at last arrive at some of those systems that prevailed among the ancients: for that they, too, when commencing their meditations, laid up a great store of instances and particulars, and digested them under topics and titles in their commonplace books, and so worked out their systems and arts, and then decided upon what they discovered, and related now and then some examples to confirm and throw light upon their doctrine; but thought it superfluous and troublesome to publish their notes, minutes, and commonplaces, and therefore followed the example of builders who remove the scaffolding and ladders when the building is finished. Nor can we indeed believe the case to have been otherwise. But to any one, not entirely forgetful of our previous observations, it will be easy to answer this objection or rather

scruple; for we allow that the ancients had a particular form of investigation and discovery, and their writings show it. But it was of such a nature, that they immediately flew from a few instances and particulars (after adding some common notions, and a few generally received opinions most in vogue) to the most general conclusions or the principles of the sciences, and then by their intermediate propositions deduced their inferior conclusions, and tried them by the test of the immovable and settled truth of the first, and so constructed their art. Lastly, if some new particulars and instances were brought forward, which contradicted their dogmas, they either with great subtlety reduced them to one system, by distinctions or explanations of their own rules, or got rid of them clumsily as exceptions, laboring most pertinaciously in the meantime to accommodate the causes of such as were not contradictory to their own principles. Their natural history and their experience were both far from being what they ought to have been, and their flying off to generalities ruined everything.

CXXVI. Another objection will be made against us, that we prohibit decisions and the laying down of certain principles, till we arrive regularly at generalities by the intermediate steps, and thus keep the judgment in suspense and lead to uncertainty. But our object is not uncertainty but fitting certainty, for we derogate not from the senses but assist them, and despise not the understanding but direct it. It is better to know what is necessary, and not to imagine we are fully in possession of it, than to imagine that we are fully in possession of it, and yet in reality to know nothing which we ought.

CXXVII. Again, some may raise this question rather than objection, whether we talk of perfecting natural phi-

losophy alone according to our method, or the other sciences also, such as logic, ethics, polities. We certainly intend to comprehend them all. And as common logic, which regulates matters by syllogisms, is applied not only to natural, but also to every other science, so our inductive method likewise comprehends them all.<sup>67</sup> For we form a history and tables of invention for anger, fear, shame, and the like, and also for examples in civil life, and the mental operations of memory, composition, division, judgment, and the rest, as well as for heat and cold, light, vegetation, and the like. But since our method of interpretation, after preparing and arranging a history, does not content itself with examining the operations and disquisitions of the mind like common logic, but also inspects the nature of things, we so regulate the mind that it may be enabled to apply itself in every respect correctly to that nature. On that account we deliver numerous and various precepts in our doctrine of interpretation, so that they may apply in some

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<sup>67</sup> The old error of placing the deductive syllogism in antagonism to the inductive, as if they were not both parts of one system or refused to cohere together. So far from there being any radical opposition between them, it would not be difficult to show that Bacon's method was syllogistic in his sense of the term. For the suppressed premise of every Baconian enthymeme, viz., the acknowledged uniformity of the laws of nature as stated in the axiom, whatever has once occurred will occur again, must be assumed as the basis of every conclusion which he draws before we can admit its legitimacy. The opposition, therefore, of Bacon's method could not be directed against the old logic, for it assumed and exemplified its principles, but rather to the abusive application which the ancients made of this science, in turning its powers to the development of abstract principles which they imagined to be pregnant with the solution of the latent mysteries of the universe. Bacon justly overthrew these ideal notions, and accepted of no principle as a basis which was not guaranteed by actual experiment and observation; and so far he laid the foundations of a sound philosophy by turning the inductive logic to its proper account in the interpretation of nature.

measure to the method of discovering the quality and condition of the subject matter of investigation.

CXXVIII. Let none even doubt whether we are anxious to destroy and demolish the philosophy, arts, and sciences, which are now in use. On the contrary, we readily cherish their practice, cultivation, and honor; for we by no means interfere to prevent the prevalent system from encouraging discussion, adorning discourses, or being employed serviceably in the chair of the professor or the practice of common life, and being taken, in short, by general consent as current coin. Nay, we plainly declare, that the system we offer will not be very suitable for such purposes, not being easily adapted to vulgar apprehensions, except by effects and works. To show our sincerity in professing our regard and friendly disposition toward the received sciences, we can refer to the evidence of our published writings (especially our books on the *Advancement of Learning*). We will not, therefore, endeavor to evince it any further by words; but content ourselves with steadily and professedly premising, that no great progress can be made by the present methods in the theory or contemplation of science, and that they cannot be made to produce any very abundant effects.

CXXIX. It remains for us to say a few words on the excellence of our proposed end. If we had done so before, we might have appeared merely to express our wishes, but now that we have excited hope and removed prejudices, it will perhaps have greater weight. Had we performed and completely accomplished the whole, without frequently calling in others to assist in our labors, we should then have refrained from saying any more, lest we should be thought to extol our own deserts. Since, however, the

industry of others must be quickened, and their courage roused and inflamed, it is right to recall some points to their memory.

First, then, the introduction of great inventions appears one of the most distinguished of human actions, and the ancients so considered it; for they assigned divine honors to the authors of inventions, but only heroic honors to those who displayed civil merit (such as the founders of cities and empire legislators, the deliverers of their country from lasting misfortunes, the quellers of tyrants, and the like). And if any one rightly compare them, he will find the judgment of antiquity to be correct; for the benefits derived from inventions may extend to mankind in general, but civil benefits to particular spots alone; the latter, moreover, last but for a time, the former forever. Civil reformation seldom is carried on without violence and confusion, while inventions are a blessing and a benefit without injuring or afflicting any.

Inventions are also, as it were, new creations and imitations of divine works, as was expressed by the poet:<sup>68</sup>

“Primum frugiferos fœtus mortalibus ægris  
Dididerant quondam præstanti nomine Athenæ  
Et recreaverunt vitam legesque rogarunt.”

And it is worthy of remark in Solomon, that while he flourished in the possession of his empire, in wealth, in the

<sup>68</sup> This is the opening of the Sixth Book of Lucretius. Bacon probably quoted from memory; the lines are—

“Primæ frugiferos fœtus mortalibus ægris  
Dididerunt quondam præclaro nomine Athenæ  
Et recreaverunt,” etc.

The teeming corn, that feeble mortals crave,  
First, and long since, renowned Athens gave,  
And cheered their life—then taught to frame their laws.

magnificence of his works, in his court, his household, his fleet, the splendor of his name, and the most unbounded admiration of mankind, he still placed his glory in none of these, but declared <sup>69</sup> that it is the glory of God to conceal a thing, but the glory of a king to search it out.

Again, let any one but consider the immense difference between men's lives in the most polished countries of Europe, and in any wild and barbarous region of the new Indies, he will think it so great, that man may be said to be a god unto man, not only on account of mutual aid and benefits, but from their comparative states—the result of the arts, and not of the soil or climate.

Again, we should notice the force, effect, and consequences of inventions, which are nowhere more conspicuous than in those three which were unknown to the ancients; namely, printing, gunpowder, and the compass. For these three have changed the appearance and state of the whole world: first in literature, then in warfare, and lastly in navigation; and innumerable changes have been thence derived, so that no empire, sect, or star, appears to have exercised a greater power and influence on human affairs than these mechanical discoveries.

It will, perhaps, be as well to distinguish three species and degrees of ambition. First, that of men who are anxious to enlarge their own power in their country, which is a vulgar and degenerate kind; next, that of men who strive to enlarge the power and empire of their country over mankind, which is more dignified but not less covetous; but if one were to endeavor to renew and enlarge the power and empire of mankind in general over the universe, such ambi-

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<sup>69</sup> Prov. xxv. 2.

tion (if it may be so termed) is both more sound and more noble than the other two. Now the empire of man over things is founded on the arts and sciences alone, for nature is only to be commanded by obeying her.

Besides this, if the benefit of any particular invention has had such an effect as to induce men to consider him greater than a man, who has thus obliged the whole race, how much more exalted will that discovery be, which leads to the easy discovery of everything else! Yet (to speak the truth) in the same manner as we are very thankful for light which enables us to enter on our way, to practice arts, to read, to distinguish each other, and yet sight is more excellent and beautiful than the various uses of light; so is the contemplation of things as they are, free from superstition or imposture, error or confusion, much more dignified in itself than all the advantage to be derived from discoveries.

Lastly, let none be alarmed at the objection of the arts and sciences becoming depraved to malevolent or luxurious purposes and the like, for the same can be said of every worldly good; talent, courage, strength, beauty, riches, light itself, and the rest. Only let mankind regain their rights over nature, assigned to them by the gift of God, and obtain that power, whose exercise will be governed by right reason and true religion.

CXXX. But it is time for us to lay down the art of interpreting nature, to which we attribute no absolute necessity (as if nothing could be done without it) nor perfection, although we think that our precepts are most useful and correct. For we are of opinion, that if men had at their command a proper history of nature and experience, and would apply themselves steadily to it, and could bind themselves to two things: 1, to lay aside received

opinions and notions; 2, to restrain themselves, till the proper season, from generalization, they might, by the proper and genuine exertion of their minds, fall into our way of interpretation without the aid of any art. For interpretation is the true and natural act of the mind, when all obstacles are removed: certainly, however, everything will be more ready and better fixed by our precepts.

Yet do we not affirm that no addition can be made to them; on the contrary, considering the mind in its connection with things, and not merely relatively to its own powers, we ought to be persuaded that the art of invention can be made to grow with the inventions themselves.