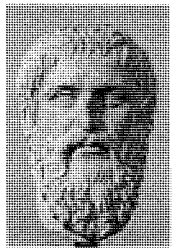
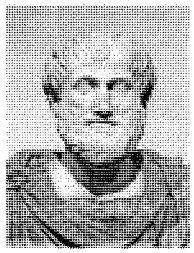
The Scientific Revolution:

Science and Society from the Renaissance to the Early Enlightenment

A Summer Institute for Teachers, June 13-17, 2011
Ohio State University, Columbus

Readings for Monday

Breakout exercise on what earlier scholars got right and wrong

Renaissance Humanism and the Protestant Reformation

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SCIENCE IN EUROPE, 1500–1800

A PRIMARY SOURCES READER

Edited by
Malcolm Oster

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"The Periodic Table."

Plato, Timaeus

objects of opinion and sensation and therefore change and come into being. And what comes into being or changes must do so, we said, owing to some cause. To discover the maker and father of this universe is indeed a hard task, and having found him it would be impossible to tell everyone about him. Let us return to our question, and ask to which pattern did its constructor work, that which remains the same and unchanging or that which has come to be? If the world is beautiful and its maker good, clearly he had his eye on the eternal; if the alternative (which it is blasphemy even to mention) is true, on that which is subject to change. Clearly, of course, he had his eye on the eternal; for the world is the fairest of all things that have come into being and he is the best of causes. That being so, it must have been constructed on the pattern of what is apprehensible by reason and understanding and eternally unchanging; from which again it follows that the world is a likeness of something else.... Don't... be surprised, Socrates, if on many matters concerning the gods and the whole world of change we are unable in every respect and on every occasion to render a consistent and accurate account. You must be satisfied if our account is as likely as any, remembering that both I and you who are sitting in judgement on it are merely human, and should not look for anything more than a likely story in such matters.

SOCRATES: Certainly, Timaeus; we must accept your principles in full. You have given us a wonderfully acceptable prelude; now go on to develop your main theme.

TIMAEUS: Let us therefore state the reason why the framer of this universe of change framed it at all. He was good, and what is good has no particle of envy in it; being therefore without envy he wished all things to be as like himself as possible. This is as valid a principle for the origin of the world of change as we shall discover from the wisdom of men, and we should accept it. God therefore, wishing that all things should be good, and so far as possible nothing be imperfect, and finding the visible universe in a state not of rest but of inharmonious and disorderly motion, reduced it to order from disorder, as he judged that order was in every way better. It is impossible for the best to produce anything but the highest. When he considered, therefore, that in all the realm of visible nature, taking each thing as a whole, nothing without intelligence is to be found that is superior to anything with it, and that intelligence is impossible without soul, in fashioning the universe he implanted reason in soul and soul in body, and so ensured that his work should be by nature highest and best. And so that most likely account must say that this world came to be in very truth, through god's providence, a living being with soul and intelligence.

On this basis we must proceed to the next question: What was the living being in the likeness of which the creator constructed it? We cannot suppose that it was any creature that is part of a larger whole, for nothing can be good that is modelled on something incomplete.... For god's purpose was to use

as his model the highest and most completely perfect of intelligible things, and so he created a single visible living being, containing within itself all living beings of the same natural order. Are we then right to speak of one universe, or would it be more correct to speak of a plurality or infinity? ONE is right, if it was manufactured according to its pattern; for that which comprises all intelligible beings cannot have a double. There would have to be another being comprising them both, of which both were parts, and it would be correct to call our world a copy not of them but of the being which comprised them. In order therefore that our universe should resemble the perfect living creature in being unique, the maker did not make two universes or an infinite number, but our universe was and is and will continue to be his only creation.

Now anything that has come to be must be corporeal, visible, and tangible: but nothing can be visible without fire, nor tangible without solidity, and nothing can be solid without earth. So god, when he began to put together the body of the universe, made it of fire and earth. But it is not possible to combine two things properly without a third to act as a bond to hold them together. And the best bond is one that effects the closest unity between itself and the terms it is combining; and this is best done by a continued geometrical proportion.... If then the body of the universe were required to be a plane surface with no depth, one middle term would have been enough to connect it with the other terms, but in fact it needs to be solid, and solids always need two connecting middle terms. So god placed water and air between fire and earth, and made them so far as possible proportional to one another, so that air is to water as water is to earth; and in this way he bound the world into a visible and tangible whole. So by these means and from these four constituents the body of the universe was created to be at unity owing to proportion; in consequence it acquired concord, so that having once come together in unity with itself it is indissoluble by any but its compounder.

The construction of the world used up the whole of each of these four elements. For the creator constructed it of all the fire and water and air and earth available, leaving over no part or property of any of them, his purpose being, firstly, that it should be as complete a living being as possible, a whole of complete parts, and further, that it should be single and there should be nothing left over out of which another such whole could come into being, and finally that it should be ageless and free from disease. For he knew that heat and cold and other things that have powerful effects attack a composite body from without, so causing untimely dissolution, and make it decay by bringing disease and old age upon it. On this account and for this reason he made this world a single complete whole, consisting of parts that are wholes, and subject neither to age nor to disease. The shape he gave it was suitable to its nature. A suitable shape for a living being that was to contain within itself all living beings would be a figure that contains all

possible figures within itself. Therefore he turned it into a rounded spherical shape, with the extremes equidistant in all directions from the centre, a figure that has the greatest degree of completeness and uniformity, as he judged uniformity to be incalculably superior to its opposite. And he gave it a perfectly smooth external finish all round, for many reasons. For it had no need of eyes, as there remained nothing visible outside it, nor of hearing, as there remained nothing audible; there was no surrounding air which it needed to breathe in, nor was it in need of any organ by which to take food into itself and discharge it later after digestion. Nothing was taken from it or added to it, for there was nothing that could be; for it was designed to supply its own nourishment from its own decay and to comprise and cause all processes, as its creator thought that it was better for it to be self-sufficient than dependent on anything else. He did not think there was any purpose in providing it with hands as it had no need to grasp anything or defend itself, nor with feet or any other means of support. For of the seven[1] physical motions he allotted to it the one which most properly belongs to intelligence and reason, and made it move with a uniform circular motion on the same spot; any deviation into movement of the other six kinds he entirely precluded. And because for its revolution it needed no feet he created it without feet or legs.

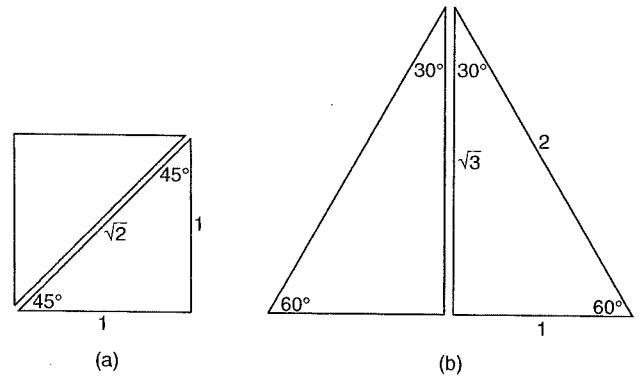
This was the plan of the eternal god when he gave to the god about to come into existence a smooth and unbroken surface, equidistant in every direction from the centre, and made it a physical body whole and complete, whose components were also complete physical bodies. And he put soul in the centre and diffused it through the whole and enclosed the body in it. So he established a single spherical universe in circular motion, alone but because of its excellence needing no company other than itself, and satisfied to be its own acquaintance and friend. His creation, then, for all these reasons, was a blessed god. [...]

My verdict, in short, may be stated as follows. There were, before the world came into existence, being, space, and becoming, three distinct realities. ... And its contents were in constant process of movement and separation, rather like the contents of a winnowing basket or similar implement for cleaning corn, in which the solid and heavy stuff is sifted out and settles on one side, the light and insubstantial on another: so the four basic constituents were shaken by the receptacle, which acted as a kind of shaking implement, and those most unlike each other were separated most widely, those most like each other pushed together most closely, with the result that they came to occupy different regions of space even before they were arranged into an ordered universe. Before that time they were all without proportion or measure; fire, water, earth and air bore some traces of their proper nature,

[1] The seven motions are: uniform circular motion in the same place, mentioned here, up and down, backwards and forwards, right and left.

but were in the disorganized state to be expected of anything which god has not touched, and his first step when he set about reducing them to order was to give them a definite pattern of shape and number. We must thus assume as a principle in all we say that god brought them to a state of the greatest possible perfection, in which they were not before. Our immediate task is to attempt an explanation of the particular structure and origin of each; its terms will be unfamiliar, but you will be able to follow as you have been trained in the branches of knowledge which it must employ.

In the first place it is clear to everyone that fire, earth, water, and air are bodies, and all bodies are solids. All solids again are bounded by surfaces, and all rectilinear surfaces are composed of triangles. There are two basic types of triangle, each having one right angle and two acute angles: in one of them these two angles are both half right angles, being subtended by equal sides, in the other they are unequal, being subtended by unequal sides. This we postulate as the origin of fire and the other bodies, our argument combining likelihood and necessity; their more ultimate origins are known to god and to men whom god loves. We must proceed to enquire what are the four most perfect possible bodies which, though unlike one another, are some of them capable of transformation into each other on resolution. If we can find the answer to this question we have the truth about the origin of earth and fire and the two mean terms between them; for we will never admit that there are more perfect visible bodies than these, each in its type. So we must do our best to construct four types of perfect body and maintain that we have grasped their nature sufficiently for our purpose. Of the two basic triangles, then, the isosceles has only one variety, the scalene an infinite number



The two types of triangle: (a) isosceles = a triangle with two sides of equal length; (b) scalene = a triangle with all three sides of different lengths.

Further, the locomotions of the elementary natural bodies – namely, fire, earth, and the like – show not only that place is something, but also that it exerts a certain influence. Each is carried to its own place, if it is not hindered, the one up, the other down. Now these are regions or kinds of place – up and down and the rest of the six directions. Nor do such distinctions (up and down and right and left) hold only in relation to us. To *us* they are not always the same but change with the direction in which we are turned: that is why the same thing is often both right *and* left, up *and* down, before *and* behind. But in *nature* each is distinct, taken apart by itself. It is not every chance direction which is up, but where fire and what is light are carried; similarly, too, down is not any chance direction but where what has weight and what is made of earth are carried – the implication being that these places do not differ merely in position, but also as possessing distinct powers....

These considerations then would lead us to suppose that place is something distinct from bodies, and that every sensible body is in place.... If this is its nature, the power of place must be a marvellous thing, and be prior to all other things. For that without which nothing else can exist, while it can exist without the others, must needs be first; for place does not pass out of existence when the things in it are annihilated. [...]

(b) On the Heavens

[...] All natural bodies and magnitudes we hold to be, as such, capable of locomotion; for nature, we say, is their principle of movement. But all movement that is in place, all locomotion, as we term it, is either straight or circular or a combination of these two which are the only simple movements. And the reason is that these two, the straight and the circular line, are the only simple magnitudes. Now revolution about the centre is circular motion, while the upward and downward movements are in a straight line, 'upward' meaning motion away from the centre, and 'downward' motion towards it. All simple motion, then, must be motion either away from or towards or about the centre....

Bodies are either simple or compounded of such; and by simple bodies I mean those which possess a principle of movement in their own nature, such as fire and earth with their kinds, and whatever is akin to them. Necessarily, then, movements also will be either simple or in some sort compound – simple in the case of the simple bodies, compound in that of the composite – and the motion is according to the prevailing element. Supposing, then, that there is such a thing as simple movement, and that circular movement is simple... then there must necessarily be some simple body which moves naturally and in virtue of its own nature with a circular movement. ...Further, this circular motion is necessarily primary. For the complete is naturally prior to the incomplete, and the circle is a complete thing. This cannot be said of any straight line: – not of an infinite line; for then it would have a limit and an end: nor of any finite line; for in every case there is

something beyond it, since any finite line can be extended. And so, since the prior movement belongs to the body which is naturally prior, and circular movement is prior to straight, and movement in a straight line belongs to simple bodies – fire moving straight upward and earthy bodies straight downward towards the centre – since this is so, it follows that circular movement also must be the movement of some simple body. For the movement of composite bodies is, as we said, determined by that simple body which prevails in the composition. From this it is clear that there is in nature some bodily substance other than the formations we know, prior to them all and more divine than they....Further, if, on the one hand, circular movement is *natural* to something, it must surely be some simple and primary body which naturally moves with a natural circular motion, as fire moves up and earth down. If, on the other hand, the movement of the rotating bodies about the centre is *unnatural*, it would be remarkable and indeed quite inconceivable that this movement alone should be continuous and eternal, given that it is unnatural. At any rate the evidence of all other cases goes to show that it is the unnatural which quickest passes away....On all these grounds, therefore, we may infer with confidence that there is something beyond the bodies that are about us on this earth, different and separate from them; and that the superior glory of its nature is proportionate to its distance from this world of ours.

In consequence of what has been said,...it is clear that not every body possesses either lightness or heaviness. We must explain in what sense we are using the words 'heavy' and 'light'.... Let us then apply the term 'heavy' to that which naturally moves towards the centre, and 'light' to that which moves naturally away from the centre. The heaviest thing will be that which sinks to the bottom of all things that move downward, and the lightest that which rises to the surface of everything that moves upward. Now, necessarily, everything which moves either up or down possesses lightness or heaviness or both – but not both relatively to the same thing; for things are heavy and light relatively to one another; air, for instance, is light relatively to water, and water light relatively to earth. But the body which moves in a circle cannot possibly possess heaviness or lightness. For neither naturally nor unnaturally can it move either towards or away from the centre. Movement in a straight line certainly does not belong to it *naturally*, since one sort of movement is, as we saw, appropriate to each simple body, and so we should be compelled to identify it with one of the bodies which move in this way....

It is equally reasonable to assume that this body will be ungenerated and indestructible and exempt from increase and alteration....Now the motions of contraries are contrary. If then this body can have no contrary, because there can be no contrary motion to the circular, nature seems justly to have exempted from contraries the body which was to be ungenerated and indestructible. For it is on contraries that generation and destruction

In those days the earth attempted also to produce a host of monsters, grotesque in build and aspect – hermaphrodites, halfway between the sexes yet cut off from either, creatures bereft of feet or dispossessed of hands, dumb, mouthless brutes, or eyeless and blind, or disabled by the adhesion of their limbs to the trunk, so that they could neither do anything nor go anywhere nor keep out of harm's way nor take what they needed. These and other such *monstrous and misshapen births were created. But all in vain.* Nature debarred them from increase....

In those days, again, *many species must have died out altogether* and failed to reproduce their kind. Every species that you now see drawing the breath of life has been protected and preserved from the beginning of the world either by cunning or by prowess or by speed. In addition, there are many that survive under human protection because their usefulness has commended them to our care. [...]

1.4 Galen, *On Anatomical Procedure*, from *Greek Medicine*, trans. and ed. Arthur J. Brock (London and Toronto: Dent, 1929), pp. 160–5

What tent-poles are to tents, and walls to houses, so to animals is their bony structure; the other parts adapt themselves to this, and change with it. Thus, if an animal's cranium is round, its brain must be the same; or, again, if it is oblong, then the animal's brain must also be oblong. If the jaws are small, and the face as a whole roundish, the muscles of these parts will also necessarily be small; and similarly, if the jaws are prominent, the animal's face as a whole will be long, as also the facial muscles. Consequently also the monkey... is of all animals the likest to man in its viscera, muscles, arteries, veins, and nerves..., because it is so also in the form of its bones. From the nature of these it walks on two legs, uses its front limbs as hands, has the flattest breast-bone of all quadrupeds, collar-bones like those of a man, a round face and a short neck. And these being similar, the muscles cannot be different; for they are extended on the outside of the bones in such a manner that they resemble them in size and form. To the muscles, again, correspond the arteries, veins, and nerves; so these, being similar, must correspond to the bones.

First of all, then, I would ask you to make yourself well acquainted with the human bones, and not to look on this as a matter of secondary importance. Nor must you merely read the subject up in one of these books which are called by some 'Osteology', by others 'The Skeleton', and by others simply 'On Bones', as is my own book; which, by the way, I am certain is better than any previously written, both as regards the exactitude of its matter and the brevity and clearness of its explanations. Make it your earnest business, then, not only to learn exactly from the book the appearance of each of the bones, but to become yourself by the use of your own eyes an eager first-hand observer of human osteology.

At Alexandria this is very easy, since the physicians in that country accompany the instruction they give to their students with opportunities for personal inspection (*autopsia*). Hence you must try to get to Alexandria for this reason alone, if for no other. But if you cannot manage this, still it is not impossible to obtain a view of human bones. Personally I have very often had a chance to do this where tombs or monuments have become broken up. On one occasion a river, having risen to the level of a grave which had been carelessly constructed a few months previously, easily disintegrated this; then by the force of its current it swept right over the dead man's body, of which the flesh had already putrefied, while the bones were still closely attached to one another. This it carried away downstream for the distance of a league, till, coming to a lake-like stretch with sloping banks, it here deposited the corpse. And here the latter lay ready for inspection, just as though prepared by a doctor for his pupil's lesson.

Once also I examined the skeleton of a robber, lying on a mountainside a short distance from the road. This man had been killed by some traveller whom he had attacked, but who had been too quick for him. None of the inhabitants of the district would bury him; but in their detestation of him they were delighted when his body was eaten by birds of prey; the latter, in fact, devoured the flesh in two days and left the skeleton ready, as it were, for anyone who cared to enjoy an anatomical demonstration.

As regards yourself, then, even if you do not have the luck to see anything like this, still you can dissect an ape, and learn each of the bones from it, by carefully removing the flesh. For this purpose you must choose the apes which most resemble man. Such are those in whom the jaws are not prominent nor the canine teeth large. In such apes you will also find the other parts as in man, whence they walk and run on two legs. Those of them, again, that are like the dog-headed baboons... have longer muzzles and large canine teeth; they have difficulty in standing upright on two legs, let alone walking about or running.

But even those apes most like human beings fall somewhat short of the absolutely erect posture. In them the head of the femur is adjusted somewhat obliquely to the hip-socket, and certain of the muscles which run down to the tibia come far forward; both of these factors impair or prevent assumption of the erect posture, as also do their feet, for in these the heels are somewhat narrow and the toes widely separated from each other. These, however, are small matters, and so the ape comes very near being able to stand erect.

Those monkeys which resemble the dog-faced baboons and have a marked divergence from the human type show also as clear difference in their bones. Choose, therefore, among the monkeys the most men-like (*anthropoid*), and learn accurately on them the nature of the bones, comparing them with my writings. You will also have to accustom yourself without delay to their names, as these will also be useful in learning the anatomy of other parts.

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kidneys, while the other one – that from which the ligature had been taken – is itself flaccid, but has filled the bladder with urine. Then, again, one must divide the full ureter, and demonstrate how the urine spurts out of it, like blood in the operation of venesection; and after this one cuts through the other also, and both being thus divided, one bandages up the animal externally. Then when enough time seems to have elapsed, one takes off the bandages; the bladder will now be found empty, and the whole region between the intestines and the peritoneum full of urine, as if the animal were suffering from dropsy. Now, if anyone will but test this for himself on an animal, I think he will strongly condemn the rashness of Asclepiades, and if he also learns the reason why nothing regurgitates from the bladder into the ureters, I think he will be persuaded by this also of the forethought and art shown by Nature in relation to animals. [...]

1.6 Sacrobosco, *The Sphere*, trans. Lynn Thorndike in *The Sphere of Sacrobosco and Its Commentators* (Chicago, IL: University of Chicago Press, 1949), pp. 118–22

The sphere... is divided into the ninth sphere, which is called the 'first moved' or the *primum mobile*; and the sphere of the fixed stars, which is named the 'firmament'; and the seven spheres of the seven planets, of which some are larger, some smaller, according as they the more approach, or recede from, the firmament. Wherefore, among them the sphere of Saturn is the largest, the sphere of the moon the smallest....

[...] THE FOUR ELEMENTS. – The machine of the universe is divided into two, the ethereal and the elementary region. The elementary region, existing subject to continual alteration, is divided into four. For there is earth, placed, as it were, as the center in the middle of all, about which is water, about water air, about air fire, which is pure and not turbid there and reaches to the sphere of the moon, as Aristotle says in his book of *Meteorology*. For so God, the glorious and sublime, disposed. And these are called the 'four elements' which are in turn by themselves altered, corrupted and regenerated. The elements are also simple bodies which cannot be subdivided into parts of diverse forms and from whose commixture are produced various species of generated things. Three of them, in turn, surround the earth on all sides spherically, except in so far as the dry land stays the sea's tide to protect the life of animate beings. All, too, are mobile except earth, which, as the center of the world, by its weight in every direction equally avoiding the great motion of the extremes, as a round body occupies the middle of the sphere.

THE HEAVENS. – Around the elementary region revolves with continuous circular motion the ethereal, which is lucid and immune from all variation in its immutable essence. And it is called 'Fifth Essence' by the philosophers. Of which there are nine spheres, as we have just said: namely, of the moon, Mercury, Venus, the sun, Mars, Jupiter, Saturn, the fixed stars, and the last heaven. Each of these spheres incloses its inferior spherically.

THEIR MOVEMENTS. – ... [T]he first movement [of the outermost sphere] carries all the others with it in its rush about the earth once within a day and night, although they strive against it, as in the case of the eighth sphere one degree in a hundred years. This second movement is divided through the middle by the zodiac, under which each of the seven planets has its own sphere, in which it is borne by its own motion, contrary to the movement of the sky, and completes it in varying spaces of time – in the case of Saturn in thirty years, Jupiter in twelve years, Mars in two, the sun in three hundred and sixty-five days and six hours, Venus and Mercury about the same, the moon in twenty-seven days and eight hours.

REVOLUTION OF THE HEAVENS FROM EAST TO WEST. – That the sky revolves from east to west is signified by the fact that the stars, which rise in the east, mount gradually and successively until they reach mid-sky and are always at the same distance apart, and, thus maintaining their relative positions, they move toward their setting continuously and uniformly. Another indication is that the stars near the North Pole, which never set for us, move continuously and uniformly, describing their circles about the pole, and are always equally near or far from one another. Wherefore, from those two continuous movements of the stars, both those that set and those which do not, it is clear that the firmament is moved from east to west.

THE HEAVENS SPHERICAL. – There are three reasons why the sky is round: likeness, convenience, and necessity. Likeness, because the sensible world is made in the likeness of the archetype, in which there is neither end nor beginning; wherefore, in likeness to it the sensible world has a round shape, in which beginning or end cannot be distinguished. Convenience, because of all... bodies the sphere is the largest and of all shapes the round is most capacious. Since largest and round, therefore the most capacious. Wherefore, since the world is all-containing, this shape was useful and convenient for it. Necessity, because if the world were of other form than round – say, trilateral, quadrilateral, or many-sided – it would follow that some space would be vacant and some body without a place, both of which are false ....

[...] THE EARTH A SPHERE. – That the earth, too, is round is shown thus. The signs and stars do not rise and set the same for all men everywhere but rise and set sooner for those in the east than for those in the west; and of this there is no other cause than the bulge of the earth. Moreover, celestial phenomena evidence that they rise sooner for orientals than for westerners. For one and the same eclipse of the moon which appears to us in the first hour of the night appears to orientals about the third hour of the night, which proves that they had night and sunset before we did, of which setting the bulge of the earth is the cause.

FURTHER PROOFS OF THIS. – That the earth also has a bulge from north to south and vice versa is shown thus: To those living toward the north, certain stars are always visible, namely, those near the North Pole, while others which are near the South Pole are always concealed from them. If, then,

From R.H. Popkin, The Philosophy of the 16th - 17th Centuries

what they do and what they leave undone by our own believing understanding of the Scriptures, and force them to follow the better understanding, and not their own. Did not Abraham in old days have to obey his Sarah, who was in stricter bondage to him than we are to any one on earth? Thus, too, Balaam's ass was wiser than the prophet. If God spoke by an ass against a prophet, why should He not speak by a pious man against the Pope? Besides, St. Paul withstood St. Peter as being in error (Gal. ii.). Therefore it behooves every Christian to aid the faith by understanding and defending it and by condemning all errors. . . .

25. The universities also require a good, sound reformation. I must say this, let it vex whom it may. The fact is that whatever the papacy has ordered or instituted is only designed for the propagation of sin and error. What are the universities, as at present ordered, but, as the book of Maccabees says, "schools of 'Greek fashion' and 'heathenish manners'" (2 Macc. iv. 12, 13), full of dissolute living, where very little is taught of the Holy Scriptures and of the Christian faith, and the blind heathen teacher, Aristotle, rules even further than Christ? Now, my advice would be that the books of Aristotle, the *Physics,* the *Metaphysics, Of the Soul, Ethics,* which have hitherto been considered the best, be altogether abolished, with all others that profess to treat of nature, though nothing can be learned from them, either of natural or of spiritual things. Besides, no one has been able to understand his meaning, and much time has been wasted and many noble souls vexed with much useless labour, study, and expense. I venture to say that any potter has more knowledge of natural things than is to be found in these books. My heart is grieved to see how many of the best Christians this accursed, proud, knavish heathen has fooled and led astray with his false words. God sent him as a plague for our sins.

Does not the wretched man in his best book, *Of the Soul,* teach that the soul dies with the body, though many have tried to save him with vain words, as if we had not the Holy Scriptures to teach us fully of all things of which Aristotle had not the slightest perception? Yet this dead heathen has conquered, and has hindered and almost suppressed the books of the living God; so that, when I see all this misery I cannot but think that the evil spirit has introduced this study.

Then there is the *Ethics,* which is accounted one of the best, though no book is more directly contrary to God's will and the Christian virtues. Oh that such books could be kept out of the reach of all

Christians! Let no one object that I say too much, or speak without knowledge. My friend, I know of what I speak. I know Aristotle as well as you or men like you. I have read him with more understanding than St. Thomas or Scotus, which I may say without arrogance, and can prove if need be. It matters not that so many great minds have exercised themselves in these matters for many hundred years. Such objections do not affect me as they might have done once, since it is plain as day that many more errors have existed for many hundred years in the world and the universities.

I would, however, gladly consent that Aristotle's books of Logic, Rhetoric, and Poetry, should be retained, or they might be usefully studied in a condensed form, to practise young people in speaking and preaching; but the notes and comments should be abolished, and, just as Cicero's Rhetoric is read without note or comment, Aristotle's Logic should be read without such long commentaries. But now neither speaking nor preaching is taught out of them, and they are used only for disputation and toilsomeness. Besides this, there are languages—Latin, Greek, and Hebrew—the mathematics, history; which I recommend to men of higher understanding: and other matters, which will come of themselves, if they seriously strive after reform. And truly it is an important matter, for it concerns the teaching and training of Christian youths and of our noble people, in whom Christianity still abides. Therefore I think that pope and emperor could have no better task than the reformation of the universities, just as there is nothing more devilishly mischievous than an unreformed university.

Physicians I would leave to reform their own faculty; lawyers and theologians I take under my charge, and say firstly that it would be right to abolish the canon law entirely, from beginning to end, more especially the decretals. We are taught quite sufficiently in the Bible how we ought to act; all this study only prevents the study of the Scriptures, and for the most part it is tainted with covetousness and pride. And even though there were some good in it, it should nevertheless be destroyed, for the Pope having the canon law *in scrinio pectoris,*[1] all further study is useless and deceitful. At the present time the canon law is not to be found in the books, but in the whims of the Pope and his sycophants. You may have settled a matter in the best possible way according to the canon law, but the Pope has his *scrinium pectoris,* to which all law must bow in all the world. Now this *scrinium* is oftentimes directed by some knave and the devil himself, whilst it

1. In the shrine of his heart.

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whenever they have been compelled to call a council, they have made it of no avail by binding the princes beforehand with an oath to leave them as they were, and to give moreover to the Pope full power over the procedure of the council, so that it is all one whether we have many councils or no councils, in addition to which they deceive us with false pretences and tricks. So grievously do they tremble for their skin before a true, free council; and thus they have overawed kings and princes, that these believe they would be offending God, if they were not to obey them in all such knavish, deceitful artifices.

Now may God help us, and give us one of those trumpets that overthrew the walls of Jericho, so that we may blow down these walls of straw and paper, and that we may set free our Christian rods for the chastisement of sin, and expose the craft and deceit of the devil, so that we may amend ourselves by punishment and again obtain God's favour. . . .

¶ (*b*) The Second Wall

That no one may interpret the Scriptures but the Pope

The second wall is even more tottering and weak: that they alone pretend to be considered masters of the Scriptures; although they learn nothing of them all their life. They assume authority, and juggle before us with impudent words, saying that the Pope cannot err in matters of faith, whether he be evil or good, albeit they cannot prove it by a single letter. That is why the canon law contains so many heretical and unchristian, nay unnatural, laws; but of these we need not speak now. For whereas they imagine the Holy Ghost never leaves them, however unlearned and wicked they may be, they grow bold enough to decree whatever they like. But were this true, where were the need and use of the Holy Scriptures? Let us burn them, and content ourselves with the unlearned gentlemen at Rome, in whom the Holy Ghost dwells, who, however, can dwell in pious souls only. If I had not read it, I could never have believed that the devil should have put forth such follies at Rome and find a following.

But not to fight them with our own words, we will quote the Scriptures. St. Paul says, "If anything be revealed to another that sitteth by, let the first hold his peace" (I Cor. xiv. 30). What would be the use of this commandment, if we were to believe him alone that teaches or has the highest seat? Christ Himself says, "And they shall be all taught of God" (St. John xi. 45). Thus it may come to pass that the Pope and his followers are wicked and not true Christians,

and not being taught by God, have no true understanding, whereas a common man may have true understanding. Why should we then not follow him? Has not the Pope often erred? Who could help Christianity, in case the Pope errs, if we do not rather believe another who has the Scriptures for him?

Therefore it is a wickedly devised fable—and they cannot quote a single letter to confirm it—that it is for the Pope alone to interpret the Scriptures or to confirm the interpretation of them. They have assumed the authority of their own selves. And though they say that this authority was given to St. Peter when the keys were given to him, it is plain enough that the keys were not given to St. Peter alone, but to the whole community. Besides, the keys were not ordained for doctrine or authority, but for sin, to bind or loose; and what they claim besides this from the keys is mere invention. But what Christ said to St. Peter: "I have prayed for thee that thy faith fail not" (St. Luke xxii. 32), cannot relate to the Pope, inasmuch as the greater part of the Popes have been without faith, as they are themselves forced to acknowledge; nor did Christ pray for Peter alone, but for all the Apostles and all Christians, as He says, "Neither pray I for these alone, but for them also which shall believe on Me through their word" (St. John xvii.). Is not this plain enough?

Only consider the matter. They must needs acknowledge that there are pious Christians among us that have the true faith, spirit, understanding, word, and mind of Christ: why then should we reject their word and understanding, and follow a pope who has neither understanding nor spirit? Surely this were to deny our whole faith and the Christian Church. Moreover, if the article of our faith is right, "I believe in the holy Christian Church," the Pope cannot alone be right; else we must say, "I believe in the Pope of Rome," and reduce the Christian Church to one man, which is a devilish and damnable heresy. Besides that, we are all priests, as I have said, and have all one faith, one Gospel, one Sacrament; how then should we not have the power of discerning and judging what is right or wrong in matters of faith? What becomes of St. Paul's words, "But he that is spiritual judgeth all things, yet he himself is judged of no man" (1 Cor. ii. 15), and also, "we having the same spirit of faith"? (2 Cor. iv. 13). Why then should we not perceive as well as an unbelieving pope what agrees or disagrees with our faith?

By these and many other texts we should gain courage and freedom, and should not let the spirit of liberty (as St. Paul has it) be frightened away by the inventions of the popes; we should boldly judge

From Popkin

It is very easy, upon accepted foundations, to build what you please; for according to the law and ordering of this beginning, the rest of the parts of the building are easily done, without contradictions. By this path we find our reason well founded, and we argue with great ease. For our masters occupy and win beforehand as much room in our belief as they need in order to conclude afterward whatever they wish, in the manner of the geometricians with their axioms; the consent and approval that we lend them giving them the wherewithal to drag us left or right, and to spin us around at their will. Whoever is believed in his presuppositions, he is our master and our God. . . . For each science has its presupposed principles, by which human judgment is bridled on all sides. If you happen to crash this barrier in which lies the principal error, immediately they have this maxim in their mouth, that there is no arguing against people who deny first principles.

Now there cannot be first principles for men, unless the Divinity has revealed them; all the rest—beginning, middle, and end—is nothing but dreams and smoke. To those who fight by presupposition, we must presuppose the opposite of the same axiom we are disputing about. For every human presupposition and every enunciation has as much authority as another, unless reason shows the difference between them. Thus they must all be put in the scales, and first of all the general ones, and those which tyrannize over us. The impression of certainty is a certain token of folly and extreme uncertainty . . .

That things do not lodge in us in their own form and essence, or make their entry into us by their own power and authority, we see clearly enough. Because, if that were so, we should receive them in the same way: wine would be the same in the mouth of a sick man as in the mouth of a healthy man; he who has chapped or numb fingers would find the same hardness in the wood or iron he handles as does another. Thus external objects surrender to our mercy; they dwell in us as we please.

Now if for our part we received anything without alteration, if the human grip was capable and firm enough to grasp the truth by our own means; these means being common to all men, this truth would be bandied from hand to hand, from one man to another; and at least there would be one thing in the world, out of all there are, that would be believed by all men with universal consent. But this fact, that no proposition can be seen which is not debated and controverted among us, or which may not be, well shows that our natural judgment does

not grasp very clearly what it grasps. For my judgment cannot make my companion's judgment accept it; which is a sign that I have grasped it by some other means than by a natural power that is in me and in all men.

Let us leave aside that infinite confusion of opinions that is seen among the philosophers themselves, and that perpetual and universal debate over the knowledge of things. For this is a very true presupposition: that men are in agreement about nothing. I mean even the most gifted and ablest scholars, not even that the sky is over our head. For those who doubt everything also doubt that; and those who deny that we can understand anything say that we have not understood that the sky is over our head; and these two views are incomparably the strongest in number.

Besides this infinite diversity and division, it is easy to see by the confusion that our judgment gives to our own selves, and the uncertainty that each man feels within himself, that it has a very insecure seat. How diversely we judge things! How many times we change our notions! What I hold today and what I believe, I hold and believe it with all my belief; all my tools and all my springs of action grip this opinion and sponsor it for me in every way they can. I could not embrace or preserve any truth with more strength than this one. I belong to it entirely, I belong to it truly. But has it not happened to me, not once, but a hundred times, a thousand times, and every day, to have embraced with these same instruments, in this same condition, something else that I have since judged false? . . .

Now from the knowledge of this mobility of mine I have accidentally engendered in myself a certain constancy of opinions, and have scarcely altered my original and natural ones. For whatever appearance of truth there may be in novelty, I do not change easily, for fear of losing in the change. And since I am not capable of choosing, I accept other people's choice and stay in the position where God put me. Otherwise I could not keep myself from rolling about incessantly. Thus I have, by the grace of God, kept myself intact, without agitation or disturbance of conscience, in the ancient beliefs of our religion, in the midst of so many sects and divisions that our century has produced.

The writings of the ancients, I mean the good writings, full and solid, tempt me and move me almost wherever they please; the one I am listening to always seems to me the strongest; I find each one right in his turn, although they contradict each other. . . .

The sky and the stars have been moving for three thousand years; everybody had so believed, until it occurred to Cleanthes of Samos,

or (according to Theophrastus) to Nicetas of Syracuse, to maintain that it was the earth that moved, through the oblique circle of the Zodiac; turning about its axis; and in our day Copernicus has grounded this doctrine so well that he uses it very systematically for all astronomical deductions. What are we to get out of that, unless that we should not bother which of the two is so? And who knows whether a third opinion, a thousand years from now, will not overthrow the preceding two? . . .

Thus when some new doctrine is offered to us, we have great occasion to distrust it, and to consider that before it was produced its opposite was in vogue; and, as it was overthrown by this one, there may arise in the future a third invention that will likewise smash the second. Before the principles which Aristotle introduced were in credit, other principles satisfied human reason, as his satisfy us at this moment. What letters-patent have these, what special privilege, that the course of our invention stops at them, and that to them belongs possession of our belief for all time to come? They are no more exempt from being thrown out than were their predecessors. . . .

How long is it that medicine has been in the world? They say that a newcomer, whom they call Paracelsus, is changing and overthrowing the whole order of the ancient rules, and maintaining that up to this moment it has been good for nothing but killing men. I think he will easily prove that; but as for putting my life to the test of his new experience, I think that would not be great wisdom.

We must not believe every man, says the maxim, because any man may say anything.

A man of that profession of novelties and of reforms in physics was saying to me not long ago that all the ancients had evidently been mistaken about the nature and movements of the winds, which fact he would make so palpable that I could touch it, if I would hear him out. After I had taken some patience to listen to his arguments, which were full of likelihood: "What?" I said to him. "Then did those who navigated under the laws of Theophrastus go west when they headed east? Did they go sideways, or backward?" "That was luck," he replied; "at all events they miscalculated." I then replied to him that I would rather follow facts than reason. . . .

Ptolemy, who was a great man, had established the limits of our world; all the ancient philosophers thought they had its measure, except for a few remote islands that might escape their knowledge. It would have been Pyrrhonizing, a thousand years ago, to cast in doubt the science of cosmography, and the opinions that were accepted about it

by one and all; it was heresy to admit the existence of the Antipodes. Behold in our century an infinite extent of terra firma, not an island or one particular country, but a portion nearly equal in size to the one we know, which has just been discovered. The geographers of the present time do not fail to assure us that now all is discovered and all is seen,

> For what we have at hand always seems best of all.
> —LUCRETIUS

The question is, if Ptolemy was once mistaken on the grounds of his reason, whether it would not be stupid for me now to trust to what these people say about it; and whether it is not more likely that this great body that we call the world is something quite different from what we judge. . . .

This subject has brought me to the consideration of the senses, in which lies the greatest foundation and proof of our ignorance. All that is known, is doubtless known through the faculty of the knower; for since judgment comes from the operation of him who judges, it stands to reason that he performs this operation by his means and will, not by the constraint of others, as would happen if we knew things through the power and according to the law of their own essence.

Now all knowledge makes its way into us through the senses; they are our masters: . . . Knowledge begins through them and is resolved into them.

After all, we would know no more than a stone, if we did not know that there is sound, smell, light, taste, measure, weight, softness, hardness, roughness, color, smoothness, breadth, depth. These are the base and the principles of the whole edifice of our knowledge. And according to some, knowledge is nothing else but sensation. Whoever can force me to contradict the senses has me by the throat; he could not make me retreat any further. The senses are the beginning and the end of human knowledge: . . .

Attribute to them as little as you can, still you must grant them this, that by way of them and by their mediation proceeds all our instruction. . . .

The first consideration that I offer on the subject of the senses is that I have my doubts whether man is provided with all the senses of nature. I see many animals that live a complete and perfect life,

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