

The New Organon or: True Directions Concerning the Interpretation of Nature

Francis Bacon

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[Brackets] enclose editorial explanations. Small ·dots· enclose material that has been added, but can be read as though it were part of the original text. Occasional •bullets, and also indenting of passages that are not quotations, are meant as aids to grasping the structure of a sentence or a thought. Any four-point ellipsis. . . . indicates the omission of a brief passage that seems to present more difficulty than it is worth. Longer omissions are reported between brackets in normal-sized type. ‘Organon’ is the conventional title for the collection of logical works by Aristotle, a body of doctrine that Bacon aimed to replace. His title *Novum Organum* could mean ‘The New Organon’ or more modestly ‘A New Organon’; the tone of the writing in this work points to the definite article.

First launched: January 2005

Last amended: May 2007

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APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 1: 78–130

78. I now come to the *causes* of these errors—so many of them, and such bad ones!—that have continued on through all those centuries. My discussion of thirteen of them will run on through **92**. You may have been wondering how the points I have made could have escaped men’s notice until now; my account of the causes should stop you wondering about that. When you understand the causes, you may have something else to be surprised by, namely the fact that someone *has* now seen through the errors, thought about them, and come up with my points against them. As for that, I see it as coming from my good luck rather than from my superior talents; it’s not that I am so clever, but rather that I was born at the right time.

(1) The first point about how long the errors went undetected is this: If you look hard at ‘all those centuries’ you’ll see that they shrink into something quite small. We have memories and records of twenty-five, and of those you can hardly pick out *six* that were fertile in the sciences or favourable to their development. (There are wastelands and deserts in times just as in regions of the earth!) We can properly count only *three* periods when learning flourished, and they lasted barely *two* centuries each: that of •the Greeks, the second of •the Romans, and the last among us—•the nations of western Europe. The intervening ages of the world were not flourishing or fertile for the growth of knowledge. (Don’t cite the Arabs or the schoolmen as counter-examples to that; for they spent the intervening times not •adding to the weightiness of the sciences but crushing them with the weight of their books!) So there is one cause for the lack of progress in the sciences, namely the brevity of the periods that can properly be said to have been favourable to them.

79. (2) Here is a second cause, and one of great all-around importance: Precisely at the times when human intelligence and learning have flourished most, or indeed flourished at all, men *didn’t* work at natural philosophy [here = ‘natural science’]. Yet it should have been regarded as the great mother of the sciences; because all arts and all sciences, though they may be polished and shaped and made fit for use, won’t *grow* at all if they are torn from this root of natural philosophy. It is clear that after the Christian religion was generally accepted and grew strong, the vast majority of the best minds applied themselves to theology, that this offered the best promise of reward and the most abundant research support of all kinds, and that this focus on theology was the chief occupation of able people in western Europe during the **third** period of the three I have named—all the more so because at about the same time literacy began to be more widespread and religious controversies sprang up. During the Roman period—the **second** of my trio—philosophers mostly worked on and thought about moral philosophy, which was to the pagans what theology is to us. Also, in those times the best intelligences usually devoted themselves to public affairs, because the sheer size of the Roman empire required the services of a great many people. And—moving back to the **first** of my trio—there was only a tiny portion of time when natural philosophy was seen to flourish among the Greeks; for in earlier times all except Thales of the so-called ‘seven wise men’ applied themselves to morals and politics; and in later times, when Socrates had drawn philosophy from heaven down to earth, moral philosophy became more fashionable than ever and diverted men’s minds from the philosophy of nature.

And right at the time when inquiries into nature *were* carried on energetically, they were spoiled and made useless by controversies and the ambitious display of new opinions. During those three periods, then, natural philosophy was largely neglected or impeded, so it's no wonder that men made so little progress with something that they weren't attending to. [This is the first of eleven remarks along the lines of 'No wonder science hasn't progressed, given the fact that. . . '—one for each of Bacon's causes of non-progress except the first and last.]

80. (3) I would add that especially in recent times natural philosophy, even among those who *have* attended to it, has scarcely ever had anyone's complete and full-time attention (except perhaps a monk studying in his cell, or an aristocrat burning the midnight oil in his country house); it has usually been treated as merely a bridge leading to something else. And so *natural philosophy*, that great mother of the sciences, has been subjected to the astonishing indignity of being degraded to the role of a servant, having to *help* medicine or mathematics in their affairs, and to give the immature minds of teen-agers a first dip in a sort of dye, to make them better able to absorb some other dye later on. Meanwhile don't look for much progress in the sciences—especially in their practical part—unless natural philosophy is applied to particular sciences, and particular sciences are applied back again to natural philosophy. It is because this hasn't been done that many of the sciences have no *depth* and merely glide over the surface of things. What sciences? Well, astronomy, optics, music, many of the mechanical arts, even medicine itself—and, more surprisingly, moral and political philosophy and the logical sciences. Because once these particular sciences have become widespread and established, they are no longer nourished by natural philosophy, which could have given them fresh strength and growth

drawn from the well-springs—from true thoughts about

- motions, rays, sounds and textures, and
- microstructures of bodies [see note on page 11], and
- feelings and intellectual processes.

So it's not at all strange that the sciences don't grow, given that they have been cut off from their roots.

81. (4) Another great and powerful cause why the sciences haven't progressed much is this: You can't run a race properly when the finishing-post hasn't been properly positioned and fixed in place. Now the true and lawful finishing-post of the sciences is just *new discoveries and powers in the service of human life*. But the great majority of the mob of supposed scientists have no feeling for this, and are merely hired lecturers. Well, occasionally some ambitious practitioner who is abler than most spends his own resources on some new invention; but most men are so far from aiming to *add* anything to the arts and sciences that they don't even *attend to* what's already there or *take* from it anything that they can't use in their lectures or use in the pursuit of money or fame or the like. And when one of that multitude *does* pay court to science with honest affection and for her own sake, even then it turns out that what attracts him is not the stern and unbending search for truth so much as the richness of the array of thoughts and doctrines. And if there should happen to be one who pursues the truth in earnest, even he will be going after *truths* that will satisfy his intellect by explaining the causes of things long since discovered, and not *truths* that hold promise of new practical applications or *the new light of axioms*. If the *end* of the sciences hasn't yet been placed properly, it isn't strange that men have gone wrong concerning the *means*.

82. (5) So men have mislocated the end and finishing-post of the sciences; but even if they hadn't, their *route* to it is

completely wrong and impassable. When you think about it carefully, it is amazing that •no mortal has *cared* enough or *thought hard* enough to lay out a securely walled road leading to the human intellect directly from the senses and experiment, and that •everything has been left either to the mists of tradition, or the whirl and eddy of argument, or the waves and mazes of random and fragmentary experience. Think about this soberly and carefully: What route *have* men customarily travelled in investigating and discovering things? No doubt what you will first come up with is a very simple and naive discovery procedure, the most usual one, namely this:

A man is bracing himself to make a discovery about something: first he seeks out and surveys **everything that has been said about it by others**; then he starts to think for himself; shaking up his mind and, as it were, praying to it to give him oracular pronouncements

—a ‘method’ that has no foundation at all, rests only on opinions, and goes where they go. Another man may perhaps call on **dialectics** to make his discovery for him, but the discoveries that dialectics is good for are irrelevant to what we are discussing—there’s nothing in common except the word ‘discovery’. [Regarding the passage between *asterisks*: Bacon writes of ‘arts’ but doesn’t give examples (medicine and ship-building). This text also expands his in other ways that ‘dots’ can’t easily indicate.] *Arts such as medicine and ship-building are made up of principles and axioms, and dialectics doesn’t discover these; all it can ‘discover’, given that you have the principles and axioms from some other source, is what else is consistent with them. If we try to insist on more than that, demanding that dialectics tell us what the •principles and axioms are, we all know that it will fling the demand back in our faces: ‘For •them you must trust the art in question. For the foundations of

medicine, for example, don’t ask *dialectics*, ask *medicine!*’*
 •Setting aside the opinions of others, and dialectics•, there remains **simple experience**—which we call ‘experiment’ if we were trying to produce it, and ‘chance’ if we weren’t. But such experience is no better than a broom with loose bristles, as the saying is—those who steer by it are like men in the dark, patting the walls as they go along hoping to find their way, when they’d have done much better to wait for daylight, or light a candle, and *then* set off. But **experience managed in the right •order** first lights the candle and then uses it to show the way. It starts with experience that is ordered and classified, not jumbled or erratic; from that it derives axioms, and from established axioms it moves on to new experiments; just as God proceeded in an •orderly way when he worked on matter. So don’t be surprised that science hasn’t yet reached the end of its journey, seeing that men have gone altogether astray, either abandoning experience entirely, or getting lost in it and wandering around as in a maze. Whereas a rightly ordered method leads by an unbroken route through the thickets of experience to the open ground of axioms.

83. This trouble •concerning not-finding-the-way• has been greatly increased by an old and *harmful* opinion or fancy, namely the self-important view that it is beneath the dignity of the human mind to be closely involved with experiments on particular material things given through the senses—especially as they are

- hard work to investigate,
- trivial to think about,
- nasty to report on,
- not suitable things for a gentleman to perform,
- infinite in number, and
- full of extremely small-scale details.

So that it has finally come to this: the true way is not merely

departed from but blocked off. It's not that experience has been abandoned or badly handled; rather, it has been fastidiously kept at arm's length.

84. (6) Men have been kept back from making progress in the sciences, as though by a magic spell, by •their reverence for antiquity, by •the authority of men of high standing in philosophy, and then by •the general acceptance of certain propositions. I have spoken of the last of these in 77 above.

As for 'antiquity', the opinion that men have about it is a lazy one that does violence to the meaning of the word. For really what is *antique* is •the world in its old age, that is the world *now*; and •the earlier age of the world when the ancients lived, though in relation to us it was the elder, in relation to the world it was the younger. We expect •an old man to know more about the human condition than •a young man does, and to make more mature judgments about it, because of his experience and the number and variety of things he has seen, heard and thought about. In the same way, more could be fairly expected from •our age (if only we knew and chose to employ its strength) than from •ancient times, because ours is a more advanced age of the world, and has accumulated countless experiments and observations.

It is also relevant that through long voyages many things in nature will be discovered that may let in new light on philosophy (and such voyages will be increasingly frequent in our age). And given that the regions of the •material domain—i.e. of the earth, the sea and the stars—have been opened up and brought to light, it would surely be disgraceful if the •intellectual domain remained shut up within the narrow limits of old discoveries.

And with regard to authority: there is something feeble about granting so much to •authors while denying •time its rights—time, which is the author of authors, or rather of all

authority. For the saying is 'Truth is the daughter of time', not '... the daughter of authority'!

We shouldn't be surprised, then, when we find that the enchantments of •antiquity and •authority and •general agreement have tied up men's powers—as though putting them under a spell—making them unable to rub shoulders with •things themselves.

85. (7) What brings man's work to a halt in face of the discoveries that have already been made is not merely his admiration for antiquity, authority and general agreement, but also his admiration for the long-time achievements of the human race. When you look at the variety and beauty of the devices that the mechanical arts have assembled for men's use, you'll surely be more inclined to admire man's wealth than to have any sense of his poverty! You won't take into account the fact that

the original human observations and natural processes (which are the soul and first mover of all that variety)

are not many and didn't have to be dug deeply for; and that apart from them it has been merely a matter of

patience, and the orderly and precise movements of hands and tools.

For example, it certainly takes precise and accurate work to make a clock, whose wheels seem to imitate the heavenly bodies and, in their alternating and orderly motion, to imitate the pulse of animals; but there isn't much scientific content in this, because the entire mechanism depends on only a couple of axioms of nature.

[Bacon next writes about 'the refinement of the liberal arts' and of the 'art' that goes into 'the mechanical preparation of natural substances', and lists the achievements in astronomy, music, language, the alphabet ('still not used in

China'), the making of beer, wine and bread, and so on. His point is that these achievements took centuries of tinkering, and that they involve very little in the way of genuinely scientific knowledge. So they—like the clock—make it less appropriate to wonder at how *much* we know than to wonder at how *little*. Then:]

If you turn from the workshop to the library, and wonder at the immense variety of books you see there, just look carefully into their contents and your amazement will be *flipped*: having seen their endless repetitions, and seen how men are always saying and doing what has been said and done before, you'll pass from •admiration at the variety to •astonishment at the poverty and scantiness of the subjects that have so far possessed the minds of men.

[Next Bacon comments derisively on the intellectual poverty of alchemy. Then:] The students of natural magic, who explain everything by 'sympathies' and 'antipathies', have in their lazy conjectures credited substances with having wonderful powers and operations. If they have ever they produced any results, they have been more productive of astonishment than of anything useful. [Followed by a slap at 'superstitious magic'; Bacon expresses some embarrassment at even mentioning this, as he does with alchemy. Finally:] It isn't surprising that the belief that one has a great deal has been a cause of our having very little.

86. (8) Furthermore, men's feeble and almost childish admiration for doctrines and arts has been increased by the tricks and devices of those who have practised and taught the sciences. For they produce them with so much fuss and flourish, putting them before the world all dressed up and masked and seemingly ready to go, as though they were wholly complete and finished. Just look at the structure and the classifications they bring with them! They seem to

cover everything that could come up in that subject, and to the minds of the vulgar they present the form and plan of a perfected science; but really the classificatory units are little more than empty bookshelves. The earliest seekers after truth did better than this. Their thoughts about things resulted in knowledge that they want to set down for later use, and they did this in *aphorisms*—i.e. short unconnected sentences, not linked by any method—and didn't pretend or profess to cover the entire art. But given the way things are these days, it's not surprising that men don't try to make further progress in matters that have been passed down to them as long since perfect and complete.

87. (9) The •ancient systems have also gained considerably in their reputation and credit from the empty-headed foolishness of those who have propounded •new ones, especially in the area of applied science. There has been no shortage of talkers and dreamers who—partly believing what they say and partly not—have loaded mankind with promises, offering the means to

prolong life,
 slow down the aging process,
 lessen pain,
 repair natural defects, . . .
 control and arouse affections,
 sharpen and heighten the intellectual faculties,
 turn substances into other substances (•e.g. lead into
 gold•),
 make things move, or move faster, at will,
 make changes in the air,
 arrange for influence from the stars,
 prophesy the future,
 make things visible from a long way off,
 reveal things that are hidden,

and many more. With regard to these ‘benefactors’ it wouldn’t be unfair to say that •their absurdities differ as much from •true arts (in the eyes of the philosopher) as •the exploits of Julius Caesar or Alexander the Great differ from •those of •such fictional characters as• Amadis of Gaul or the Knights of the Round Table. . . . It isn’t surprising that prejudice is raised against new propositions, especially ones that are said to have practical implications, because of those impostors who have tried something similar. . . .

88. (10) Far more harm has been done to knowledge by pettiness, and the smallness and triviality of the tasks that men have tackled. It is made worse by the fact that this pettiness comes with a certain air of arrogance and superiority. A now-familiar general device that is found in all the arts is this: the author blames *nature* for any weakness in his art, declaring—on the authority of his art!—that whatever his art can’t achieve is intrinsically impossible. [‘Art’ refers to any human activity that involves techniques and requires skills.] If arts are to be their own judges, then clearly none will be found guilty! Moreover, the philosophy that is now in play hugs to itself certain tenets whose purpose. . . .is to persuade men that we can’t expect art or human labour to come up with any results that are hard to get, requiring that nature be commanded and subdued. The doctrine that the sun’s heat and fire’s heat differ in kind is an example of this, and another is the doctrine about mixture—both mentioned earlier, •in 75•. If you think about it carefully you’ll see that all this involves a wrong limiting of human power; it tends—and is *meant to tend*—to produce an unnatural despair; and this not only messes up the auguries that might give hope but also cuts the sinews and spurs of industry, and loads the dice against experience itself. And all for the sake of having us think that their art has been completed, and for the miserable

‘triumph’ of getting us to believe that whatever *hasn’t yet* been discovered and understood *can’t ever* be discovered or understood.

And when someone *does* get in touch with reality and try to discover something new, he will confine himself to investigating and working out some *one* topic, such as

the nature of the magnet,

the tides,

mapping the heavens,

and things like that, which seem to be somewhat isolated from everything else and have hitherto been tackled without much success; whereas really it is an ignorant mistake to study something in isolation. Why? Because a nature that seems to be •latent and hidden in some things is •obvious and (as it were) palpable in others, so that people puzzle over it in •the former while nobody even notices it in •the latter. Consider the *holding-together* •of material things•. Wood and stones hold together, but people pay no attention to that fact, merely saying of wood and stone that ‘they are *solid*’ and giving no further thought to why they don’t fall apart, breaking up their continuity; while with water-bubbles—in which a sort of hemispherical skin is formed, fending off for a moment the breaking up of the continuity—the holding-together seems to be a subtle matter.

In fact, what in some things is regarded as special to them •and not present in the rest of nature• also occurs elsewhere in an obvious and well-known form, but it won’t be recognized *there* as long as the experiments and thoughts of men are engaged only on the former, •i.e. on the less obvious and supposedly ‘special’ cases•. But generally speaking, in mechanics all that is needed for someone to pass off an old result as something new is •to refine or embellish it, •to combine it with some others, •to make it handier for practical application, •to produce the result on a larger or a smaller

scale than had been done before, or the like.

So it is no wonder that no important discoveries worthy of mankind have been brought to light, when men have been satisfied—indeed *pleased*—with such trifling and puerile tasks, and have even fancied that in them they were trying for something great, if not achieving it.

89. (11) Bear in mind also that in every period natural philosophy has had a troublesome and recalcitrant adversary in superstition and blind religious extremism. Among the Greeks those who first proposed *natural* causes for lightning and for storms were condemned for disrespect towards the gods. And some of the fathers of the early Christian church were not much milder in their attitude to those who, on most convincing grounds that no sane person would question today, maintained that the earth is round and thus that the antipodes exist.

Even today it is harder and more dangerous than it ought to be to talk about nature, because of the procedures of the theological schoolmen. They regularized theology as much as they could, and worked it into the shape of an art [here = ‘academic discipline’], and then incorporated into the body of religion more of Aristotle’s contentious and thorny philosophy than would properly fit there. The same result is apt to arise, though in a different way, from the theories of those who have been so bold as to infer the truth of the Christian religion from the principles of philosophers, and to confirm it by their authority. They have solemnly and ceremonially celebrated this union of the senses with faith as a lawful marriage, entertaining [*permulcentes*] men’s minds with a pleasing variety things to think about but also mixing [*permiscentes*] the human with the divine in an unseemly fashion. In such mixtures of theology with philosophy only the accepted doctrines of philosophy are included, while new

ones—which may be changes for the better—are driven off and wiped out.

Lastly, you will find that some ignorant divines close off access to any philosophy, however ‘purified’ it may be. Some are feebly afraid that a deeper search into nature would take one beyond the limits of what is proper; and they take what is said in the Scriptures against those who pry into

sacred mysteries,

wrenching it away from there and transferring it to

the hidden things of *nature*,

which are not fenced off by any prohibition in the Bible.

Other divines are more complex and thoughtful: they think that if middle causes [see note in 65] aren’t known then it will be easier to explain *everything* in terms of God’s hand and rod; and they think that this is greatly in the interests of religion, whereas really it’s nothing but *trying to gratify God by a lie*. Others are led by past examples to fear that movements and changes in philosophy will end in attacks on religion. And others again—bringing us to the end of my list—seem to be afraid that if nature is investigated something may be found to subvert religion or at least to shake its authority, especially with the unlearned. But these two last fears strike me as having come from thinking at the level of the lower animals, like a dog cowering in fear when it hears an unfamiliar noise; it’s as though these men in their heart of hearts weren’t sure of the strength of religion and of faith’s domination of the senses, and were therefore scared that the investigation of truth in nature might be dangerous to them. But in point of fact natural philosophy is second only to the Bible as the best antidote to superstition and the most approved nourishment for faith. So natural philosophy deserves its place as religion’s most faithful handmaid: religion displays God’s will, while natural philosophy displays his power. . . . Summing up: it isn’t surprising that natural

philosophy is stunted in its growth when religion, the thing that has most power over men's minds, has been pulled into the fight *against* it by the stupidity and incautious zeal of certain people.

90. (12) Moving on now: in the customs and institutions of schools, academies, colleges, and similar bodies whose role is to house learned men and to develop learning, *everything* turns out to work against the progress of the sciences. Their lectures and tests are devised in such a way that it would be hard for anyone to think or speculate about anything out of the common rut. And if one or two have the courage to *judge freely*, they'll have to do it all by themselves with no help from the company of others. And if they can put up with that too, they will find that their hard work and breadth of mind are a considerable hindrance to their careers! For the studies of men in these places are confined—as it were *imprisoned*—in the writings of certain authors, and if anyone disagrees with them he is immediately accused of being a trouble-maker and a revolutionary. But this is all wrong, because the situation of the arts is quite different from that of the state, and the coming of new light in the arts is not like the coming of new events in the state. In matters of state any change—even a change for the better—is under suspicion of making trouble, because politics rests on authority, consent, fame and opinion, not on demonstration. But arts and sciences should be like quarries, where the noise of new works and further advances is heard on every side. That is how things stand according to right reason, but it's not what actually happens; and the things I have reported in the administration and government of learning severely restrain the advancement of the sciences.

91. Indeed, even if that hostility towards new work stopped, the growth of the sciences would still be held back by the

fact that high aims and hard work in this field go unrewarded. For the *rewarding* of scientific achievement and the *performing* of it are not in the same hands. The growth of the sciences comes from high intelligence, while the prizes and rewards of them are in the hands of the common people, or of 'great' persons who are nearly all quite ignorant. Moreover, not only do scientific advances bring no rewards or other benefits, they don't even get popular applause. For the common run of people aren't up to the task of understanding such matters, so that news about them is apt to be blown away by the gales of popular opinions. And it's not surprising that endeavours that are not honoured don't prosper.

92. (13) By far the greatest obstacle to the progress of science—to the launching of new projects and the opening up of new fields of inquiry—is that men despair and think things impossible. For in these matters it's the careful, serious people who have no confidence at all, and are taken up with such thoughts as that

nature is dark,
 life is short,
 the senses are deceptive,
 judgment is weak,
 experiments are hard to do,

and the like. They think that throughout the centuries the sciences have their ebbs and flows, sometimes growing and flourishing and at others withering and decaying, but that a time will come when the sciences are in a state from which no further progress will be possible. And they evidently think that that time lies in the *very* near future. So if anyone expects or undertakes to make further discoveries, they set this down to his immature irresponsibility. Such endeavours, they think, start well, become harder as they go on, and end in confusion. This is a way of thinking that

sober intelligent men are likely to fall into, and we mustn't let *their* charms and attractions lead us to relax or mitigate our judgment of their line of thought. We should carefully note what gleams of hope there are and what direction they come from; and—changing the metaphor—we should disregard the lighter breezes of hope but seriously and attentively follow the winds that seem to be steadier. We must also look to political prudence for advice, and to *take* the advice it gives; it is distrustful on principle, and takes a dim view of human affairs. So my topic here and to the end of **114** is *hope*; for I don't trade in promises, and don't want to affect men's judgments by force or by trickery; rather, I want to lead them by the hand without coercion. The best way to inspire hope will be to bring men to *particulars*, especially ones that are set out in an orderly way in the Tables of Discovery (partly in this work **112–113** and **218**, but much more in the fourth part of my Great Fresh Start [see note in **31**], because this isn't merely a •hope for the thing but •the thing itself. But I want to come at things gently, so instead of jumping straight to the Tables I shall proceed with my plan of *preparing* men's minds, for **hope** is a significant part even of preparation. If all the other inducements aren't accompanied by **hope**, their effect on men is not to •ginger them up and get them busy but rather to •make them depressed by giving them an even darker view of how things now stand and making them even more fully aware of the unhappiness of their own condition. So there is a point in my revealing and recommending the views of mine that make **hope** in this matter reasonable. It's like what Columbus did *before* his wonderful voyage across the Atlantic, giving reasons for his belief that hitherto unknown lands and continents might be discovered. His reasons were rejected at first, but later they were vindicated by experience, and were the causes and beginnings of great events.

93. We have to assume that the force behind everything is God; for our subject matter—namely nature—is good in such a way that it plainly comes from God, who is the author of good and the father of light. Now in divine operations even the smallest beginnings lead unstoppably to their end. It was said of spiritual things that 'The kingdom of God cometh not with observation' [Luke 17:20], and it is the same with all the greater works of divine providence: everything glides on smoothly and noiselessly, and the work is well under way before men are aware that it has begun. And don't forget Daniel's prophecy concerning the last ages of the world: 'Many shall run to and fro, and knowledge shall be increased' [Daniel 12:4], clearly indicating that the thorough exploration of the whole world is fated to coincide with the advancement of the sciences. (By 'fated' I mean 'destined by •God's• providence'. I would add that there have been so many distant voyages that 'the thorough exploration of the whole world' seems to have reached completion or to be well on the way to it.)

94. Next topic: the best of all reasons for having **hope**, namely *the errors of the past, the wrong roads so far taken*. In the course of censuring a poorly run government the critic said something excellent:

The worst things in the past ought to be regarded as the best for the future. For if you had conducted yourself perfectly yet still ended up in your present •miserable• condition, you would have not even a **hope** of improvement. But as things stand, with your misfortunes being due not to the circumstances but to your own errors, you can **hope** that by abandoning or correcting these errors you can make a great change for the better.

Similarly, if throughout many years men had gone the right

way about discovering and cultivating the sciences, and the sciences had still been in the state they are now actually in, it would have been absurdly bold to think that further progress was possible. But if the wrong road has been taken, and men have worked on things that weren't worthwhile, it follows that the troubles have arisen not from •circumstances that weren't in our power but from •the human intellect—and the use and application of *that* can be remedied. So it will be really useful to expound these errors; because every harm they have done in the past gives us reason to **hope** to do better in the future. I have already said a little about these errors, but I think I should set them out here in plain and simple words.

95. Those who have been engaged in the sciences divide into *experimenters* and *theorists*. The experimenters, like •ants, merely collect and use •particular facts•; the theorists, like •spiders, make webs out of themselves. But the •bee takes a middle course: it gathers its material from the flowers of the garden and the field, but uses its own powers to transform and absorb this material. A true worker at philosophy is like that:

- he doesn't rely solely or chiefly on the powers of the mind •like a theorist = spider•, and
- he doesn't take the material that he gathers from natural history and physical experiments and store it up in his memory just as he finds it •like an experimenter = ant•. Instead,
- he stores the material in his intellect, altered and brought under control.

So there is much to **hope** for from a closer and purer collaboration between these two strands in science, experimental and theoretical—a collaboration that has never occurred before now.

96. We have never yet had a natural philosophy that was pure. What we have had has always been tainted and spoiled: in Aristotle's school by logic; in Plato's by natural theology; in the second school of Platonists (Proclus and others) by mathematics, which ought only to set natural philosophy's limits, not generate it or give it birth. From a pure and unmixed natural philosophy we can **hope** for better things •than can be expected from any of those impure systems•.

97. No-one has yet been found who was sufficiently firm of mind and purpose to decide on *and to carry out* this programme:

Clean right out all theories and common notions, and apply the intellect—thus scrubbed clean and evenly balanced—to a fresh examination of particulars.

For want of this, the human knowledge that we have is a mish-mash, composed of •childish notions that we took in along with our mothers' milk, together with •the results of• much credulity and many stray happenings. So if someone of mature years, with functioning senses and a well-purged mind, makes a fresh start on examining experience and particular events, better things may be **hoped** for from him. In this respect, I pledge myself to have good fortune like that of Alexander the Great. Don't accuse me of vanity until you have heard me out, because what I am getting at—taken as a whole—goes *against* vanity. Aeschines said of Alexander and his deeds: 'Assuredly we don't live the life of mortal men. What we were born for was that in after ages wonders might be told of us', as though Alexander's deeds seemed to him miraculous. But •what I am saying about myself is not like that, but rather like this•: in the next age Livy took a better and a deeper view of the matter, saying of Alexander that 'all he did was to have the courage to neglect sources of fear that were negligible'. I think that a similar judgment may be

passed on me in future ages: that I did no great things, but simply cut down to size things that had been regarded as great. . . .

98. We can't do without experience; but so far we haven't had any foundations for experience, or only very weak ones. No-one has searched out and stored up a great mass of particular events that is adequate

in number,
in kind,
in certainty, or
in any other way

to inform the intellect. On the contrary, learned men—relaxed and idle—have accepted, as having the weight of legitimate evidence for constructing or confirming their philosophy, bits of hearsay and rumours about experience. Think of a kingdom or state that manages its affairs on the basis not of •letters and reports from ambassadors and trustworthy messengers but of •street-gossip and the gutter! Well, the way philosophy has managed its relations with experience has been *exactly* like that.

Nothing examined in enough careful detail,
nothing verified,
nothing counted,
nothing weighed,
nothing measured

is to be found in natural history. And observations that are loose and unsystematic lead to ideas that are deceptive and treacherous. Perhaps you think that this is a strange thing to say. You may want to comment:

Your complaint is unfair. Aristotle—a great man, supported by the wealth of a great king—composed an accurate natural history of animals; and others, with greater diligence though making less fuss about

it, made many additions; while yet others compiled rich histories and descriptions of metals, plants, and fossils.

If so, it seems that you haven't properly grasped what I am saying here. For the rationale of a •natural history that is composed for its own sake is not like the rationale of a •natural history that is collected to supply the intellect with the concepts it needs for building up philosophy. They differ in many ways, but especially in this: the former attends only to the variety of natural species ·as they are found in nature·, not to ·deliberately constructed· experiments in the mechanical arts. In the business of life, the best way to discover a man's character, the secrets of how his mind works, is to see how he handles trouble. In just the same way, nature's secrets come to light better when she is artificially shaken up than when she goes her own way. So we can **hope** for good things from natural philosophy when natural history—which is its ground-floor and foundation—is better organized. Then, but not until then!

99. Furthermore, even when there are plenty of mechanical experiments, there's a great scarcity of ones that do much to enlarge the mind's stock of concepts. The experimental technician isn't concerned with discovering the truth, and isn't willing to raise his mind or stretch out his hand for anything that doesn't bear on his ·practical· project. There will be grounds for **hope** of scientific advances when ·and only when· men assemble a good number of natural-history experiments that •are in themselves of no ·practical· use but simply •serve to discover causes and axioms. I call these 'experiments of light', to distinguish them from the ·practically useful but theoretically sterile· ones that I call 'experiments of fruit' [here 'fruit' = 'practical results']. Now, experiments of this kind have one admirable property: they never miss or fail!

Their aim is not to •produce some particular effect but only to •discover the natural cause of something; and such an experiment succeeds equally well however it turns out, for either way it settles the question.

100. Many more experiments should be devised and carried out, and ones of an utterly different kind from any we have had up to now. But that is not all. There should also be introduced an entirely different method, order, and procedure for carrying through a programme of experiments. To repeat something I have already said [82]: when experimentation wanders around of its own accord, it merely gropes in the dark and confuses men rather than instructing them. But when there is a firmly regulated, uninterrupted *series* of experiments, there is **hope** for advances in knowledge.

101. Even after we have acquired and have ready at hand a store of natural history and experimental results such as is required for the work of the intellect, or of philosophy, *still* that is not enough. The intellect is far from being able to retain all this material in memory and recall it at will, any more than a man could keep a diary all in his head. Yet until now there has been more *thinking* than *writing* about discovery procedures—experimentation hasn't yet become *literate!* But a discovery isn't worth much if it isn't •planned and reported• in writing; and when this becomes the standard practice, better things can be **hoped** for from experimental procedures that have at last been made literate.

102. The particulars •that have to be studied• are very numerous, and are like an army that is dispersed across a wide terrain, threatening to scatter and bewilder the intellect •that tries to engage with them•. There's not much to be **hoped** for from intellectual skirmishing •with these particulars•, dashing here and there among them in a disorderly way. What is needed is first •to get the relevant particulars drawn up

and arranged, doing this by means of tables of discovery that are well selected, well arranged, and *fresh* (as though living); and •to put the mind to work on the prepared and arranged helps that these tables provide.

103. But after this store of particulars has been laid before our eyes in an orderly way, we shouldn't pass straight on to the investigation and discovery of new particulars or new discoveries; or anyway if we *do* do that we oughtn't to stop there. I don't deny that when all the experiments of all the arts have been collected and ordered and brought within the knowledge and judgment of one man, new useful things may be discovered through taking the experimental results of one art and re-applying them to a different art (using the approach to experiments that I have called 'literate', •meaning that the results are properly recorded in writing•). But nothing much can be **hoped** for from that procedure. Much more promising is this: from those particular results derive axioms in a methodical manner, then let the light of the axioms point the way to new particulars. For our road does not lie on a level, but goes up and down—up to axioms, then down again to scientific practice.

104. But the intellect mustn't be allowed •to jump—to *fly*—from particulars a long way up to axioms that are of almost the highest generality (such as the so-called 'first principles' of arts and of things) and then on the basis of them (taken as unshakable truths) •to 'prove' and thus secure middle axioms. That has been the practice up to now, because the intellect has a natural impetus to do that and has for many years been trained and habituated in doing it by the use of syllogistic demonstration. Our only **hope** for good results in the sciences is for us to proceed thus: using a valid ladder, we move up gradually—not in leaps and bounds—from particulars to lower axioms, then to middle axioms, then up and

up until at last we reach the most general axioms. The two ends of this ladder are relatively unimportant because the lowest axioms are not much different from reports on bare experience, while the highest and most general ones—or anyway the ones that we have now—are notional and abstract and without solid content. It's the middle axioms that are true and solid and alive; they are the ones on which the affairs and fortunes of men depend. Above them are the most general axioms, which also have value, but I am talking not about abstract axioms but rather about ones of which the middle axioms are limitations and which thus get content from the middle axioms. So the human intellect should be supplied not with wings but rather weighed down with lead, to keep it from leaping and flying. This hasn't ever been done; when it is done we'll be entitled to better **hopes** of the sciences.

105. For establishing axioms we have to devise a different form of induction from any that has been use up to now, and it should be used for proving and discovering not only so-called 'first principles' but also the lesser middle axioms—indeed *all* axioms. The induction that proceeds by simply listing positive instances is a childish affair; its conclusions are precarious and exposed to peril from a contradictory instance; and it generally reaches its conclusions on the basis of too few facts—merely the ones that happen to be easily available. A form of induction that will be useful for discovery and demonstration in the sciences and the arts will have to separate out a nature through appropriate rejections and exclusions, and then, after a sufficient number of negatives, to reach a conclusion on the affirmative instances. [Bacon will start to explain this in ²15.] No-one has ever done this, or even *tried to*, except for Plato who does indeed make some use of this form of induction for the purpose of discussing

definitions and ideas. But for this kind of induction (or demonstration) to be properly equipped for its work, *many* things have to be done that until now no mortal has given a thought to; so that much more work will have to be spent on this than has ever been spent on the syllogism. And this induction should be used not only in the discovery of axioms but also in drawing boundaries around notions. It is in this induction that our chief **hope** lies.

106. When establishing an axiom by this kind of induction, we must carefully note whether the axiom is shaped so as to fit only the particulars from which it is derived, rather than being larger and wider. And if it is larger and wider, we must see whether its greater scope is confirmed and justified by new particulars that it leads us to. Such a justified increase of scope saves us from being stuck with things that are already known (but if it isn't justified then we are overstretching, loosely grasping at shadows and abstract forms rather than at solid things in the world of matter). When we do things in this way we shall at last have justified **hope**.

107. At this point I should remind you of what I said earlier [80] about extending the range of natural philosophy so that the particular sciences can be grounded in it, and the branches of knowledge don't get lopped off from the trunk. For without that there will be little **hope** of progress.

108. That's all I have to say about getting rid of despair and creating **hope** by banishing or fixing past errors. Now, what other ways are there of creating **hope**? Here's a thought that occurs at once: Many useful discoveries have been made accidentally by men who weren't looking for *them* but were busy about other things; so no-one can doubt that if men seek for something and are busy about *it*, proceeding in an orderly and not a slapdash way, they will discover far more. Of course it can happen occasionally that someone acciden-

tally stumbles on a result that he wouldn't have found if he had searched hard for it, but on the whole the opposite is the case—things are discovered by methodical searching that couldn't have been found by accident. So, far better things, and more of them, and at shorter intervals, are to be **hoped** for from •hard thinking, hard focussed work and concentration than from •lucky accidents, undisciplined whims and the like, which until now have been the main source of discoveries.

109. Here is another ground for **hope**: Discoveries have sometimes been made that would have been almost unthinkable in advance, and would have been written off as impossible. Men think about the *new* in terms of the *old*: to questions about what the •future holds they bring an imagination indoctrinated and coloured by the •past. This is a terrible way of forming opinions, because streams fed by nature's springs don't run along familiar channels.

Suppose that before gunpowder was invented someone described it in terms of its effects—'There is a new invention by means of which the strongest towers and walls can be demolished from a long way off. That would no doubt have set men thinking about how to increase the power of *catapults* and *wheeled ramming devices* and the like. The notion of a fiery blast suddenly and forcefully expanding and exploding would hardly have entered into any man's mind or imagination, because nothing closely analogous to that had ever been seen. Well, except perhaps in earthquakes and lightning, but *they* wouldn't have been seen as relevant because they are mighty works of *nature* which *men* couldn't imitate.

Or suppose that before the discovery of silk someone had said: 'They've discovered new a kind of thread for use in clothing and furniture-coverings; it is finer, softer, more

beautiful and *stronger* than linen or wool.' Men would have begun to think of some silky kind of plant or of very fine hair of some animal or of the feathers and down of birds; they would *not* have thought of a web woven by a tiny worm in great quantities and renewing itself yearly. If anyone *had* said anything about a worm, he'd have been laughed at as dreaming of a new kind of cobweb! [Bacon then gives a third example: the magnet.] Yet these things and others like them lay concealed from men for centuries, and when they did come to light it wasn't through science or any technical skill but by accident and coincidence. As I have remarked, they were so *utterly* different in kind from anything previously known that they couldn't possibly have been discovered through a preconceived notion of them.

So there are strong grounds for **hoping** that nature has concealed in its folds many wonderfully useful •things that aren't related to or parallel with anything that is now known, and lie right outside our imaginative reach. As the centuries roll on, •they too will doubtless come to light of their own accord in some roundabout way, as did gunpowder and the others; but by the method I am discussing they can be presented and anticipated speedily, suddenly and all at once.

110. Other discoveries prove that this can happen: splendid discoveries are lying at our feet, and we step over them without seeing them. The discoveries of

gunpowder,
silk,
the magnet,
sugar,
paper,

or the like may seem to depend on certain properties of things of and nature—properties that might have been hard to discover. But there is nothing in *printing* that isn't wide

open and almost easy. All that was needed was to see that

- although it is harder to arrange letter-types than to write by hand, the two procedures differ in that once the types have been arranged any number of impressions can be made from them, whereas hand-writing provides only a single copy,

and to see that

- ink can be so thickened so that it does its job but doesn't run, especially when the type faces upwards and the ink is rolled onto it from above.

It was merely because they didn't notice *these* ·obvious· facts that men went for so many ages without this most beautiful invention which is so useful in the spreading of knowledge.

But the human mind is such a mess when it comes to this business of discoveries that it first •distrusts and then •despises itself:

- before the discovery: it is not credible that any such thing can be found,
- afterwards: it is incredible that the world should have missed it for so long!

And this very thing entitles us to some **hope**, namely the hope that there is a great mass of discoveries still to be made—not just ones that will have to be dug out by techniques that we don't yet have, but also ones that may come to light through our transferring, ordering and applying things that we do know already, this being done with the help of the experimental approach that I call 'literate' [101].

111. Another ground of **hope** should be mentioned. Let men reflect on their infinite expenditure of intellect, time, and means on things of *far* less use and value ·than the discoveries I am talking about·. If even a small part of this were directed to sound and solid studies, there is no difficulty that couldn't be overcome. I mention this ·matter of

the use of resources· because a collection of Natural and Experimental History, as I envisage it and as it ought to be, is a great—as it were, a *royal*—work, and I freely admit that it will involve much labour and expense. [It will appear in ²11 on page ?? that the 'collection' Bacon talks of is an orderly written account of phenomena, experiments and their results, not a physical museum.]

112. In the meantime, don't be put off by *how many* particulars there are; rather, let this give you **hope**. ·The fact is that you will be in worse trouble if you *don't* engage with them·; for the •particular phenomena of nature are a mere handful compared to the ·great multitudes of· •things that human ingenuity can fabricate if it cuts itself off from the clarifying effects of reality. And this road ·through the study of *real* events· soon leads to open ground, whereas the other—the route through *invented* theories and thought-experiments—leads to nothing but endless entanglement. Until now men haven't lingered long with •experience; they have brushed past it on their way to the ingenious •theorizings on which they have wasted unthinkable amounts of time. But if we had someone at hand who could answer our questions of the form 'What are the *facts* about this matter?', it wouldn't take many years for us to discover all causes and complete every science [the Latin literally means 'to discover all causes and sciences'].

113. Men may take some **hope**, I think, from my own example (I'm not boasting; just trying to be useful). If you are discouraged ·about the chances of progress in the sciences·, look at me!

- I am busier with affairs of state than any other man of my time,
- I lose a lot of time to ill-health, and
- in this ·scientific· work I am wholly a pioneer, not following in anyone's tracks and not getting advice from anyone.

And yet, ·despite these three sources of difficulty·, I think I have pushed things on a certain amount by sticking to the true road and submitting my mind to reality. Well, then, think what might be expected (now that I have pointed out the way) from men

- with plenty of free time,
- in good health·, and
- working together, on the basis of previous work ·by others·.

Unlike the work of sheerly *thinking up* hypotheses, proper scientific work *can* be done collaboratively; the best way is for men's efforts (especially in collecting experimental results) to be exerted separately and then brought together. Men will begin to know their strength only when they go this way—with one taking charge of one thing and another of another, instead of all doing all the same things.

114. Lastly, even if the breeze of **hope** that blows on us from that New Continent were fainter and less noticeable than it is, still we have to *try*—unless we prefer to have minds that are altogether abject! The loss that may come from •not trying is much greater than what may come from ·trying and· •not succeeding: by •not trying we throw away the chance of an immense good; by •not succeeding we only incur the loss of a little human labour. But from what I have said (and from some things that I *haven't* said) it seems to me that there is more than enough **hope** not only •to get a vigorous man to *try* but also to make a sober-minded and wise man *believe* ·that he will succeed·.

115. That completes what I wanted to say about getting rid of the pessimism that has been one of the most powerful factors delaying and hindering the progress of the sciences. I have also finished with the signs and causes of errors, of sluggishness and of the prevailing ignorance. ·I've said more

about this than you might think·, because the more subtle causes—the ones that aren't generally noticed or thought about—come under what I said about the 'idols' of the human mind.

And this should also bring to an end the part of my Great Fresh Start [see note in **31**] that is devoted to *rejection*, which I have carried out through three refutations:

- (1) the refutation of innate human reason left to itself [see Preface at page 2];
- (2) the refutation of demonstrations [see **44** and **69**];
- (3) the refutation of the accepted philosophical doctrines [see **60–62**].

I refuted these in the ·only· way I *could* do so, namely through signs and the evidence of causes. I couldn't engage in any other kind of confutation because I differ from my opponents both on first principles and on rules of demonstration.

So now it is time to proceed to the actual techniques for interpreting nature and to the rules governing them—except that there is *still* something that has to be said first! In this first book of aphorisms my aim has been to prepare men's minds not just for •*understanding* what was to follow but for •*accepting* it; and now that I have •cleared up and washed down and levelled the floor of the mind, I have to •get the mind into a good attitude towards the things I am laying before it—to *look kindly* on them, as it were. ·This has to be worked for·, because anything new will be confronted by prejudgments ·against it·, not only ones created by old opinions but also ones created by false ideas about what the new thing is going to be. So I shall try to create sound and true opinions about what I am going to propose; but this is only a stop-gap expedient—a kind of security deposit—to serve until I can make the stuff itself thoroughly known.

116. First, then, don't think that I want to found a new sect in philosophy—like the ancient Greeks and like some moderns such as Telesio, Patrizzi or Severinus. For that's not what I am up to; and I really don't think that human welfare depends much on what abstract opinions anyone has about nature and its workings. No doubt many old theories of this sort can be revived and many new ones introduced, just as many theories of the heavens can be supposed that fit the phenomena well enough but differ from each other; but I'm not working on such useless speculative matters.

My purpose, rather, is to see whether I can't provide humanity's power and greatness with firmer foundations and greater scope. I have achieved some results—scattered through some special subjects—that I think to be far more true and certain and indeed more fruitful than any that have so far been used (I have collected them in the •fifth part of my Fresh Start); but I don't yet have a complete theory of everything to propound. It seems that the time hasn't come for that. I can't hope to live long enough to complete the •sixth part (which is to present science discovered through the proper interpretation of nature); but I'll be satisfied if in the middle parts I conduct myself soberly and usefully, sowing for future ages the seeds of a purer truth, and not shying away from the start of great things. [See note in **31**.]

117. Not being the founder of a sect, I am not handing out bribes or promises of particular works. You may indeed think that because I talk so much about 'works' or 'results' and drag everything over to *that*, I should produce some myself as a down-payment. Well, I have already clearly said it many times, and am happy now to say it again: my project is not to get

works from works or
experiments from experiments (like the •empirics),

but rather to get

causes and axioms from works and experiments,
and then to get

new works and experiments from those causes and
axioms (like the •legitimate interpreters of nature).

[An 'empiric' is someone who is interested in *what* works but not in *why* it works; especially a physician of that sort, as referred to by Locke when he speaks of 'swallowing down opinions as silly people do empirics' pills, without knowing what they are made of or how they will work'.] If you look at

- my Tables of Discovery that •will• constitute the fourth part of the Fresh Start, and
- the examples of particulars that I present in the second part, •i.e. the present work•, and
- my observations on the history that I •will• sketch in the third part,

you won't need any great intellectual skill to see indications and outlines of many fine results all through this material; but I openly admit that the natural history that I have so far acquired, from books and from my own investigations, is too skimpy, and not verified with enough accuracy, to serve the purposes of legitimate interpretation.

To anyone who is abler and better prepared •than I am• for mechanical pursuits, and who is clever at getting results from experiment, I say: By all means go to work snipping off bits from my history and my tables and apply them to getting results—this could serve as *interest* until the *principal* is available. But I am hunting for bigger game, and I condemn all hasty and premature interruptions for such things as these, which are (as I often say) like Atalanta's spheres. I don't go dashing off after golden apples, like a child; I bet everything on art's winning its race against nature. [On Atalanta and the race see **70**.] I don't scurry around clearing out moss and weeds; I wait for the harvest when the crop is ripe.

118. When my history and Tables of Discovery are read, it will surely turn out that some things in the experiments themselves are not quite certain or perhaps even downright false, which may lead you to think that the foundations and principles on which my discoveries rest are ·also· false and doubtful. But this doesn't matter, for such things are bound to happen at first. It's like a mere typographical error, which doesn't much hinder the reader because it is easy to correct as you read. In the same way, ·my· natural history may contain many experiments that are false, but it won't take long for them to be easily expunged and rejected through the discovery of causes and axioms. It is nevertheless true that if big mistakes come thick and fast in a natural history, they can't possibly be corrected or amended through any stroke of intelligence or skill. Now, my natural history has been collected and tested with great diligence, strictness and almost *religious* care, yet there may be errors of detail tucked away in it; so what should be said of run-of-the-mill natural history, which is so careless and *easy* in comparison with mine? And what of the philosophy and sciences built on that kind of sand (or rather *quicksand*)? So no-one should be troubled by what I have said.

119. My history and experiments will contain many things that are

- trivial, familiar and ordinary, many that are
- mean and low [see **120**], and many that are
- extremely subtle, merely speculative, and seemingly useless [see **121**].

Such things could lead men to lose interest or to become hostile ·to what I have to offer. I shall give these one paragraph each·.

Men should bear in mind that until now *their* activities have consisted only in explaining unusual events in terms of

more usual ones, and they have simply taken the usual ones for granted, not asking what explains *them*. So they haven't investigated the causes of

weight,
rotation of heavenly bodies,
heat,
cold,
light,
hardness,
softness,
rarity,
density,
liquidity,
solidity,
life,
lifelessness,
similarity,
dissimilarity,
organicness,

and the like. They have accepted these as self-evident and obvious, and have devoted their inquiring and quarrelling energies to less common and familiar things.

But I *have to* let the most ordinary things into my history, because I know that until we have properly looked for and found the causes of common things and the causes of those causes, we can't make judgments about uncommon or remarkable things, let alone bring anything new to light. Indeed, I don't think that anything holds up philosophy more than the fact that common and familiar events don't cause men to stop and think, but are received casually with no inquiry into their causes. A result of this we need •to pay attention to things that are known and familiar at least as often as •to get information about unknown things.

120. As for things that are low or even filthy: as Pliny says, these should be introduced with an apology, but they should be admitted into natural history just as the most splendid and costly things should. And that doesn't pollute the natural history that admits them; the sun enters the sewer as well as the palace, but isn't polluted by that! I am not building a monument dedicated to human glory or erecting a pyramid in its honour; what I'm doing is to lay a foundation for a holy temple in the human intellect—a temple modelled on the world. So I follow that model, because whatever is worthy of *being* is worthy of *scientific knowledge*, which is the image or likeness of being; and low things *exist* just as splendid ones do. And another point: just as from certain putrid substances such as musk and civet the sweetest odours are sometimes generated, so also mean and sordid events sometimes give off excellent and informative light. That is enough about this; *more* than enough, because this sort of squeamishness is downright childish and effeminate.

121. The third objection must be looked into much more carefully. I mean the objection that many things in my history will strike ordinary folk, and indeed *non-ordinary* ones trained in the presently accepted systems, as intricately subtle and *useless*. It is especially because of this objection that I have said, and should *again* say, that in the initial stages *of the inquiry* I am aiming at experiments of light, not experiments of fruit [see 99]. In this, as I have often said [see 70], I am following the example of the divine creation which on the first day produced nothing but light, and gave that a day to itself without doing any work with matter. To suppose, therefore, that things like these *'subtleties'* of mine are useless is the same as supposing that light is useless because it isn't a *thing*, isn't solid or material. And well-considered and well-delimited knowledge of simple natures

is like light: it gives entrance to all the secrets of nature's workshop, and has the power to gather up and draw after it whole squadrons of works and floods of the finest axioms; yet there is hardly anything we can *do with it* just in itself. Similarly the *letters* of the alphabet taken separately are useless and meaningless, yet they're the basic materials for the planning and composition of all discourse. So again the *seeds* of things have much latent power, but nothing comes of it except in their development. And *light* is like scientific subtleties in another way, namely: the scattered rays of light don't do any good unless they are made to converge.

If you object to speculative subtleties, what will you say about the schoolmen [= 'mediaeval and early modern Aristotelians'], who have wallowed in subtleties? And *their* subtleties were squandered on *words* (or on popular notions—same thing!) rather than on *facts* or nature; and they were useless the whole way through, unlike mine, which are indeed useless right now but which promise endless benefits later on. But this is sure, and you should know it:

All subtlety in disputations and other mental bustling about, if it occurs after the axioms have been discovered, comes too late and has things backwards. The true and proper time for subtlety, or anyway the chief time for it, is when pondering experiments and basing axioms on them.

For that other *later* subtlety grasps and snatches at [*captat*] nature but can never get a grip on [*capit*] it. . . .

A final remark about the lofty dismissal from natural history of everything *common*, everything *low*, everything *subtle* and as it stands useless: When a haughty monarch rejected a poor woman's petition as unworthy thing and beneath his dignity, she said: 'Then leave off being king.' That may be taken as an oracle. For someone who won't attend

to things like •these because they are too paltry and minute can't take possession of the kingdom of nature and can't govern it.

122. This may occur to you: 'It is amazing that you have the nerve to push aside all the sciences and all the authorities at a single blow, doing this single-handed, without bringing in anything from the ancients to help you in your battle and to guard your flanks.'

Well, I know that if I had been willing to be so dishonest, I could easily have found support and honour for my ideas by referring them either •to ancient times before the time of the Greeks (when natural science may have flourished more •than it did later•, though *quietly* because it hadn't yet been run through the pipes and trumpets of the Greeks), or even, in part at least, •to some of the Greeks themselves. This would be like the men of no family who forge genealogical tables that 'show' them to come from a long line of nobility. But I am relying on the evidentness of •the truth about• things, and I'll have nothing to do with any form of fiction or fakery. Anyway, it *doesn't matter* for the business in hand whether the discoveries being made now •were known to the ancients long ago and •have alternately flourished and withered through the centuries because of the accidents of history (just as it doesn't matter to mankind whether the New World is the island of Atlantis that the ancients knew about or rather is now discovered for the first time). It doesn't matter because *discoveries*—•even if they are *rediscoveries*—have to be sought [*petenda*] from the light of nature, not called back [*repetenda*] from the shadows of antiquity.

As for the fact that I am finding fault with everyone and everything: when you think about it you'll see that *that* kind of censure is more likely to be right than a partial one would be—and less damaging, too. For a partial censure would

imply that the errors were not rooted in primary notions, and that there had been some true discoveries; they could have been used to correct the false results, •and the people concerned would have been to blame for not seeing this•. But in fact the errors were fundamental; they came not so much from false judgment as from not attending to things that should be attended to; so it's no wonder that men haven't obtained what they haven't tried for, haven't reached a mark that they never set up, haven't come to the end of a road that they never started on.

As for the insolence that •you might think• is inherent in what I am doing: if a man says that

•his steady hand and good eyes enable him to draw a straighter line or a more perfect circle than anyone else,

he is certainly •making a comparison of abilities; but if he says only that

•with the help of a ruler or a pair of compasses can draw a straighter line or a more perfect circle than anyone else can by eye and hand alone,

he isn't •making any great boast. And I'm saying this not only about these first initiating efforts of mine but also about everyone who tackles these matters in the future. For my route to discovery in the sciences puts men on the same intellectual level, leaving little to individual excellence, because it does everything by the surest rules and demonstrations. So I attribute my part in all this, as I have often said, to good luck rather than to ability—it's a product of *time* rather than of *intelligence*. For there's no doubt that luck has something to do with men's thoughts as well as with their works and deeds.

123. Someone once said jokingly ‘It can’t be that we think alike, when one drinks water and the other drinks wine’; and this nicely fits my present situation. Other men, in ancient as well as in modern times, have done their science drinking a crude liquor—like water

(1) flowing spontaneously from a spring or (2) hauled up by wheels from a well, (1) flowing spontaneously from the intellect or (2) hauled up by logic.

Whereas I drink a toast with a liquor strained from countless grapes, ripe and fully seasoned ones that have been gathered and picked in clusters, squeezed in the press, and finally purified and clarified in the vat. No wonder I am at odds with the others!

124. This also may occur to you: ‘You say it against others, but it can be said against you, that the goal and mark that you have set up for the sciences is not the true or the best.’ ‘The accusation would develop like this:’

Contemplation of *the truth* is a worthier and loftier thing than thinking about how *big and useful* one’s practical results will be. Linger long and anxiously on •experience and •matter and •the buzz of individual events drags the mind down to earth, or rather sinks it to an underworld of turmoil and confusion, dragging it away from a much more heavenly condition—the serene tranquillity of abstract wisdom.

Now I *agree* with this line of thought; what the objectors here point to as preferable is what I too am after, above everything else. For I am laying down in the human intellect the foundations for a *true model of the world*—the world as it turns out to be, not as one’s reason would like it to be. This can’t be done unless the world is subjected to a very diligent dissection and anatomical study. As for the stupid models of the world that men have dreamed up in philosoph-

ical systems—like the work of *apes!*—they should be utterly scattered to the winds. You need to know what a big difference there is (as I said above [23]) between the •idols of the human mind and the •ideas in the divine mind. The former are merely arbitrary abstractions; the latter are the creator’s little seals on the things he has created, stamped into matter in true and exquisite lines. In these matters, therefore, truth and usefulness are the very same thing; and practical applications of scientific results are of greater value as pledges of truth than as contributing to the comforts of life.

125. Or you may want to say this: ‘You are only doing what the ancients did before you; so that you are likely, after all this grinding and shoving, to end up with one of the systems that prevailed in ancient times.’ The case for this goes as follows:

The ancients also provided at the outset of their speculations a great store and abundance of examples and particulars, sorted out and labelled in notebooks; then out of them they constructed their systems and techniques; and when after that they had checked out everything they published their results to the world with a scattering of examples for proof and illustration; but they saw no need to take the considerable trouble of publishing their working notes and details of experiments. So they did what builders do: after the house was built they removed the scaffolding and ladders out of sight.

I’m sure they did! But this objection (or misgiving, rather) will be easily answered by anyone who hasn’t completely forgotten what I have said above. The form of inquiry and discovery that the ancients used—they declared it openly, and it appears on the very face of their writings—was simply this:

From a few examples and particulars (with some common notions thrown in, and perhaps some of the most popular accepted opinions). they rushed to the most general conclusions, the ·would-be· first principles of ·their· science. Taking the truth of *these* as fixed and immovable, they proceeded to derive from them—through intermediate propositions—lower-level conclusions out of which they built their system. Then if any new particulars and examples turned up that didn't fit their views, they either •subtly moulded them into their system by distinctions or explanations of their rules, or •coarsely got rid of them by ·tacking· exceptions ·onto their principles·. As for particulars that weren't in conflict ·with their views·, they laboured away through thick and thin to assign them causes in conformity with their principles.

But this wasn't the experimental natural history that was wanted; far from it. And anyway dashing off to the highest generalities ruined everything.

126. This will occur to you too: 'By forbidding men to announce principles and take them as established until they have arrived at the highest generalities in the right way through intermediate steps, you are inviting them to *suspend judgment*, bringing this whole affair down to Acatalepsy.' Not so. What I have in mind and am propounding is not Acatalepsy [from Greek, = 'the doctrine that nothing can be understood'] but rather Eucatalepsy [from Greek, = 'the provision of what is needed for things to be understood']. I don't •disparage the senses, I •serve them; I don't •ignore the intellect, I •regulate it. And it is surely better that we should

know everything that we need to know, while thinking that our knowledge doesn't get to the heart of things than that we should

think our knowledge gets to the heart of things, while we don't yet know anything we need to know.

127. You may want to ask—just as a query, not an objection—whether I am talking only about natural philosophy, or whether instead I mean that the other sciences—logic, ethics and politics—should be conducted in my way. Well, I certainly mean what I have said to apply to them all. Just as •common logic (which rules things by syllogisms) extends beyond natural sciences to all sciences, so does •mine (which proceeds by induction) also embrace everything. I am constructing a history and table of discovery for

- anger, fear, shame, and the like; for
- matters political; and for
- the mental operations of memory, composition and division, judgment and the rest,

just as much as for

- heat and cold, light, vegetative growth and the like.

But my method of interpretation ·differs from the common logic in one important respect; my method·, after the history has been prepared and set in order, concerns itself not only with •the movements and activities of the mind (as the common logic does) but also with •the nature of things ·outside the mind·. I guide the mind so that its way of engaging with any particular thing is always appropriate. That's why my doctrine of interpretation contains many different instructions, fitting the discovery-method according to the quality and condition of the subject-matter of the inquiry.

128. 'Do you want to pull down and destroy the philosophy, arts and sciences that are now practised?' There ought to be no question about that. Far from wanting to destroy them, I am very willing to see them used, developed and honoured. I don't want to get in the way of their •giving men something to dispute about, •supplying decoration for discourse,

•providing the ‘experts’ with an income, and •facilitating civil life—acting, in short, like coins that have value because men agree to give it to them. Let me clear about this: what I am presenting won’t be much use for purposes such as those, since it can’t be brought within reach of the minds of the vulgar except ·indirectly·, through effects and works. My published writings, especially my *Two Books on the Advancement of Learning*, show well enough the sincerity of my declaration of friendly good will toward the accepted sciences, so I shan’t expend more words on that topic here. Meanwhile I give clear and constant warning that the methods now in use won’t lead to any great progress in the theoretical parts of the sciences, and won’t produce much in the way of applied-science results either.

129. All that remains for me to say are a few words about the excellence of the end in view. If I had said them earlier they might have seemed like mere *prayers*; but perhaps they’ll have greater weight now, when hopes have been created and unfair prejudices removed. I wouldn’t have said them even now if I had done the whole job myself, not calling on anyone else to help with the work, because ·words said in praise of the object of this exercise· might be taken as a proclamation of my own deserts. But ·I’m not going it alone·; I do want to energize others and kindle their zeal, so it is appropriate that I put men in mind of some things, ·even at the risk of *seeming* to boast·.

The making of great ·scientific· discoveries seems to have pride of place among human actions. That was the attitude of the ancients: they honoured the makers of discoveries as though they were *gods*, but didn’t go higher than *demigods* in their honours for those who did good service in the state (founders of cities and empires, legislators, saviours of their country from long endured evils, quellers of tyrannies, and

the like). And if you think accurately about the two ·kinds of benefactor· you will see that the ancients were right about them. Why? **(1)** Because the benefits of ·scientific· discoveries can •extend to the whole of mankind, and can •last for all time, whereas civil benefits •apply only to particular places and •don’t last for very long.

(2) Also, improvements in civil matters usually bring violence and confusion with them, whereas ·scientific· discoveries bring delight, and confer benefits without causing harm or sorrow to anyone.

·Scientific· discoveries are like new creations, imitations of God’s works. . . . It seems to be worth noting that Solomon, the marvel of the world, though mighty in empire and in gold, in the magnificence of his works, his court, his household, his fleet, and the lustre of his name, didn’t glory in any of these, but pronounced that ‘It is the glory of God to conceal a thing; but the honour of kings is to search out a matter’ (*Proverbs* 25:2).

If you compare how men live in the most civilized provinces of Europe with how they live in the wildest and most barbarous areas of the American continent, you will think the difference is big enough—the difference in •the condition of the people in themselves as well as in •what conveniences and comforts they have available to them—to justify the saying that ‘man is a god to man’. And this difference doesn’t come from the Europeans’ having better soil, a better climate, or better physiques, but from the arts [see note on ‘art’ on page 1].

Notice the *vigour* of discoveries, their power to generate consequences. This is nowhere more obvious than in three discoveries that the ancients didn’t know and whose origins (all quite recent) were obscure and humdrum. I am talking about the arts of •printing, •gunpowder, and •the nautical compass. These three have changed the whole aspect and

state of things throughout the world—the first in literature, the second in warfare, the third in navigation—bringing about countless changes; so that there seems to have been no empire, no philosophical system, no star that has exerted greater power and influence in human affairs than these mechanical discoveries.

For my next point, I need to distinguish the three kinds—three *levels*, as it were—of human ambition. **(1)** Some people want to extend their power within their own country, which is a commonplace and inferior kind of ambition. **(2)** Some work to extend the power and dominion of their country in relation to mankind in general; this is certainly not as base as **(1)** is, but it is just as much a case of greed. **(3)** If a man tries to get mankind’s power and control over the universe off to a fresh start, and to extend it, *his* ambition (if it is ambition at all) is certainly more wholesome and noble than the other two. Now—this being the point I wanted to make—man’s control over things depends wholly on the arts and sciences, for we can’t command nature except by obeying her.

A further point: it sometimes happens that •one particular discovery is so useful to mankind that the person who made it and thus put the whole human race into his debt is regarded as superhuman; so how much higher a thing it is to discover something through which •everything else can easily be discovered! •Not that a discovery’s consequences are the main thing about it. *Light* is useful in countless ways, enabling us to walk, practise our arts, read, recognize one another, and yet something that is finer and lovelier than all those uses of light is *seeing light*. Similarly, merely contemplating things as they are, without superstition or imposture, error or confusion, is in itself worthier than all the practical upshots of discoveries.

Final point: If anyone counts it against the arts and sciences that they can be debased for purposes of wickedness, luxury, and the like, don’t be influenced by that. The same can be said of all earthly goods: intelligence, courage, strength, beauty, wealth—even *light*! Just let the human race get back the right over nature that God gave to it, and give it scope; how it is put into practice will be governed by sound reason and true religion.

130. The time has come for me to present the art of interpreting nature—the art itself, not just remarks about the need for it, its virtues, and so on. Although I think I have given true and most useful precepts in it, I don’t say that this art is absolutely necessary, implying that nothing could be done without it. In fact, I think that if

•men had ready at hand a sound history of nature and of experiments, •were thoroughly practised in it, and •imposed on themselves two rules: **(1)** set aside generally accepted opinions and notions, and **(2)** for a while keep your mind away from the highest and second-to-highest generalizations,

they would arrive at my form of interpretation sheerly through their own natural intelligence, with no help from any other rules or techniques. For interpretation is the true and natural work of the mind when it is freed from blockages. It is true, however, that it can all be done more readily and securely with help from my precepts.

And I don’t say, either, that my art of interpreting nature is complete so that nothing can be added to it. On the contrary: I am concerned with the mind not only in respect of its own capacities but also in respect of how it engages with things; so I have to think that the art of discovery can develop as more discoveries are made.