

# The New Organon

## or: True Directions Concerning the Interpretation of Nature

Francis Bacon

Copyright ©2005–2010 All rights reserved. Jonathan Bennett

[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

## Contents

<b>PREFACE</b>	<b>1</b>
<b>APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 1: 1–77</b>	<b>5</b>
<b>APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 1: 78–130</b>	<b>25</b>
<b>APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 2: 1–25</b>	<b>49</b>
<b>APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 2: 26–43</b>	<b>76</b>
<b>APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 2: 44–52</b>	<b>103</b>

## APHORISMS CONCERNING THE INTERPRETATION OF NATURE: BOOK 2: 44–52

**44.** So much for instances that help the senses. These are useful mainly for the informative part of my topic, because information starts from the senses. But the end-point of the whole project consists in *works*: start with information, end with works. So I now come to instances that are chiefly useful for the applied part. There are **seven** kinds of these *practical instances*, as I call them, and they fall into two groups, corresponding to the two ways in which things can go wrong in the practical part of the scientific endeavour. An application may fail, or it may be too much trouble to carry out. When it simply fails (especially if the relevant natures have been carefully investigated), that is because the forces and actions of bodies haven't been properly discovered and measured. For the forces and actions of bodies to be properly described and measured, we have to answer questions of these forms:

How far away are they?  
 How long did it last?  
 How much of the stuff was there?  
 What power did it have?

Unless we have carefully accurate answers to these questions we won't get anywhere with our practical applications, however pretty our science is as a purely theoretical affair. To the **four** instances that correspond to these I give the general name 'mathematical instances' and 'instances of measurement'.

When an application is too laborious, that will be because there is a clutter of useless stuff  
 too much equipment is needed, or  
 the scale on which something has to be done is too great.

So we should value instances that either point our applications towards things that most closely concern mankind, or keep down the amount of equipment, or enable things to be done on a smaller scale. To the **three** instances that bear on these three matters I give the general name 'propitious' and 'benevolent instances'.

I'll now discuss these **seven** instances one by one; and that will bring me to the end of my treatment of privileged or leading instances.

**45.** Class 21 of privileged instances: **instances of the measuring-stick**, which I also call 'instances of range' or 'no-further instances'. The distances across which the powers and motions of things act and take effect are not indefinite or matters of chance; rather, they are definite and fixed. It's of great practical value to observe and note these distances in relation to any natures that we are investigating; that will help us to avoid downright errors, and will also give our applications wider scope and greater power. For we can sometimes increase powers and in a way reduce distances, as for example by the use of telescopes.

Most powers act and take effect only by out-in-the-open contact, as in collisions, where one body makes another move only by coming into contact with it. Also medical remedies that are applied externally, like ointments or plasters, don't do any good unless they touch the patient's body. And we don't taste or touch anything without coming into contact with it.

Some other powers act at a distance, though a very small one. These haven't been much attended to; there are many more of them than you might think. Some examples involve humdrum objects: amber or jet attracts straws; a bubble

will burst another bubble when they come close; certain laxatives draw down bodily fluids; and so on. The magnetic power by which a magnet comes together with a piece of iron or with another magnet iron operates within a fixed, narrow sphere of action. But if there is any magnetic power coming from the earth (just below the surface, it seems) and affecting the polarity of an iron needle, it must be operating at a considerable distance.

Again, if there is magnetic force operating by agreement [see long note on page 88] between the globe of the earth and heavy bodies, or between the globe of the moon and the waters of the ocean (as seems highly likely judging by the twice-monthly cycle of high and low tides), or between the starry heaven and the planets whereby the planets are drawn up to their highest points, all these must operate at very great distances. Some cases have been found in which materials—the naphtha at Babylon is said to be one—catch fire from a great distance. Heat also travels great distances, as does cold: the inhabitants of Canada feel the cold that is given off far away by the icebergs that break loose and float through the Atlantic toward their shores. . . . Lastly, light and sound operate at vast distances.

Whether they are great or small, all the distances at which these powers act are definite and known to nature [see note in <sup>122</sup> on page 7]. So ·in each case· there is a kind of *no further* which depends either on

- how much matter there is in the ·interacting· bodies,
- how strong or weak their powers are, or
- how much the forces are helped or hindered by the intervening medium

—and all of these should be noted and brought into the calculation. We should also measure so-called ‘violent’ motions [see page 18]—movements of missiles, guns, wheels, etc.—because clearly these also have their fixed limits.

Over against motions and powers that operate •by contact and not at a distance, there are ones that operate •at a distance and not by contact, and others that operate •weakly at a short distance and more powerfully at a longer one. Vision, for example, requires a distance across a medium; it doesn’t work well by contact. . . . Still, it is clear that one doesn’t have a clear view of large bodies unless they are at. . . . a certain distance ·from the eye·. And old people see objects better when they are a little way off than when they are very close. With missiles, too, it is certain that the impact is not as powerful at a very short distance as it is a little further off. These are some of the things that we should take account of. . . .

Another kind of spatial measurement of motion shouldn’t be ignored. It has to do not with linear motions ·in which something goes from one place to another· but rather with the motion that is involved when a body expands or contracts. Among our measurements of motions of this kind we must include inquiries into how much compression or extension bodies naturally allow, and at what point they begin to resist, until at last they will take it *no further*. When an inflated bladder is compressed, for example, it allows some compression of the air, but if it is compressed far enough it eventually can’t take it any longer, and bursts.

I tested this more precisely with a subtle experiment. I took a small metal bell, light and thin like a salt-cellar, and lowered it into a basin of water in such a way that it carried the air contained down with it. I had previously put a small globe at the bottom of the basin, and when I lowered the bell I put it over the globe—·over, not onto; the entire globe was inside the inner space of the bell·. It turned out that if the globe was small enough in proportion to the cavity of the bell, the air retreated into a smaller space, and was simply compressed rather than being squeezed out. But

if the globe, though still small enough to go wholly inside the cavity, was too large for the air to give way freely, then the air wouldn't submit to the greater pressure, and instead tilted the bell and rose to the surface in bubbles.

And here is an experiment I did to find out to what extent air could be *decompressed*. I took a glass egg with a small hole at one end, and drew air out of it by strong suction, of course leaving some of the air still in there, expanded to fill the whole interior space of the egg. Then I immediately blocked the hole with my finger, immersed the egg in water, and then took away my finger. The air, having been decompressed by the suction and expanded beyond its natural volume, and now trying to pull itself in again (so that if the egg hadn't been under water it would have drawn in air with a hissing sound), now pulled in enough water for the air to recover its previous volume.

It is certain that less dense bodies (such as air) can be considerably compressed, as I have said, but that tangible bodies (such as water) are much harder to compress and can't be compressed as much. To find out how much compression they allow, I conducted the following experiment.

I had a hollow globe made out of lead, with a capacity of about one quart and with sides thick enough to stand a considerable force. Having made a hole in it, I filled it with water and then closed the hole with molten lead, so that the globe became quite solid. I then flattened the globe by beating two opposite sides of it with a heavy hammer; this forced the water to shrink into less space, because a sphere is the most capacious of shapes. When the hammering had no more effect in making the water shrink, I used a vise to flatten the globe further, until the water couldn't take any more pressure and leaked through the solid lead like a fine dew. I then calculated how much space had been lost by the compression, and concluded that this was the extent of

compression which the water had allowed, but only when put under great force.

Bodies that are denser, dry, or more compact—such as wood, stones and metals—are much harder to compress; any contraction they undergo under pressure is scarcely perceptible. They free themselves by breaking, by moving away, or by other tactics, as we can see in the bending of wood or metal, in the unwinding of springs that drive clocks, in projectiles, in hammering, and in countless other motions. All these things with their measures should be noted and tested in the investigation of nature—either exactly, or by estimate, or by comparison, as opportunity arises.

**46.** Class 22 of privileged instances: **running instances**. . . . These measure nature by periods of time, as the instances of the measuring-stick measure it by spatial distances. Every natural motion or action is performed in time, some quicker, some slower, but all across periods that are certain and known to nature. Even events that seem to be performed instantly—in the blink of an eye, as we say—are found to last for more or less time.

Let us start by looking at some processes and their various speeds, starting with some protracted ones and gradually moving to ones that go faster. The revolutions of heavenly bodies take known periods of time, as does the cycle of the ocean's high and low tides. The movement of heavy things falling to the earth and of light things floating up towards the region of the heavens happens in definite periods which vary according to the body that is moving and the medium through which it is moving. The sailing of ships, the movements of animals, the onward thrust of missiles—these too take periods of time that can be calculated in rough and ready terms. As for heat, we see boys in wintertime bathe their hands in flame without being burned. And flow of

liquids: jugglers nimbly and smoothly upend jars of wine or water and then turn them right way up again, not spilling the liquid. And so on. The compression, expansion and eruption of bodies occur at different rates depending on the kind of body and kind of motion, but all of them take *some* time. When several cannons go off at once, they may be heard thirty miles away, but they will be heard *earlier* by people who are close by. The action of eyesight, though extremely rapid, does take some time to occur; this is shown by things that move too fast to be seen. For example, when a bullet is fired from a gun it goes too quickly for an impression of it to reach the eye, and that shows that it *takes time* for eyesight to work.

Facts like these have at times prompted me to suspect (though this is *strange*) that

the face of a serene and starlit sky is seen not exactly when it really exists but a little later,

which involves suspecting that

so far as our sight of heavenly bodies is concerned, there is a difference between real time and seen time, like the distinction between real place and seen place that astronomers take account of when they correct for parallax.

This suspicion came from its seeming incredible to me that the images or rays of heavenly bodies could reach our eyes across such an immense space *instantaneously*, rather than taking a perceptible length of time to reach us. But the suspicion that there is an appreciable interval between real time and seen time vanished entirely when I came to think of •how *enormously* much brighter the stars are than they appear to us to be (because of how far away they are); and of •the fact that merely white bodies on earth are seen *instantly* across •large• distances—sixty miles or more, •two days' journey for a man•. There is no doubt that the light of the heavenly

bodies is *many* times more vigorous in its radiation not only than merely white things but also than the light of every flame known to us here on earth. •And if radiation x is vastly •more vigorous than radiation y, it can hardly be the case that x is •slower than y!• Also, the immense velocity of the body itself [presumably meaning: the sun or any star] that we see in its daily motion (a velocity so amazing that some serious thinkers prefer to believe that it's only the earth that moves) makes it easier to believe in this wonderfully fast emission of rays. But what carried most weight with me was the thought that if any perceptible interval of time passed between the reality and the sighting, the images would often be intercepted and confused by disturbances that occurred in the medium during that interval—clouds arising and the like. That completes what I have to say about simple •non-comparative• measurements of time.

Much more important than those, however, are comparisons amongst the times taken by various motions and actions; for this information is extremely useful and relates to very many things. •Here are some comparisons that we know about•. •It seems that light travels faster than sound: we see the flash of a gun before we hear the bang, although the bullet must strike the air •thus causing the bang• before the flame behind it can get out •thus causing the flash•. •Visual images are taken up by sight faster than they are discarded. Examples of this:

- When a violin string is plucked with a finger, it looks like two or three strings, because •as it moves• new images are received before the old one is discarded;
- spinning rings look like globes;
- a lighted torch carried swiftly at night seems to have a tail.

(Galileo built his theory of the tides on the basis of the unequal speeds of motions. He held that the earth revolved

too fast for the oceans to keep up, so that the water heaps up and then falls down, as we see it do in a basin of water moved quickly. But in building this theory he took for granted something that can't be taken for granted, namely that the earth moves. Also, he wasn't well informed about the six-hourly movement of the ocean.)

A genuine example of my double topic—the comparative measures of motions and the enormous *usefulness* of the comparative measurement of motions—is the following. When gunpowder is used in subterranean mines, a tiny amount of the powder upsets vast masses of earth, buildings, and so on, throwing them into the air. What causes this is that the expanding motion of the gunpowder (the impelling force) is many times faster than the only motion that could provide any resistance, namely the motion from the weight of the earth, buildings etc.; so that the first motion is all over before the countermotion gets started, which means that at first there is no resistance. That is also why it is that to get a projectile to carry a long way you need to give it not a strong launching but a sharp quick one. And why can the small quantity of animal spirit in animals, especially in such huge creatures as whales and elephants, steer and control such a vast bodily mass? It is because the spirit moves very quickly and the bodily mass moves slowly in exerting its resistance. . . .

Lastly, we should note the *before* and *after* aspects of every natural action. [He gives examples involving the extracting of medicines or aromas—first this one, then that—from various substances.]

**47.** Class 23 of privileged instances: **instances of quantity.** . . . These are instances that measure powers in terms of the quantity of the bodies that have them, showing what quantity of the body generates how much of the power. First,

there are some powers that are possessed only by world-sized quantities of matter, that is, quantities that agree with the structure and fabric of the world as a whole. For the earth stands fast; its parts fall. The ebb and flow of waters occurs in the oceans but not in rivers (except from the sea flowing in to them). Then there are particular powers nearly all of which act according to whether it is a large or a small body that has them. Large quantities of water go stale and bad slowly, small ones quickly. Wine and beer mature and become fit to drink much more quickly in small containers than in casks. . . . In its effect on the human body, a bath is one thing, a light sprinkling another. Unlike heavy dews and outright rain, light dews in the air never fall, but are dissipated and incorporated into the air. (If you breathe on a precious stone you'll see that little bit of moisture instantly dissolved, like a cloud scattered by the wind.) A whole magnet draws more iron than a piece of it does. And then there are powers that are *greater* when *small* quantities of matter are involved—for example, a sharp point pierces more quickly than a blunt one does, a pointed diamond engraves on glass, etc.

But we shouldn't linger on these indefinite relations between quantity of stuff and amount of power. We should investigate *how much* the power of a body varies with its quantity. Don't think that there is no need to investigate this because it is obvious how power is proportioned to quantity. It would be natural to think that the relationship is one of equality, so that a one-ounce piece of lead will fall to the ground twice as quickly as a two-ounce piece. But the fact is that it won't! And the power-to-quantity proportions are different for different kinds of power. To get these measures, therefore, we must go to the things themselves—to empirical experiments—and not rely on likelihood or conjecture. . . .

**48.** Class 24 of privileged instances: **instances of strife**, which I also call ‘instances of predominance’. These indicate relative strengths and weaknesses of powers—which of them is stronger and prevails, which is weaker and gives way. This is a more complex matter than you might think, because the motions and efforts of bodies can be compounded, decomposed, and remixed, just as the bodies themselves can. If I am to identify and explain instances of strife and predominance, doing this clearly, I need first to compare the strengths of various kinds of power; and to do that I must first say what the main kinds of motion or active power are. There are nineteen of them, and they will occupy my next ten pages.

(1) I take first *the motion of antitypy*. [In the standard sense of this word—it is pronounced an-*tit*-apee—a thing has ‘antitypy’ if it occupies a region of space in such a way that while it is there no other body can be there. Bacon understands it differently, though at the end of this paragraph he points to the standard meaning.] This is in every single portion of matter, so that it absolutely refuses to be annihilated. Thus, no fire or weight or pressure or force or passage of time can reduce any portion of matter, however small, to nothing. A portion of matter will always be something, and be somewhere. When it is under stress it may escape by changing its form or moving to somewhere else; but if it can’t do either, it will stay as it is and where it is; it will never be brought to the point of being nothing or being nowhere. The Schoolmen (who usually name and define things by effects and negative consequences rather than by inner causes) call the motion of antitypy ‘the motion to prevent penetration of dimensions’ or express it through the axiom *Two bodies can’t be in one place at the same time*. I needn’t give examples of this motion, because it is inherent in every body.

(2) In the second place I take *motion of bonding*, by which

a body doesn’t allow itself to be separated at any point from contact with another body—as though they enjoyed being bonded and in contact. The Schoolmen call this ‘the motion to prevent a vacuum’, as when water is drawn up by suction or in a pump, when flesh is pulled up by cupping glasses, when water stays in a pot that has a hole at the bottom unless the mouth of the jar is opened to let in air, and countless things of that sort.

(3) Thirdly, what I call *motion of liberty*, by which a body tries to free itself from unnatural pushes or pulls and to restore itself to the shape suitable to its nature. We have countless examples of this too. I’ll start with ones that involve getting free from pushes: the motion of water around a swimming fish, of air around a flying bird, of water around the oars of rowers, of air in wind-gusts, of springs in clocks. We have a neat example in the motion of compressed air in children’s popguns. [He tells the reader how to make a popgun. Then:] As for bodies getting free from pulls: this motion displays itself in the air that remains in a glass egg after suction; in strings, leather and cloth, which regain their shape after the pulling stops (unless the pull has gone too far for that), and in similar phenomena. The Schoolmen call this ‘motion in accordance with the form of the element’, but this was ignorance on their part; the motion in question belongs not only to fire, air, and water (traditionally classified as ‘elements’), but to every kind of solid substance—wood, iron, lead, cloth, parchment, etc. An individual body composed of one of these has its own characteristic shape which can’t easily be much altered.

[In this next paragraph, mentions of ‘being squeezed down to nothing’ are translations of some uses of ‘penetration of dimensions’. That is not at all what the phrase has standardly meant; its standard meaning, like that of ‘antitypy’, concerns a body’s not sharing its space with any other body. But it is clear that in this present context Bacon does, bizarrely,

use ‘penetration of dimensions’ to mean a body’s being squeezed down to nothing; and the present version makes that explicit, in the interests of clarity.] Just because there is so much of this motion of liberty and because it is so obvious, it would be as well to be very clear about exactly *what* motion it is. Some people carelessly confuse **(3)** this motion with **(1,2)** its two predecessors. Specifically,

- they confuse **(3)** getting free from pushes with the motion of **(1)** •antitypy, the idea being that when bodies are pushed they **(3)** push back so that **(1)** nothing will be squeezed down to nothing; and
- they confuse **(3)** getting free from •pulls with the motion of **(2)** •bonding, the idea being that when bodies are pulled they **(3)** pull back so that **(2)** there won’t be a vacuum.

•Both these lines of thought are quite wrong. If air under pressure were to contract itself to the density of water, or wood to the density of stone, that wouldn’t require it to be squeezed down to nothing; these bodies could let themselves be compressed far more drastically than they ever are in fact, without any risk of contracting to *nothing*; •so it can’t be right to explain their resistance to pressure as required to avoid being squeezed down to nothing. Similarly, if water were to expand to the rareness of air, or stone to the rareness of wood, that wouldn’t require there to be a vacuum; these bodies could let themselves be expanded far more than they ever are in fact, without any risk of a vacuum; •so it can’t be right to explain their resistance to pulling as required to avoid vacuum. In short:

- Condensation and •rarefaction don’t involve
- squeezing down to nothing or •vacuum, except at their extreme limits; and the motions I am talking about—ones that actually occur—are nowhere near these limits. They are merely the tendencies that

bodies have to keep their own shapes. . . . unless they are altered gently and through agreement.

•So much for a couple of things that the motion of liberty is *not*. A more important point, with a lot riding on it, concerns something that the motion of liberty is. Think about so-called ‘violent’ motion [see page 18], which I call ‘mechanical’ motion, and that Democritus (who in his exposition of his ‘primary motions’ doesn’t rise to the level of mediocrity!) called motion of the *blow*. I now say that this—e.g. the motion of a ball when it is kicked—is simply the motion of liberty, that is, of getting free from compression and loosening up again. When you kick a ball, the ball as a whole won’t start to move until your kick compresses parts of it more than is natural for them. *Then* those parts will push against adjacent parts, and so on through all the parts—and eventually the entire ball is moved. (Essentially the same story holds for the ball’s subsequent movement through the air). . . .

That’s all I want to say about this kind of motion.

(4) Fourthly there is the kind of motion that I call *matter motion*. [When talking about this kind of motion, but nowhere else in the work, Bacon uses the Greek word for ‘matter’, not the Latin one.] It is a kind of opposite of the motion of liberty that I have just been discussing. In the motion of liberty the body in question hates and avoids taking on a new shape or size, and tries its hardest to get back to its original state. By contrast, in this matter motion a body wants a new size or shape, and works towards it freely and promptly, and sometimes with most vigorous effort, as in the case of gunpowder. The chief instruments of this motion—perhaps the most powerful ones, and certainly the commonest—are heat and cold. For example, when air is expanded by ‘pulling’, as by suction in glass eggs, it struggles to •contract and thereby restore itself to its pre-suction size. But if air is heated, it wants to •expand and to take on a new size and shape, and it readily acquires

that and passes over into a so-called ‘new form’. And after achieving a certain degree of expansion it doesn’t want to return, unless invited to do so by an application of cold, and what that brings about is not really a *return* but rather a renewed transformation. Similarly, when water is made to contract by pressure, it resists and wants to return to its previous state, i.e. it wants to become larger. But if it is then subjected to intense and continued cold, it spontaneously and freely changes itself to the density of ice; and if the cold continues for a long time without a break (as happens in deep caves), it turns into crystal or some such, and never returns to its previous liquid state.

(5) In fifth place I take the *motion of cohesion or inter-connection*. I don’t mean the simple basic holding-together of a pair of bodies (that’s the motion of bonding), but the holding-together or cohesion of a single body just in itself. It is quite certain that all bodies resist a breaking up of their continuity—some more than others, but *all* to some extent. In hard bodies such as steel and glass the resistance to breaking up is exceedingly strong. And in liquids, where the power of cohesion seems to be absent or at any rate very weak, we never find it to be *entirely* absent though in liquids it is present in very low degree. It shows itself in a multitude of empirical events: bubbles, the roundness of drops, thin little trickles of water, stickiness of glutinous bodies, and the like. But this force for holding together is most evident when you try to break up very small fragments. When something is being ground in a mortar, after a certain stage the pestle stops having any effect. Water doesn’t penetrate into minute chinks; even air itself, finely broken up as it is, gets through the pores of fairly solid vessels only when given a long time to do so. Whereas the water and the air would rapidly and easily pass through if there were no limit to how finely they could easily be divided.

(6) Sixthly, there is what I call *motion for gain* or motion of *need*. It is what comes into play when a body is placed among other bodies that are quite unlike it and almost hostile to it, and it finds an opportunity to get away from these and to connect up with bodies that are more like itself. Even if these others have no great agreement with it, the body in question embraces them, chooses them as preferable, and seems to view this connection as a *gain* (hence the label), and as though it *needed* such bodies. For example, gold or any other metal in leaf form doesn’t like the surrounding air, and if it comes across any thick tangible body (finger, paper, what you will) it instantly sticks to it and isn’t easy to peel off. So too paper, cloth, and the like aren’t comfortable with the air that is lodged in their pores, and gladly soak up water or other moisture and drive out the air. If you dip a sugar-lump or a sponge half-way into water or wine, it will gradually draw the liquid upward.

This gives us excellent rule for opening up and dissolving bodies. Set aside corrosives and acids that have their own ways of opening up bodies. Then: Suppose that a body x is forcibly united with another body y, and that you want to drive them apart. Find some suitable body z that is more friendly and agreeable to x than y is; and x will immediately open up, loosen itself, and take in z while rejecting y. This motion for gain can exist and act without immediate contact. For the electric operation of which Gilbert and his followers have stirred up such fables is nothing but the result of activating a body by gentle friction so that it doesn’t tolerate the air and prefers whatever other tangible body it can find nearby.

(7) In seventh place is what I call *the motion of major aggregation*, by which bodies are carried towards masses that are like themselves—heavy bodies to the globe of the earth, light ones to the sphere of the heavens. The School-

men called this ‘natural motion’, for the trivial reason that •they couldn’t see any external cause for it, from which they inferred that it was a built-in aspect of things’ nature, or perhaps just because •it never stops. *Of course* it never stops! the heavens and the earth are always there, whereas the causes and origins of most other motions are sometimes absent and sometimes present. So the Schoolmen regarded this motion as in-built and perpetual, and all others as •not in-built but• caused from outside, because it starts up the moment the others leave off. In fact, though, this motion is fairly weak and dull; except in very large bodies, this motion gives way to all other motions as long as they are in operation. And though this motion has filled men’s thoughts to the almost total exclusion of all others, they know very little about it and are involved in many errors about to it.

(8) Eighthly, there is the motion of ‘minor aggregation’. In this kind of motion

- the homogeneous *parts* of a body separate themselves from the heterogeneous parts and combine together;

and also

- whole* bodies that are alike in substance embrace and cherish each other, sometimes having come together through attraction across a considerable distance.

An example of this is provided by milk that has stood awhile, when the cream rises to the top; and by wine in which the dregs sink to the bottom. What causes these events is not the mere motion of heaviness (dregs to the bottom) or lightness (cream to the top), but rather the desire of the homogeneous parts to come together and coalesce into one.

This motion differs from (6) the motion of *need* in two ways. (a) In the motion of need the main stimulus comes from a malignant and contrary nature, whereas in *this* motion the parts unite (provided they aren’t blocked or tied

down) through friendship; they don’t have to be escaping from some other thing whose nature is troublesome to them. (b) This motion produces a union that is closer and more *chosen* (as it were) •than the union produced by the motion of need•. In the motion of need, bodies that don’t have much to do with one another will come together •loosely• just to avoid some body that is hostile to them; whereas in this •motion of minor aggregation• substances are drawn together •tightly• into a kind of unity by the tie of close relationship. This motion is present in all compound bodies, and would easily show up in each one if it weren’t for the fact that other appetites and necessities in the bodies tie it down and constrain it, thus interfering with •the forming of• the union. [Recall that Bacon introduced this long section on page 107 with remarks about ‘powers’, then ‘motions and efforts’ (it could be ‘motions and forces’), then ‘the main kinds of motion or active power’. From there on he has said it all in terms of ‘motion’, not ‘power’, but his basic topic is *powers*. What he means in the sentence starting ‘This motion is present’ is not that certain movements secretly occur, but that a certain power is secretly present.]

When this motion is tied down, that usually happens in one of three ways: through •the sluggishness of bodies, through •the constraint of a dominant body, or through •external motions. •These are large topics, and I shall give them a paragraph each•.

**Sluggishness:** It is certain that tangible bodies have in varying degrees a kind of laziness, a dislike of moving, so that unless they are stimulated they prefer remaining in their present state (whatever it is) to changing for the better. There are three ways for this sluggishness to be thrown off: by •heat, or by •the dominant power of some related body, or by •a lively and powerful motion. **Heat:** It is because of this role of heat that it was defined by Aristotelians as *what*

*separates heterogeneous things and brings together homogeneous things.* Gilbert rightly mocked this definition, saying that it is on a par with defining *man* as *something that sows wheat and plants vines*—the point being that each is a definition in terms of a few of the effects of the item whose name is being defined. But the Aristotelian definition has a worse fault, namely that the effects that it picks on (such as they are)

aren't special to heat,

because cold produces the same effects, as I shall show later; and also they

don't come directly from heat as such.

What directly causes the effects in question is the desire of homogeneous parts to come together, and heat takes an indirect hand in this by help the body to shake off the sluggishness that had been getting in the way of the desire. **The power of a related body:** There's a fine example of this in any armed magnet [explained in note on page 75], the power of which enables a piece of iron to throw off its sluggishness, thus activating its power of holding onto other pieces of iron to which it is attracted because their substance is similar to its own. **Help from motion:** This is shown in wooden arrows that have wooden points. When such an arrow is shot into wood, its point penetrates more deeply than it would have if it had been tipped with iron, because of the wood-to-wood the similarity of substance; and what gets the arrow to throw off its sluggishness and act in this way is its fast motion through the air. I mentioned these two experiments in the section on concealed instances [25 on page 74].

**Constraint of a dominant body:** This kind of hindering of the motion of minor aggregation can be seen in the way blood and urine are broken up by cold. As long as blood or urine is filled with an active spirit that dominates the whole thing

and controls and keeps in check all its parts of whatever kind, the homogeneous parts are restrained from coalescing. But when that spirit has evaporated, or been choked by cold, then the parts are freed from restraint and coalesce in accordance with their natural desire. That's why any body containing a sharp, strong spirit (salt or the like) doesn't separate out into different kinds of matter, and instead stays whole—because of the permanent, durable restraint of a dominant and commanding spirit.

**External motion:** The clearest example of external motion hindering the motion of minor aggregation is the shaking of bodies that prevents them from going rotten. All putrefaction is based on the coalescing of parts of the same kind, which gradually leads to the undoing of the so-called 'prior form' and the creation of a new one. If the preceding coalescing of parts of the same kind isn't impeded, it is a simple process of the separating out of parts, with nothing rotten about it. But if it encounters various obstacles, *then* putrefactions start up, and they are the beginnings of a new generation, i.e. the creation of a new form. Now, this motion of separating out and re-uniting is a delicate and sensitive affair, which needs to be free from disturbances from the outside. If the body in question is subjected to frequent agitation caused by some external motion, then the motion is disturbed, and stops. So there are three ways things could go, depending on what happens to the motion of minor aggregation: (a) It happens without interference, resulting in simple distillation or separating out of the parts. (b) It is somewhat obstructed, resulting in putrefaction. (c) It is subjected to great agitation, resulting in the body's remaining in its present condition, not divided into kinds and not rotten. We see countless examples of (c): water that flows, or that is often stirred, doesn't go bad; winds keep off pestilence in the air; corn that

is turned over and shaken up in the granary remains unspoiled; in short, anything that is disturbed from the outside will be slower to rot inwardly.

I should mention the coming-together of the parts of bodies that is the chief cause of hardening and desiccation. [Bacon seems here to use *desiccatio* to mean something like ‘the condition of being *visibly obviously* dried out’.] When the spirit (or moisture turned into spirit) has evaporated from some porous body such as wood, parchment or the like, then the denser parts contract and combine with greater force, and that leads to hardening and desiccation. What is going on here, I think, is not a motion of bonding [see (2) on page 108] or the fear of a vacuum, but rather this motion of friendship and union.

What about coming together from a distance? That happens rarely, but more often than is generally recognized. Examples of it:

- when one bubble dissolves another,
- when medicines draw out bodily fluids because their substance is similar,
- when the string in one lute makes a string in another lute give off the same sound,

and so on. This motion is very active in the spirits of animals, though nobody ·else· has noticed this. It is conspicuous in magnets and magnetized iron. (Since the topic of magnets has come up, I should make clear some distinctions amongst their motions. Magnets have four powers—four kinds of thing they do—that should be kept apart, though men in general, in wonder and bewilderment ·about the magnet in general·, have confused them. They are:

- the attraction of magnet to magnet, of iron to magnet, of magnetized iron to iron;
- the magnet’s north-south polarity, and at the same time its deviation from that;
- its penetration through gold, glass, stone, everything;

- its communication of its power from ·lode·stone to iron, and from iron to iron, with no intervening substance.

My present topic is the first of these powers, the magnet’s power to combine.) Remarkable also is the coming-together motion between mercury and gold: gold attracts mercury, even when made up into ointments; men who work amidst mercury fumes usually hold a piece of gold in their mouths to collect the fumes that would otherwise invade their skulls and bones—and in this process the gold quite soon turns white. And that’s all I have to say about the motion of minor aggregation.

(9) The ninth ·kind of· motion is *magnetic motion*. Although in a general way it belongs to the species *motion of minor aggregation*, when it operates across great distances and on large masses it deserves to be investigated separately—especially if it doesn’t start with contact as do most cases of motion of aggregation, or lead to contact as do *all* [? = ‘all other’] cases of motion of aggregation, but simply raises bodies or makes them swell, and nothing more. When the moon ·raises the waters, or makes moist things swell; when the starry heaven ·draws planets to their high-points; when the sun ·holds Venus and Mercury so that they never get further from it than a certain distance; these motions don’t seem like good cases of either major or minor aggregation, but rather to involve a sort of intermediate and incomplete aggregation, and therefore to deserve to have a species to themselves.

(10) The tenth ·kind of· motion is *motion of avoidance*. In this bodies are driven by antipathy to flee from hostile bodies and drive them away—to withdraw from them and refuse to mingle with them. (So it’s the opposite of the motion of minor aggregation.) In some cases this motion may seem to be an incidental result of some motion of minor aggrega-

tion: homogeneous things can't meet without dislodging and pushing away heterogeneous things, and that could look like motion of minor aggregation. But we should recognize the motion of avoidance as belonging to a species all of its own, because in many cases we can see that the drive to avoid is more dominant than the drive to combine.

This motion is remarkably conspicuous in animals' excretions and in other objects that are offensive to some of the senses, especially smell and taste. The sense of smell rejects a fetid odour so strenuously that it brings about, through agreement, a motion of expulsion in the mouth of the stomach [i.e. it makes one throw up]; a bitter nasty taste is so strongly rejected by the palate or the throat that it brings about, through agreement, a shaking of the head and a shudder. But this motion of avoidance occurs elsewhere as well. It is observed in certain forms of reaction; the coldness of the middle region of the air seems to be a result of the exclusion of the nature of cold from the region of the heavenly bodies; just as the great heat and fire that is found in subterranean places appear to be results of the exclusion of the nature of heat from the deeper parts of the earth's interior. For heat and cold, in small quantities, wipe one another out. But when they occur in large masses, like opposing armies, the outcome of the conflict is that each displaces and ejects the other. It's said that cinnamon and other perfumes retain their scent longer when placed near to latrines and other foul-smelling places, because they refuse to come out and mingle with the nasty odours. Liquid mercury would unite into a single undivided mass if left to itself, but it is certainly kept from doing so by saliva, hog's lard, turpentine and the like, owing to the its parts' lack of agreement with such bodies. When any of these substances is scattered, the mercury withdraws, its avoidance of these intervening bodies being more powerful than its desire to unite with other parts like

itself. They call this 'mortifying' the mercury. Why doesn't oil mix with water? Not because their weights are different, but because of the poor agreement between them. You can see that weight isn't the reason, from the fact that alcohol, though even further from the weight of water than oil is, mixes well with water. . . .

(11) In the eleventh place is the *motion of assimilation* or of self-multiplication or of simple generation. In that last phrase I'm not talking about the generation of whole organically structured bodies such as plants and animals, but of bodies that don't have organic structure and instead are of uniform texture. With this sort of motion, that is, such uniform bodies convert others that are kin to them, or at least well disposed to them and well prepared, into their own substance and nature. Thus flame over vapours and oily substances multiplies itself and generates new flame; air over water and watery substances multiplies itself and generates new air; vegetable and animal spirit over the more delicate parts of watery and of oily substances in food multiplies itself and generates new spirit; the solid parts of plants and animals—leaf, flower, flesh, bone and so on—generate new substance out of the juices of their food. Don't be taken in by the wild talk of Paracelsus who holds that nutrition consists purely of separation; that eye, nose, brain and liver lie hidden in bread and meat, and that root, leaf, and flower lie hidden in the moisture of the ground. A human sculptor, he points out, brings leaf, flower, eye, nose, hand, foot etc. out of the raw stone by separating out and rejecting what he doesn't want in it; and he likens this to Archaeus, the inner craftsman, who he says makes the various organs and parts of our body by selecting some parts of our food and rejecting the rest. (I suppose he was drunk from his own distillations when he wrote this!) Leaving this nonsense aside, it's certain that the individual parts of plants and animals—parts

that are themselves organically structured as well as parts that aren't—do at first take in somewhat selectively the juices of their food. . . .and then assimilate them and turn them into their own nature. What distinguishes this from the fantasy of Paracelsus is the *assimilation* part of the story. I don't say that the form or nature of the nose, eyes, fingers etc. are latent in the food, but merely that the food contains material that the nose, eyes, fingers etc. can take over and remould into its own form. This assimilation or simple generation doesn't occur only in living bodies; inanimate bodies also share in it, as I said regarding flame and air. Moreover, the non-living spirit contained in every tangible animated thing is constantly at work to digest the denser parts and turn them into spirit which will afterwards be discharged; from which arises weight-loss and desiccation, as I said earlier [page 113]. Assimilation includes a kind of *accretion* which no-one thinks is a case of nourishment; as when •clay between stones thickens and turns into a stony material, or •the scaly substance on the teeth turns into a substance as hard as the teeth themselves, and so on. [In the clay example: 'thickens' translates the Latin *concrescit*. Look up 'concretion' in any encyclopaedia.] For I hold that *all* bodies have a desire for •assimilation as well as for •uniting with substances that are like them; but the •former power is held in check, as is the •latter, though not by the same means. These means should be thoroughly investigated, as also should the ways of escape from them—i.e. the ways of enabling the assimilation process to be freed to continue—because this is relevant to the reinvigoration of old age.

And a final point: It is worth noting that in the nine other motions I have discussed—setting aside (1) the motion of antitypy, as an absolutely special case—bodies seem to desire only the •preservation of their nature, but in this eleventh they desire its •propagation.

(12) The twelfth motion is the *motion of arousal*. It seems to be of the same kind as *assimilation*, and I sometimes call by that name. Each of these motions is

- diffusive rather than narrowly focussed,
- communicative,
- transitive i.e. something's affecting something *else*,
- multiplicative, i.e. something's generating *more* of itself,

and they have pretty much the same effect, though differing in •how, and •on what, they bring it about. **How:** The motion of assimilation proceeds as though with power and authority: it *orders* y the assimilated body to change into x the body that is assimilating it—it *forces* it to do so. But the motion of arousal proceeds as though it were cunningly and stealthily wheedling y the body that is being acted on, *inviting* it to acquire the nature of x the body that is acting on it, and getting it to *want* to. **On what:** What the motion of assimilation multiplies and transforms are •bodies and substances, for example •bringing it about that there is more flame, more air, more spirit, more flesh. But what the motion of arousal multiplies and transfers are only •powers—•leading to more heat, more magnetic power, more putrefying.

This motion is especially conspicuous in heat and cold. When a hot body x makes another body y become hot, it doesn't do this by spreading its own heat through y; rather, it arouses the parts of y to engage in the kind of motion that is the form of heat (I have dealt with this in the first harvest concerning the nature of heat [20 at page 68]). That's why it takes much longer to arouse heat in stone or metal than in air: stone and metal are unfit and unready for that motion. So it's likely that there are deep in the bowels of the earth materials that altogether refuse to be heated because their great density deprives them of the spirit with which •the response to• this motion of arousal generally begins. Similarly,

a magnet doesn't lose any of its own power when it gets a piece of iron to have a new layout of *its* parts and a motion to match. Similarly

- leaven arouses and invites a successive and continued motion in dough,
- yeast arouses and invites it in beer,
- rennet arouses and invites it in cheese, and
- certain poisons arouse and invite it in the human body,

not so much by the force of the arousing body as by readiness and easy compliance of the body that is aroused.

(13) Thirteenth is the *motion of pushing*. The subtlest of the diffusive motions, it belongs to the genus of the motion of assimilation; but I have thought fit to assign it to a species of its own, because of a striking difference between it and the motions of arousal and of assimilation. The simple motion of •assimilation actually transforms the bodies themselves, so that if you remove the original source of the motion that makes no difference to what follows. The later states of a fire in a grate are not affected by whatever external cause it was that first started the fire. . . . Similarly with the motion of •arousal: it continues in full force—or, more accurately, the motion that it brings about in the aroused body continues in full force—for a very long time after the first mover has been withdrawn. Examples are a heated body when the primary heat has been removed; magnetized iron when the magnet has been put away; bread dough when the leaven has been taken out. But the motion of •pushing, though diffusive and transitive [i.e. involves something's affecting something *else*], seems to remain dependent on the first mover; so that if *it* is taken away or stops operating, the motion *immediately* fails and comes to an end. So the motion of pushing must have its effect instantly, or anyway in a very brief space of time. . . . It shows up in three things: (a) rays of light, (b) the com-

munication of magnetic power, (c) the making of sounds by percussion. **(a)** By removing light you immediately make colours and its other images disappear. **(b)** Take away the magnet and the iron immediately drops. We can't take away the moon from •influencing• the ocean, or the earth from •influencing• falling heavy bodies, so we can't do experiments on those, but the same kind of thing is going on •in them as when a magnet holds up a piece of iron•. **(c)** If you stop drumming, and thus stop the vibration of the drum, the sound soon dies away. . . . If you strike a bell, the sound seems to continue for a while, and that might make us think that during the whole that time the •original• sound is floating and hanging in the air. But it isn't. What we hear then is not the very same sound that we first heard, but a repetition of it. . . . If the bell is held firmly so that it can't vibrate, the sound immediately stops. . . .

(14) In the fourteenth place I put the *motion of configuration or position*. This occurs when a body seems to want not to •combine with other bodies, or to •separate from them, but to •have some specific position or relative to them or to enter into some specific pattern with them. This little-known motion hasn't been well investigated. In some cases, indeed, it looks as though it couldn't have a cause. Why do the heavens revolve from east to west rather than from west to east? Why is the axis on which they pivot near the Bear constellation rather than near Orion or some other part of heaven? The questions seem almost crazy, because •it seems that• these phenomena should simply be accepted on the basis of experience and classified as brute facts •with no explanation•. But I don't think that's right. No doubt some things in nature *are* basic and uncausable, but it doesn't seem to me that this motion •of configuration or position• is one of them. I think that it comes from a certain harmony and agreement of the universe that hasn't yet come under

observation. ·Don't think you can evade the questions by denying that the heavens revolve at all·. Take it as given that *the earth* revolves. It must still revolve on an axis, and we can ask: Why is the axis where it is rather than somewhere else? Again the polarity, direction, and deviation of the magnet can be explained in terms of this motion. . . .

(15) The fifteenth motion is the *motion of passage*. . . . It is because of this that the powers of bodies are more or less impeded or promoted by the media they are in, depending on the nature of the body, of the active powers, and of the medium. For one medium suits light, another sound, another heat and cold, another magnetic powers, and so on.

(16) The sixteenth motion is what I call the *royal motion* or the *political motion*. Through this, the predominant and commanding parts in any body

curb, tame, subdue, and regulate the other parts, and compel them to unite, separate, stand still, move, and arrange themselves, not in accordance with their own desires but so as to favour the well-being of the commanding part;

so that the ruling parts of the body exercise a sort of government over the subject parts. This motion is especially conspicuous in animal spirit which, as long as it is in full strength, modifies all the motions of the other parts ·of the animal's body·. It is also found in lower degree in other bodies. As I said [on page 112], blood and urine don't decompose until the spirit that mixes their parts and keeps them together is discharged or stifled. In most bodies the spirits are in charge because they move so fast and so penetratingly, but the royal motion isn't entirely confined to them. In denser bodies that aren't filled with a strong and lively spirit (such as mercury and vitriol have), the thicker parts are the masters, so that there's little hope of transforming such bodies unless we can devise some method of shaking

off this bridle and yoke.

A possible misunderstanding should be headed off. My whole purpose in listing and classifying motions is to help us investigate which of them dominates which others in instances of *strife*—remember that all this started at page 108 under the heading 'instances of strife or of predominance'. You might think that I have muddied the waters by talking as though just *one* of the nineteen listed kinds of motion concerns the dominance of some •motions by others, but I haven't. This royal motion that I have been describing has to do with domination not over •motions or powers but over •parts of bodies.

(17) I take as the seventeenth motion the *spontaneous motion of rotation*, by which bodies that delight in motion and are well placed for it •enjoy their own nature, •follow themselves and not some other body, and, so to speak, •hug themselves to themselves. For bodies seem either to

move without any terminus, or

remain entirely at rest, or

move in a way that brings them to a terminus

—the terminus being either •rotation or •rest, depending on the nature of the body. Those that are well placed and delight in motion move perpetually in a circle. (Those that are well placed and hate motion, stay entirely still. Those that are not well placed move in a straight line—the shortest path—to be in the company of bodies of their own nature.) ·Any case of· this motion of rotation is marked off by nine features:

1. the centre around which the body moves,
2. its axis of rotation,
3. its distance from the centre,
4. its velocity,
5. the course of its motion, whether from east to west or from west to east,
6. its deviation from a perfect circle by spiral lines more

- or less distant from the centre,
7. its deviation from a perfect circle by spiral lines more or less distant from the axis,
  8. the greater or lesser distance of these spirals from each other,
  9. the variation of the poles themselves, if they are movable.

But movements *of* the poles are not part of the motion-of-rotation story unless the poles move around in a circle. For centuries the motion of rotation has been widely thought to belong exclusively to the heavenly bodies, though this has been seriously questioned by some of the ancients and by some moderns who say that the earth moves and the heavens don't. But on the basis that the earth doesn't rotate, a different and more reasonable question arises (unless it's now beyond question), namely: is rotatory motion confined to the heavenly bodies, or does it come down from them and get communicated to the atmosphere and the oceans? (Not the rotations of missiles—darts, arrows, musket balls etc.—because they involve the motion of liberty [(3) on page 108].)

(18) The eighteenth motion is the *motion of trepidation*. I haven't much faith in the astronomers' version of this. But we come across it when we search seriously and thoroughly for the drives of natural bodies, and it seems to rate being counted as a species by itself. It is like the motion of something that is in perpetual captivity. It occurs when a body is in a position that is not quite right for its nature but isn't downright bad either, so that it is forever trembling and stirring restlessly, not content as it is but also not daring to break out. This kind of motion is found in the hearts and pulses of animals; and it must occur in all bodies that are caught between good states and bad in such a way that when they are shaken up they try to free themselves, suffer defeat, then try again—and again and again, for ever.

(19) The nineteenth and last motion is one that I'll call *the motion of repose* or the motion of hatred of moving. It barely answers to the label 'motion', yet it clearly *is* one. [See the note on 'motion' on page 111.] It is by this motion that the earth stands still in its mass while parts of it well away from the centre move towards the centre—not to an imaginary centre but to union with the stuff that is there. The motion of repose is at work here because although things on the world's periphery move towards its centre, the mass at or near the centre doesn't move out to meet the things from the periphery. This is also the appetite by which very dense bodies reject motion. Indeed, their only appetite is their desire not to move. In many ways they can be enticed and challenged to move, but they do their best to maintain their own nature. When forced to move, they still seem always to act so as to resume their state of rest and not move any more. While they are doing *that*, indeed, they show up as busily agile, struggling quickly and persistently as though weary and impatient of all delay. We can see here only a partial representation of this, because in our part of the universe. . . . all tangible things are not only *not* utterly dense but even have some spirit mixed in with them.

So there you have it: I have presented the most widespread species or simple elements of motions, appetites, and active powers. And in setting them out I have sketched a significant portion of natural science. I don't deny that other species may be added, or that my classification may be reformed so as to get closer to carving up reality at its joints, or reduced to a smaller number. But I don't see what I am offering as an abstract classification, like saying that

bodies desire *either* the preservation *or* the growth *or* the reproduction *or* the enjoyment of their nature;  
or that

the motions of things tend to the preservation and the

good *either* of the whole (antitypy and bonding) *or* of great wholes (major aggregation, rotation and hatred of moving), *or* of particular forms (the others).

These assertions are true, but unless their content and structure correspond to the true lines ·in nature· they are merely useless bits of theory. ·The status of each of them depends on the status of its ‘either x or y or z or w’ element. If that is just a rag-bag of different items with no one important property common to all of them, then the assertion is a relatively idle bit of abstract theorizing. The assertion will be better than that—will be a real addition to science—if its ‘either x or y or z or w’ element does correspond to some single natural kind, united by some one property·.

In the meantime, these—by which I mean the items in my nineteen-part classification of motions—will suffice and be useful in weighing dominances of powers and tracking down instances of strife, which is my present topic. For some of the motions I have presented are quite invincible; some are stronger than others, fettering, curbing, controlling them; some extend further ·in space· than others; some last longer than others or go faster than they do; some cherish, strengthen, enlarge, and accelerate others.

The motion of antitypy [see page 108] is altogether invincible—an immovable object ·so to speak·. Whether the motion of bonding [page 108] is also invincible I am still not sure, because I can’t say for sure whether there is a vacuum (whether all together ·as empty space· *or* mixed in with matter). But I am sure of this: the reason that Leucippus and Democritus gave for introducing vacuum is wrong. They held that there must be vacuum because without it a body couldn’t fold, and fill sometimes larger and sometimes smaller spaces. But clearly a material coil *can* fold and unfold itself in space, within certain limits, without vacuum coming into it. . . .

The other motions sometimes rule and sometimes are ruled, depending on their vigour, quantity, speed and force of projection, and also on what helps or hindrances they encounter. Here are five examples.

•An armed magnet will hold and suspend iron of sixty times its own weight; that’s how greatly [page 111] the motion of minor aggregation (·the pull of the magnet·) prevails over [page 110] the motion of major aggregation (·the pull of the earth·). But with a still greater weight it—i.e. the magnet’s force—is overcome. •A lever of given strength will raise a given weight; to that point [page 108] the motion of liberty prevails over that of major aggregation. But with a greater weight it—i.e. the lever with that amount of force applied to it—is overcome. •Leather stretches to a certain extent without breaking; that’s how far [page 110] the motion of cohesion prevails over the motion of ·escape from· tension [see (3) on page 108]. But if the tension is increased the leather breaks and the motion of cohesion is overcome. •Water runs out through a crack of a certain size; that’s how far the motion of major aggregation prevails over the motion of cohesion. But with a narrower crack, it—i.e. the motion of major aggregation—gives way and the motion of cohesion prevails. •If you charge a gun with a bullet and simple sulphur, and apply fire, the bullet won’t be discharged, because in this case the motion of major aggregation overcomes the matter motion. But if you put gunpowder in, [page 109] the matter motion in the sulphur prevails, helped by the matter motion and [page 113] the motion of avoidance in the nitre. And so on with the other motions.

So instances of strife, which concern the dominance of powers and indicate the various ratios between dominating and giving way, should be sought with keen and careful diligence everywhere.

We should also look carefully into *how* and *why* these motions give way. Under the ‘how’ question I include this, stated as for a single kind of motion: ‘When it gives way, does it altogether *stop*, or does it continue the struggle until it is overpowered?’ No terrestrial body is ever really motionless—as a whole or in its parts—though sometimes they appear to be. This *apparent* rest is caused either by

- equilibrium, as in scales that stand still if the weights are equal, or by
- absolute dominance of one motion by another, as in watering pots with tiny holes in them, where the water stays still and is kept from falling by the dominance of the motion of bonding.

But, I repeat, when a motion succumbs, we should note how much resistance it puts up when doing so. Compare: a man pinned to the ground and tied hand and foot; he may struggle hard, putting up enormous resistance although it isn’t enough to get him free. But if the answer to our question ‘Is the motion that yields to one that dominates it outright annihilated, or does it continue to put up a resistance that we can’t see?’ is hidden from us when motions •conflict, perhaps it will become apparent to us when they •co-operate. For example, try this experiment with a gun: Find out how far it will carry a bullet horizontally. . . .; then try it again to see how much power the bullet has, after going that same distance, (a) when it is fired with an upward tilt (with no help being given to the motion of the blow and (b) when it is fired with a downward tilt (where the motion of the blow is helped by the motion of gravity). [The ‘motion of the blow’ is the impetus from the explosion of the gunpowder]. . . .

**49.** Class 25 of privileged instances: **suggestive instances**, the ones that suggest or point to benefits for man. Mere power and mere knowledge *expand* human nature, but they

don’t necessarily *do it any good*. So from the whole store of things we must gather those that do the most good for human life. A better place to deal with this is when I come to discuss practical applications. Moreover, in the actual work of interpretation in each particular subject, I always provide a place for the human chart, or chart of things to wish for. For science requires not only asking good questions but also wishing good wishes.

**50.** Class 26 of privileged instances: **multi-purpose instances**. These are ones that are relevant to various topics and come up quite often, thus sparing us a lot of work and fresh proofs. The right place to discuss the instruments and contrivances themselves will be when I come to deal with practical applications and experimental methods. Those that are already known and in use will be described in the particular histories of the different arts [reminder: in this work, ‘art’ refers to any human activity that involves techniques and requires skills]. In the meantime I’ll add some general remarks about them simply as examples of multi-purposiveness.

Apart from simply assembling and disassembling things made of natural bodies, man works on natural bodies in seven main ways—

1. by keeping out obstructive and disturbing items,
2. by compressing, stretching, shaking, and the like,
3. by heat and cold,
4. by letting time pass while the body is kept in a suitable place,
5. by checking and controlling motion,
6. by exploiting special cases of agreement between things,
7. by appropriately alternating or otherwise stringing together some or all the above six.

•I shall discuss these in turn, taking seven pages to do so.

(1) We are ·often· considerably disturbed by ordinary air that is all around us and pressing in. (As we are also by the rays of the heavenly bodies, ·but I shan't say much about them·). So anything that serves to exclude air can fairly be counted as multipurpose. For example [slightly simplifying what Bacon wrote]: when we have put something inside a vessel for some practical purpose, we can keep out the air by having a vessel whose sides are very thick and dense, and blocking its opening with the stuff that the alchemists call 'clever clay'. Also very useful is a liquid sealant, as when they pour oil on wine or herb juices—it spreads over the surface like a lid and protects the stuff from the air. Powders are good too. They have air mixed in with them, but they keep off the force of the open air, as we see when grapes and other fruits are preserved in sand and flour. It is also good to coat things with wax, honey, pitch, and such sticky substances, to make an even better job of sealing them in and keeping off the air and ·rays from· heavenly bodies. I have sometimes tried the experiment of placing a vessel or some other body in mercury, which is by far the densest of all the substances that can be poured. Caves and underground cavities are very useful for preventing exposure to the sun and keeping off the ravages of the open air; they are used for that purpose as granaries in northern Germany. Sinking bodies in deep water has the same effect. I remember hearing this: someone put some wineskins full of wine into a deep well to cool; through accident or neglect they were left there for many years, and then taken out; and the wine hadn't gone flat or stale, and indeed tasted much finer, apparently because its parts were more thoroughly mixed ·during all those years in the well·. And if some project requires that bodies be submerged in deep water—river or sea—while surrounded only by air, having no contact with the water and not being shut up in sealed vessels, there is a very useful device for doing that. It is

a vessel that has sometimes been used for working under water on sunken ships; it lets divers stay under water for a long time, intermittently taking breaths. Here it is:

A hollow metal bell is evenly lowered into the water with its mouth remaining parallel to the surface of the water. It takes all the air it contains down to the bottom. It stands there (like a tripod) on three feet that are little shorter than a man is tall; so that when the diver can't hold his breath any longer he can put his head into the hollow of the bell, breath in, and then go on with his work.

(I have also heard of a machine has been invented—a little ship or boat—that can carry men under water for some distance.) Under the bell device that I have described it would be easy to suspend bodies of any sort—that's what makes it relevant to my present topic.

I have talked about the sealing off of bodies so as to keep air from getting *in*; it can also be useful to keep the spirit of the body that we are working on from getting *out*. For someone who is experimenting on natural bodies has to be certain of his total quantities—i.e. that nothing evaporates or leaks out. For profound alterations occur in bodies when nature prevents annihilation while human skill prevents loss or evaporation of any part. [Bacon reports the common opinion that when spirits of bodies are hot enough they can't be held by any container, however dense. This would be bad news for scientists, he says, if it were true—but it isn't. He sketches and criticises reasons that have been given for this false opinion. Then:]

(2) With regard to the second item on my list of seven kinds of operation on bodies—namely compressing, stretching, shaking, etc.—it should be especially noted that forceful means such as *compression* are enormously powerful in their effects on movement, e.g. of machines and projectiles, even

going so far as to *destroy* •organic bodies and •any powers that consist only in motion. Compression destroys all life and all flame and fire, ignition, and damages or disables every kind of machine. It also destroys powers that consist in the arrangement of crudely dissimilar parts. Colours, for example: a bruised flower doesn't have the same colour that it had when intact. . . . Also tastes: an unripe pear tastes significantly less sweet than one that has been squeezed and softened. But •such forceful methods aren't much use for producing the more notable transformations and alterations of bodies of uniform structure, because •they don't give bodies a new stable consistency but only a temporary one that is always trying to free itself and get back to where it was. Still, it would be a good idea to look more carefully into the question of whether a body of very uniform structure (such as air, water or oil) can by some application of force be made permanently denser or rarer, in a way changing its nature. This should be tried first by •applying the force in question and then• just waiting for a while. I could have done this (if only I had thought of it!) when I was condensing water by hammering and flattening its spherical container until the water burst out [page 105]. I ought to have left the flattened sphere alone for a few days, and *then* drained the water from it, and noted whether it immediately had the same volume that it had before condensation. If it •didn't do so, either immediately or at any rate pretty soon, the condensation would have shown itself to be stable; if it •did, that would have shown that a restoration had taken place and •thus• that the compression had been short-lived. [He makes the same point about his air-in-glass-egg experiment, page 105. Then:] In cases like these, it is likely that the state brought about by forceful means *is* stable. Anyway, it would be worthwhile to look into this experimentally; since in bodies that are less internally uniform •than water, oil,

and air•, changes brought about by forceful means and then left alone for a while *do* turn out to be stable. For example, a stick that stays bent for some time under pressure doesn't straighten out •the moment the pressure stops•. Don't think 'That's because during that interval the wood loses some of its quantity'; because the same thing happens when a strip of steel is kept bent by pressure (for a longer period of time), and *steel* doesn't waste away! I said that we should *first* see what the sheer passage of time would do. If that doesn't produce a stable new state, we should try •applying force and then• using aids and agreements to keep the new state stable. For it would be a considerable thing if we could use forceful means •together perhaps with other aids• to impose fixed and stable •new• natures on bodies. Such a technique would enable us to turn air into water by condensation, and produce many other such effects—because the application of *force* is what man does best!

(3) The third on my list of seven ways of operating on bodies is *heat and cold*—the great instrument of the operations of nature and of art. In this matter human power is plainly lopsided. We have the heat of fire which is infinitely more intense than the heat of the sun as it reaches us, and than the heat of animals. But the only cold we can get is from winter storms, underground caves, or packing things in snow and ice. *How* cold is that? Well, it about *as cold* as the heat of the sun at noon in the tropics, increased by bouncing off mountains and walls, is *hot*. •That's not extreme•. For a short time animals can endure that much cold or that much heat. This heat is nothing compared with that of a burning furnace, and this cold is nothing compared with the cold that matches the heat of a furnace in intensity. That's why here among us things drift towards rarefaction and desiccation and exhaustion, and hardly anything moves towards condensation and thickening, except •when this is brought

about by mixtures and artificial methods. So instances of cold should be collected most carefully. We can find them, it seems, when bodies are

exposed on towers in sharp frosts,  
put in underground caves,  
packed in snow and ice in pits dug for the purpose,  
lowered into wells,  
buried in mercury and metals, or  
plunged into liquids that turn wood into stone.

The last of these is said to be what the Chinese do when making porcelain. Masses of material made for this purpose are left underground for forty or fifty years, we are told. . . . We should also investigate all natural condensations brought about by cold, so that when we know their causes we can build them into techniques of our own. . . .

As well as things that are cold to the touch there are others that don't feel cold but have the power of cold, and also condense. They seem to act only on the bodies of animals, hardly at all on anything else. Many medicines and plasters turn out to be like this. Some of them—such as astringent medicines and thickening medicines—condense flesh and tangible parts. Others—most notably the soporifics—condense spirits. There are two different ways in which soporific medicines induce sleep. (a) One is by calming the spirits down. Examples are violets, dried rose leaves, lettuce, and other such blessed and blessing medicines: through their kindly and gently cooling vapours they invite the spirits to unite and put an end to their fierce and anxious motion. . . . (b) The other is by putting the spirits to flight. Opiates and their like do this, utterly driving out the spirits by their malignant and hostile nature. When an opiate is applied externally, the spirits immediately flee from that part and don't easily flow back to it. When an opiate is swallowed, its vapours rise into the head, and the spirits contained

in the ventricles of the brain flee in all directions. These retreating spirits can't escape, so they come together and are condensed. Sometimes this uniting-and-getting-denser totally smothers and extinguishes the spirits; but in other cases—when the opiate is taken in a moderate dose—it strengthens the spirits, makes them sturdier, and quells their useless and inflammatory motions. In this way an opiate can contribute to curing diseases and prolonging life. . . .

Because nature supplies cold so sparingly, we must do what the apothecaries do. When there's some medicinal ingredient that they can't get, they use a substitute instead—e.g. using aloes in place of balsam, cassia in place of cinnamon. We should follow suit, looking around carefully to see if there are any 'substitutes' for cold, i.e. any way of making bodies denser other than the standard way, namely cooling them. So far, only four such ways have been found.

(1) The first is simple compression. This may be a help in some processes but it can't have much effect on permanent density because bodies spring back. (2) The second involves the contraction of the larger parts of a body after the tiny parts have left. That is what happens when a metal object is repeatedly made red hot by fire and then doused in cold water. (3) The third involves the coming together of the most solid of the homogeneous parts in a body, parts that had previously been dispersed and mixed with the less solid parts. . . . (4) The fourth involves agreement, when condensation is achieved by applying stuff that has a hidden power to do this. These agreements don't show up much, which is not surprising: we can't expect much success in an inquiry into agreement until we have discovered more about forms and microstructures.

There is no doubting that for animal bodies there are many remedies—internal as well as external—that condense as though by agreement, as I have just said. But this doesn't

happen much with non-animal bodies. [Bacon then reports two stories of condensation activities in trees and bushes, and regretfully dismisses them as fables. He mentions also moisture found on oak-leaves, and explains why it is also not an example of his present topic. Then:]

As for heat: we have plenty of that, and great power over it; but some extremely important aspects of it haven't yet been empirically investigated—whatever the alchemists may say when hawking their wares! The doings of intense heat have been looked for and observed, but those of gentler heat, which come closest to nature's own ways, haven't been explored and therefore remain hidden. This is unfortunate, because there is more to be learned from gentle than from fierce heat. Heat from the furnaces that are in favour nowadays

- excites the spirits of bodies, e.g. nitric acid and other chemical oils;
- hardens the tangible parts and sometimes fixes them while the volatile parts are discharged;
- separates the homogeneous parts;
- incorporates heterogeneous bodies in a coarse way, and coarsely mixes them up together; and above all,
- smashes and confuses the microstructures of composite bodies.

The operations of a gentler heat ought to have been tried and explored. That way, subtler microstructures and more orderly configurations might be created and brought to light, following nature's example and imitating the works of the sun—as I sketchily indicated in the aphorism on instances of alliance [35 at page 84]. Nature performs its operations on *much* smaller portions of matter at a time, and by arrangements that are much more delicate and varied than anything we can produce by fire, used the way we use it now. We would see a real increase in man's power of man if we

used heat and artificial forces to do something of the same basic kind as what nature does but with three differences: perfected in power, varied in quantity, and, I may add, accelerated in time. [He gives examples of slow natural processes and fast artificial ones. Then:] Returning now to my present topic: every kind of heat, and its effects, should be diligently collected from every source and investigated: the heat

- of heavenly bodies through rays that are direct, reflected, refracted, and concentrated in burning-glasses and mirrors;
- of lightning, flame, and coal fire;
- of fire from different materials;
- of open fires and closed fires;
- of fire modified by the different designs of furnaces;
- of fire excited by blowing, and of fire that is quiescent and not excited;
- of distant fire and fire close by;
- of fire passing through various media.

In addition to the heats of kinds of fire, there should be a study of •moist heats, such as that of a Mary's bath, dung, external and internal animal warmth, and hay stored in a closed place; and •dry heats, such as the warmth of ashes, lime and warm sand. In short, heats of *all* kinds with their degrees. [A Mary's bath is a bowl of custard baked while sitting in a pan of water.]

But above all we must try to investigate *changes* of heat—specifically changes that are •gradual, •orderly and •periodic, and taking account of the relevant facts about distances and durations. We need to find out what happens *in* these events and what results *from* them. I emphasize •those three adjectives, because nothing great can be expected from heat that is fierce or heat-changes that are sudden, or irregular. The kind of orderly change that I want investigated is truly the daughter of heaven and mother of generation. This is

obvious even in plants. In the wombs of animals there are heat-changes caused by movement, sleep, eating, and the passion of the pregnant female. Lastly, in the wombs of the earth itself, I mean the wombs in which metals and fossils are formed, such changes also occur and have power. . . . That is all I have to say about the operations and effects of heat. Now is not the time to examine them thoroughly, when we haven't investigated and brought to light the forms of things and the microstructures of bodies. It will time for us to seek, apply, and adapt our instruments when we have solid knowledge of the exemplars—i.e. the natural things and structures on which our instruments will be modelled.

(4) The fourth way of dealing with natural bodies is to stand back and let time pass. *Just waiting* is nature's way too; it is nature's table-waiter, store-keeper, in a way its dispenser of stores. I call it 'just waiting' when a body is left to itself for a considerable time, protected throughout from all external force. When there stops being any motion caused from the outside, that's when the internal motions of the body in question show themselves and run their full course. The works of time are far subtler than those of fire.

- Wine can't be clarified by fire as it can be by time.
- Ashes produced by fire aren't as fine as the dust that substances are turned into by time.
- When fire abruptly incorporates some bodies into others and mixes them, the results are much inferior to the incorporations and mixtures produced by time.
- The complex and various microstructures that time aims for by just waiting—for example those involved in putrefaction—are destroyed by fire or any fierce heat.

It is relevant to point out that when bodies are closely confined, their motions have something of violence in them. For such imprisonment impedes the spontaneous motions of

the body. So for distilling purposes an open vessel is best; for mixtures a more or less closed one; and for putrefactions a vessel that is open enough to let in air. Anyway, instances showing what happens with the passage of time, and what results from that, should be carefully collected from all quarters.

(5) The regulation of motion (which is the fifth way of treating bodies) is very useful. I call it 'regulation of motion' when one body blocks, repels, allows or steers the spontaneous motion of another body. It is mostly done through the choice of shape and orientation of containers. For condensing vapours in a still, an upright cone is best. For draining off the dregs in refining sugar, an inverted cone is best. Sometimes what is needed is a winding shape that narrows and widens alternately. That is what *straining* requires: body x lets through one element in body y and holds back another. Straining, and other regulation of motion, isn't always done from outside. It can also be done by a body within a body, as when stones are dropped into water to collect the slime; and when syrups are clarified with egg-white—the coarser parts stick to it and can then be removed. . . .

(6) Operations by agreements or aversions (which is the sixth way) often lie deeply hidden. You might think that we have plenty of access to them, because of what is known about so-called occult and specific properties, and sympathies and antipathies. But *they* are not what I am talking about: they are to a great extent philosophy gone bad. We can't have much hope of discovering relational facts about the agreements between things before we have learned the non-relational facts about the forms and microstructures of individual things. For agreement between two things is just a symmetry between the forms and microstructures of one and those of the other.

But the broader and more general agreements between

things are not so obscure, so I'll start with them. The principal division between agreements is this:

(1) Sometime one body agrees with another in microstructure, while differing greatly from it in respect of how much matter it contains, i.e. its density or rarity.

(2) Sometimes one body agrees with another in respect of its density or rarity, while differing greatly from it in microstructure.

Here first is an example of (1). . . . In mercury and sulphur we can see two of the most widespread general agreements in nature:

- sulphur agrees with •oil and fatty vapour, •flame, and perhaps •the material that stars are made of;

- mercury agrees with •water and watery vapours, •air, and perhaps •the pure ether between the stars.

The members of each of these two quartets. . . .differ enormously in how much matter they contain and how dense they are, but there is much evidence that they agree very well in microstructure. Now an example of (2). Various metals agree with one another very well in quantity of matter and density (especially as compared with plants), but their microstructures differ in many ways. Similarly, the microstructures of plants and animals vary in countless ways, but they don't differ much in their quantity of matter or density.

The next most general agreement is that between the principal kinds of bodies and. . . .their support systems and their food. So we should investigate:

- in what climates, in what sort of ground, and at what depth each kind of metal is generated;

- whether gems come into being *in* rocks or *between* layers of them;

- in what soil each kind of tree and shrub and herb grows best and prospers;

- what kinds of plant-food—dung of some sort? chalk? sea-sand? ashes? and so on—do the most good; and which of them works best in which kind of soil.

Something else that depends heavily on agreement is the biological process involved in the grafting of trees and plants, and the facts about what plants prosper best on what stocks. Until now grafting has been done only with fruit trees; it would be an agreeable experiment to try also grafting forest trees, so as to get more leaves and nuts and also more shade. Similarly, we should note what each kind of animal eats, and what it doesn't eat. . . . We should also note the different materials of putrefaction from which tiny animals are generated.

The agreements between principal bodies and their subordinates (for that's how I see the ones I have just listed) are sufficiently obvious. So are the agreements between the senses and their objects; and because these have been well observed and keenly explored, they may throw much light on other, hidden agreements.

The inner agreements and aversions, or friendships and enmities, of bodies haven't fared well in human hands. They have been (a) said to exist where they don't, or (b) mixed with fables, or (c) ignored and thus not well known. (Note the terminology that I used for this matter. As for the time-honoured terms 'sympathy' and 'antipathy'—I'm sick of them because they are so much tied to superstitions and stupidities.) (a) 'The vine and the cabbage are at odds with one another, because they don't thrive when planted next to one another'—wrong! The real reason is obvious: both of these plants are full of sap, and make fierce demands on the soil, so that they compete for nourishment. 'Corn has agreement and friendship towards the cornflower and the wild poppy, because these three plants hardly ever come up except in cultivated fields.' Wrong! The truth is that

there is discord between corn and those other two, because the poppy and cornflower are germinated and grow from some juice in the soil that the corn didn't want and so left behind, so that sowing corn prepares the ground for growing poppy and cornflower. There have been very many such false ascriptions. **(b)** As for fables, they should be utterly exterminated. **(c)** A small but established set of agreements have been solidly established by experiment—the magnet and iron, gold and mercury, and the like. Some other significant ones have been found in chemical experiments on metals. But the biggest group of discovered agreements (it's still small!) have to do with certain medicines whose so-called 'occult' and specific properties have a relationship ·that could be one of agreement· with limbs, or humours, or diseases, or sometimes with individual natures. And let's not overlook the agreements between the moon's motions and changes and the states of bodies here below—results gathered from careful experiments in agriculture, navigation, medicine, and other sciences, which we can honestly accept. As for universal instances of more hidden agreements: the fewer of them there are, the more earnestly we should inquire after them, making use of faithful and honest traditions and narrations, and doing this not in shallow willingness to believe anything, but rather in a frame of mind in which we are almost sceptical and are nervous at the prospect of believing something! We shouldn't neglect—indeed we should carefully follow up—a kind of agreement between bodies which, though it is a natural phenomenon, is useful to us in many ways. I mean the coming together or uniting of bodies—whether easy or difficult, whether by •composition or by •simple juxtaposition. [This last phrase foreshadows our distinction between •chemical compounds and •physical mixtures.] Some ·pairs of kinds of· bodies freely and easily mix with and incorporate one another; others do this only awkwardly and with difficulty. Thus

powders mix best with water, ashes and lime with oils, and so on. And we should collect not only instances of bodies' propensity for or aversion from mixing, but also ·the properties of the resultant mixture·: what sort of mixture is it? how are the parts distributed and arranged? in the completed mixture which ·set of parts· is dominant?

(7) All that remains is the seventh of the listed ways of operating on bodies, namely by alternating uses of the other six. It wouldn't be appropriate to offer examples of this before we dig deeper into each of the six separately. Such an alternating chain of operations, aiming at something in particular, is a very useful thing but a hard one to devise. ·Not many of them *are* devised, because· men are utterly impatient of the theory of this as well as of the practice, though in any big project this is the thread that can lead us through the labyrinth. That's all I have to say about examples of multi-purposiveness.

**51.** Finally, class 27 of privileged instances: **magical instances**. That is my name for instances where the material or efficient cause is slight or small in comparison with the effect. An event of this kind, even if it is of a common sort, seems at first like a miracle—and sometimes it goes on seeming so even after careful thought. Nature hasn't given us a generous supply of these; but we'll see what emerges when nature's folds have been shaken out and we have made discoveries of forms and processes and microstructures. As at present advised, I conjecture that these magical effects come about in three ways: **(1)** By self-multiplication; as in fire, in so-called 'specific' poisons, and also in motions that increase in power as they pass from wheel to wheel [he is talking about *gears*]. **(2)** By exciting or inviting some other body, as in the magnet, which excites countless needles without losing any of its power, or in yeast and the like. **(3)** By a motion's *getting*

*in first*, as in the case I mentioned of gunpowder, cannons and mines [page 107]. To understand (1) and (2) we need a knowledge of agreements, for (3) a knowledge of the measurement of motions. I have at present no reliable evidence indicating whether there is any way for us to •change bodies through their smallest parts, their so-called ‘minima’, or to •change the subtler microstructures of matter (which has to happen in every sort of transformation of bodies). If we did find a way of doing this, we would be able artificially to do *quickly* things that nature does in very round-about ways. . . .

**52.** That completes what I have to say about privileged instances. Do bear in mind that in this Organon of mine the topic is logic, not philosophy [here = ‘not philosophy or science’]. But it shouldn’t surprise you that observations and experiments of nature are scattered throughout the work. They are there as illustrations, and as samples of the art I teach. My logic aims to instruct and train the intellect in how to dissect nature truly, and to discover the powers and operations of bodies, with their laws laid down in matter, so as to achieve a science that emerges not merely from the nature of •the mind but also from the nature of •things. Contrast this with vulgar logic! It aims to enable the mind to put out slender tendrils to clutch at abstractions.

What I have said shows that there are twenty-seven kinds of privileged instances:

1. solitary instances (aphorism **22**, starting on page 71)
2. shifting instances (**23**, page 72)
3. revealing instances (**24**, page 73)
4. concealed instances (**25**, page 74)
5. constitutive instances (**26**, page 76)
6. matching instances (**27**, page 77)
7. unique instances (**28**, page 79)

8. deviant instances (**29**, page 80)
9. borderline instances (**30**, page 81)
10. instances of •human power (**31**, page 107)
11. instances of friendship and of enmity (**33**, page 83)
12. terminal instances (**34**, page 84)
13. instances of alliance (**35**, page 84)
14. signpost instances (**36**, page 87)
15. instances of separation (**37**, page 92)
16. door-opening instances (**39**, page 93)
17. summoning instances (**40**, page 95)
18. instances of the road (**41**, page 99)
19. instances of supplement (**42**, page 100)
20. dissecting instances (**43**, page 101)
21. instances of the measuring-stick (**45**, page 103)
22. running instances (**46**, page 105)
23. instances of quantity (**47**, page 107)
24. instances of strife (**48**, page 108)
25. suggestive instances (**49**, page 120)
26. multi-purpose instances (**50**, page 120)
27. magical instances (**51**, page 127)

What makes any one of these instances •privileged, i.e. •better than run-of-the-mill instances, has to do with either •the information aspect of our project or •the practical aspect or •both. As regards information: the privileged instances assist either the *senses*, as do (16–20) the five torchlight instances [see **38** on page 93], or the *intellect*,

- by hastening the exclusion of the form, as (1) solitary instances do, or
- by narrowing and sharpening the affirmative •account of a form, as do (2) shifting and (3) revealing instances, and instances of (11) friendship and (12) terminal instances, or
- by raising the intellect and leading it to general and common natures, either

- immediately, as do (4) concealed and (7) unique instances, and (13) instances of alliance, or
- at one remove, as do (5) constitutive instances, or
- very indirectly, as do (6) matching instances, or;
- curing the intellect of its ·bad· habits, as do (8) deviant instances, or
- by leading it to the great form or fabric of the world, as do (9) borderline instances, or
- by warning it against false forms and causes, as do (14) signpost instances and (15) instances of separation.

As for the practical aspect of our project: the privileged instances either •point out or •measure or •facilitate practice. •They point it out by showing where we should begin so as not to go again over old ground, as do (10) instances of ·human· power; or showing what we should try for if we become able to do it, as do (25) suggestive instances. •The four mathematical instances (21–4) measure practice. •The (26) multi-purpose and (27) magical instances facilitate it. [In this paragraph, each of the twenty-seven instances is mentioned exactly once.]

Of these twenty-seven kinds of instance there are some that we should start collecting right away, not waiting for specific investigation of natures. (I've already said this about some of them.) The kinds in question are: (6–11) matching, unique, deviant and borderline instances, and instances of ·human· power, and (16) door-opening and (25–7) suggestive, multipurpose and magical instances. ·These need to be embarked on right away· because they either help and cure

the intellect and the senses, or provide general instructions for practice. The remainder needn't be inquired into until we come to draw up tables of presentation [see **15**, page 65] for the work of the interpreter of some particular nature. For the instances that are marked off as 'privileged' are like a *soul* amid the common instances of presentation; and, as I said at the outset ·concerning solitary instances· [**22** on page 71], a few of them will do the work of many; so in making up our tables we must vigorously investigate them—i.e. our chosen privileged instances—•and include them in the tables. . . .

But now I must proceed to the supports for induction and corrections of it, and then to concrete things, and hidden processes and hidden microstructures, and then to the other tasks set out in aphorism **21** [on page 71]. My aim is to act like an honest and faithful guardian: when men's intellect has broken free and come of age, I shall put men's fortunes into their own hands. This is bound to lead to an improvement in the human condition and an increase in power over nature. In the Fall ·as recorded in the book of Genesis·, man underwent a •loss of innocence *and* a •weakening of his power over creation. Both of these losses can be to some extent made good, even in this life—the •former by religion and faith, the •latter by arts and sciences. For the curse ·that God laid on Adam and Eve· [Genesis 3:14–19] didn't make the creation a complete outlaw for ever. The part of it that said 'In the sweat of thy face shalt thou eat bread' means that by various labours (*not* by disputations or empty magical ceremonies!) man will in due course and to some extent compel the created world to provide him with bread, i.e. to serve the purposes of human life.