NOTE FOR BOOK ONE, READING TEN

In the Second Reading, Aristotle divided the opinions of the philosophers before him on the beginning or causes of natural things. This division makes clear what seems to be their almost complete disagreement. No two philosophers seem to say the same thing.

This is discouraging, but Aristotle does not despair and give up, as so many others have done faced with this common situation in the history of human thinking.

But his hope of still finding the truth is balanced by the fear of mistake so he is not so bold as to seek the truth by himself alone.

Rather he seems in many, if not all, the readings to be following the advice of the central thinker in human thought, Heraclitus. Heraclitus had said that “Those who speak with understanding must be strong in what is common to all”.

In the eighth reading, Aristotle finds a common thought among those who said there was one beginning or cause and also a common thought among those who said there were many beginnings.

Those who said there was only one beginning, although they differed as to what this one beginning was, agreed that things came to be by the condensation or rarefaction of this one matter.

Those who said there were many beginnings, although disagreeing as to what those many were, agreed that those many were mixed together or segregated (separated in kind). When we compare, for example, Anaxagoras and Empedocles, at first we see only disagreement. Empedocles says that matter is the four elements (earth, air, fire and water) while Anaxagoras says that matter is made up of an infinity of infinitely small pieces of everything. And Empedocles says that the mover or movers are love and hate while Anaxagoras speaks of the greater mind as the mover. But Empedocles says that love mixes the four elements together and hate segregates them while Anaxagoras speaks of how everything was mixed together in matter, and the greater mind as beginning to segregate or to separate them. Thus they both speak of mixture and segregation.

Now in the beginning of the Tenth Reading, Aristotle reaches a common thought or understanding shared by all the Greek natural philosophers. They all understand change by contraries. For some use dense and rare and others use mixed and segregated. And both these pairs are contraries. And when we consider them more at length, we see that besides sharing one of these two pairs of contraries, they also often bring in some other pair of contraries. Empedocles speaks of love and hate; Democritus, of the full and the empty; Parmenides, of the hot and the cold, Pythagoras, of the odd and even. Thus all their thinking about change involves contraries.

When we stand back with our wider knowledge of human history, we can see that, unknown to Aristotle, in the center of civilization furthest from Greece, the Chinese, men are also trying to understand change by contraries. For in the classic Book of Changes, the *I Ching*, the Chinese are trying to understand change by the Yin and the Yang, the male and the female principles, represented by the unbroken and broken lines. “East is East and West is West and never the twain shall meet”, said Kipling, and there is much truth this saying. But here they do meet in trying to explain change by contraries.

And when we look at the modern scientists, we meet contraries many times when they try to explain change. Thus Helmholtz tried to explain all change by attraction and repulsion between unalterable particles. And others tried to explain the motion of the earth by a balance of centrifugal and centripetal forces. And Newton said that for every action there is an equal and opposite reaction. And some have spoke of matter as condensed energy and energy as rarefied matter.

Thus it seems that anyone who thinks about change and tries to understand it, whether in the East or the West, in ancient or in modern times, comes up with some kind of contraries to explain it. We can see then how sage was the advice of the central thinker, Heraclitus, when he urged us to follow what was common.

We can enumerate a number of statements about change and contraries. Change is between contraries. Change is from one contrary to the other. We even say that in change, one contrary becomes the other (as the hot becomes cold and the healthy become sick and vice-versa), although this has a certain appearance of involving a contradiction. For something will be what it becomes. So if one contrary becomes the other, one contrary will be the other. But this involves a contradiction.

But the advice of Heraclitus, not only urges us to find what is common, but to become *strong* in it.

Aristotle will go through a number of steps to become strong in what is common to all natural philosophers. Perhaps the greatest step is in the next reading, but most of this Tenth Reading contains steps whereby Aristotle becomes stronger in the common understanding of change by contraries.

We can distinguish perhaps five steps in this Reading which Aristotle takes to become stronger in this common understanding.

First he gives a reason for what everyone is saying without giving a reason. He gives a reason why the first beginnings should be the first pair of contraries. The reason or middle term is a definition of what we all understand by first beginnings.

They are not from anything else or from each other, but everything else is from them. If they were from anything else, those other things would be the first beginnings of them. If one was from the other, both would not be a first beginning, but one would be the beginning of the other. And of course, beginnings must have something proceeding from them and from the first beginnings everything else must proceed.

The major premiss of the argument is thus obvious for one term is the definition of the other. We can lay down then the major premiss thus: what are not from anything else, or one from the other, but all else from them are the first beginnings.

If we can then show that these three elements of the definition of first beginnings belong to the first pair of contraries, we can syllogise that the first pair of contraries are the first beginnings, thus giving a reason for what everyone is saying without giving a reason.

That change is between contraries and from one contrary to the other and that even in some way one contrary can be said to become the other is shown by induction. This induction was begun by Heraclitus as we can see in his fragments. Then Socrates in the *Phaedo* made an induction to show this statement which he wanted to use in his first reasoning to the immortality of the soul. And Aristotle also shows it here by induction.

One could also give as a sign of the truth of this connection of change with contraries the fact that we do not recognize change without contraries. To show this simply. If we know that X is soft at ten o'clock and cold at eleven o'clock, we do not know that a change has taken place for the same thing could be soft and cold like ice cream. But if it was soft at ten o'clock and hard at eleven o'clock, or it was hot at ten o'clock and cold at eleven o'clock, we would know that a change had taken place. For contraries like soft and hard, or hot and cold, cannot belong to the same thing at the same time.

Moreover, no one thinks that change is remaining the same, but rather becoming other or different which involves some kind of contrariety.

So everything seems to come to be from its contrary.

But if the beginnings are contrary, one cannot reduce one of them to the other because of their opposition.

But to satisfy the third element of the definition (not from anything else), one must take not just any pair of contraries, but the first pair for one pair of contraries can give rise to another pair, as hot and cold make the butter soft and hard.

Thus we can see the truth of the minor premiss that the first pair of contraries are not from anything else or reduced to each other, but everything else is from them (since everything is from its contrary and if these are secondary contraries they are from the first ones).

In this way, then, we are able to syllogize in the first figure what everyone is saying without giving a reason.

This is the first step Aristotle takes in this Reading to become strong in what is common to all.

Another step Aristotle takes is to see that this beginning thought about change is not an hypothesis which according to Einstein is something freely imagined. If something were freely imagined, everyone who thinks about change, East or West, ancient or modern, would not have it. For freedom and imagination lead to diversity. Rather it seems something unavoidable when we think about change. It is, as Aristotle says here, forced on the mind by truth itself, even

without knowing a reason that can be given for it. This is why everyone who thinks about change seems to come up with it.

The third step Aristotle takes to become strong in what is common to all is to consider the differences of thinkers in selecting the first pair of contraries. For some judge this more by their senses, as those who said that hot and cold are first, while others took a pair that struck reason as first, such as odd and even or love and hate. In different ways, then, it is clear that they both thought not just any pair of contraries but those that seemed to be first.

A fourth step Aristotle takes to become strong in what is common to all is to see the ways in which, despite all their disagreement, they were all saying the same.

One way, of course, is already evident. They were all saying the same in general, but not in particular. They were all saying in general that the beginnings were contraries although they disagreed as to which pair of contraries in particular were first. This is a striking confirmation of what we learned in the First Reading of this book. There we learned that the general is more known and more sure for us than the particular. Now men clearly agree more about the more known to us and tend to disagree more about the less known to us. Hence, the fact that they all agree in general and disagree in particular here about contraries is a good sign of the truth taught in the First Reading.

But Aristotle now adds a second way in which they are all saying the same. They are all saying the same proportionally. (I am using the word proportion to name the likeness of ratios.) To use a mathematical likeness where proportions are first seen. If one thinker said the beginnings were two and three and another said they were four and six and yet another said they were eight and twelve, at first sight we might see only disagreement. But on second thought, we might notice that eight is twelve as four is to six, as two is to three. They are all saying the same proportionally. Likewise, in the case of the natural philosophers. For the dense is to the rare as the mixed is to the segregated as love is to hate as the full is to the empty as hot is to cold.

A fifth step Aristotle takes to become strong is brought out by Thomas who unfolds another meaning in the words “and worse and better”. In each pair of contraries, one member seems better or more positive and the other worse or lacking something. Love seems better or more positive than hate. The empty is surely lacking something compared to the full. The dense has more matter than

the rare in the same volume. (A mug of yellow beer than a mug of beer foam which is rarefied beer). The mixed has something that the segregated does not have. And the cold seems to lack something the hot has. The importance of lack will come out in the Thirteenth Reading of this First book of *Natural Hearing*.

In the following text, Thomas distinguishes the ways in which something is said to come to be *from* its opposite per se and per accidens:

> ...Si ly *ex* nominet causam, non fit aliquid ex opposito nisi per accidens, ratione scilicet subiecti.
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> Si vero nominet ordinem, tunc fit aliquid ex opposito etiam per se;
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> unde et privatio dicitur principium esse fiendi, sed non essendi.
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> Hoc autem modo dicitur aliquid fieri ex nihilo...[1]

And in this text, Thomas gives an interesting distinction on the order of the introduction of a form and the elimination of its contrary

> ...quamvis ex parte recipientis prius sit expulsio contrarii quam introductio formae, tamen ex parte causae agentis est prius introductio formae, quia non expellitur contrarium nisi introducendo formam.[2]

In a play or drama, the poet or playwright represents a change in the fortunes of the main characters. This change in a tragedy is from happiness to misery (or wretchedness) and in a comedy it is the reverse. These (happiness and misery) are contraries so there is a harmony between what the philosopher discovers about change and the change represented by the poet. When Juliet is discovered apparently dead on her wedding-day, there is a change to the contrary as noted in these words of her father:

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[1] *De Potentia*, Q. III, Art. 1, Ad 16

[2] *Scriptum Super Lib. IV Sententiarum* , Distinctio I, Quaestio II, Art. IV, Ad Quaestiuncula III, Responsio

> All things that we ordained festival
> Turn from their office to black funeral -
> Our instruments to melancholy bells,
> Our wedding cheer to a sad burial feast,
> Our solemn hymns to sullen dirges change,
> Our bridal flow'rs serve for a bury'd corse,
> And all things change them to the contrary.[3]

Shakespeare also touches upon the four principal passions as they relate to these contrary movements in the plots of tragedy and comedy in these words of Edgar:

> Yet better thus, and known to be contemn'd,
> Then still contemn'd and flatter'd. To be worst,
> The lowest and most dejected things of fortune,
> Stands still in esperance, lives not in fear.
> The lamentable change is from the best;
> The worst returns to laughter.[4]

When Aristotle states that this common beginning in the thought of the Greek natural philosophers about change (that it is by contraries) seems to be forced on their mind by truth itself, he touches upon a distinction in the beginnings of our thinking. In the book *On the Universe* (called in Latin the *de Coelo et Mundo*), he speaks of another kind of beginning which is more like the hypothesis in modern science. These two passage touching upon two kinds of beginning in our thinking can be laid down together here to make clear their distinction. We give first the passage from the present Reading and then that from the book *On the Universe:*

> They all say that the elements and what they call the beginnings are contraries although they lay this down without giving a reason, as if being forced by the truth itself.[5]

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[3] Shakespeare, *Romeo and Juliet*, Act IV, Sc. 4

[4] *King Lear*, Act IV, Sc. 1

[5] Aristotle, *Physics*, Book One, Chapter 5, 188b 27-30

> It happens that, in speaking about the phenomena, they say things that do not agree with the phenomena. The cause of this is not taking well first principles, but wishing to reduce all things to some determined opinions...For these men, on account of their love of those principles, seem to do the same as those maintaining positions in dialectic. They endure everything that follows as though having true principles; as if there were not some principles which ought to be judged from their results, and especially from the end result. Now the end of a science that makes is the product while of natural science it is always what appears authoritatively according to the senses.[6]

In the first passage, Aristotle is talking about a beginning or principle in our thinking that is forced on the mind by truth itself. Such a beginning does not seem to be like the beginning called an hypothesis in modern science. Einstein said that the hypothesis is *freely imagined.* What is freely imagined is not apt to be the same for everyone who thinks about something. But everyone who thinks about change, ancient and modern, East and west, comes up with some contrariety to explain change.

But in the second passage, Aristotle speaks of the need for a principle or beginning in our thought which is more like the hypothesis in modern science. Such a beginning must be judged, he says, by its consequences.

Aristotle sees this second kind of beginning in the study of natural things as like the beginning in dialectic where Socrates, for example, asks what you think and then deduces from what you think conclusions which can be compared to other things you think, or even to other things known or thought to be so, to see if they are in harmony or in contradiction.

Aristotle also sees that this second kind of beginning is like the beginning in the productive arts or sciences where we say that the proof of the pudding is in the eating and not in the recipe. The recipe is like an hypothesis to be judged by its result when something is made according to it.

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[6] Aristotle, *On the Universe*, Book Three, Chapter 7, 306a 6-18

Aristotle also saw that the Pythagoreans accustomed to the first kind of beginning from geometry sought it everywhere, not seeing the need for another kind of beginning as one goes from the very general in the beginning of our study of natural things to the particular.

Christian Huygens, in the early years of modern science, was also able to see that there are these two beginnings in our thinking. In the Preface to his *Treatise on Light,* he writes:

> There will be seen in it [the Treatise] demonstrations of those kinds which do not produce as great a certitude as those of Geometry, and which even differ much therefrom, since whereas the Geometers prove their Propositions by fixed and incontestable Principles, here the Principles are verified by the conclusions to be drawn from them; the nature of these things not allowing of this being done otherwise.[7]

Huygens distinguishes between two kinds of beginning or principle in our thought. One is judged by its consequences, by the conclusions that follow from it; but the other is that by which the conclusions that follow from it are judged. The former is found in experimental science and the latter in geometry (and also, as Aristotle had seen, in the beginning or very general study of natural things.)

If one is accustomed to one of these beginnings only, he may think that all beginnings are similar. This shows the great influence of custom upon our thinking. Thus the Pythagoreans sought in the particular study of natural things, or what we might call the experimental sciences of nature, the kind of beginning they had in geometry. But we moderns, who are immersed in the experimental sciences and therefore accustomed only to the second kind of beginning, often seek that kind of beginning everywhere (even in geometry). But Aristotle and Huygens rise above this enslavement to custom and see that there are these two kinds of beginning and that they should be sought in different places.

It seems to escape the modern slave of custom (who thinks that every beginning is an hypothesis to be tested by its consequences) that he uses a beginning which cannot be so tested. We test an hypothesis by deducing its consequences and seeing whether they agree with experiment and observation or are contradicted thereby. We reject or modify an hypothesis that is

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[7] Christian Huygens, Preface to his *Treatise on Light*, Dover Publications, p. vi

contradicted by observation or experiment. And thus we take as a beginning in our work that something cannot both be and not be. Now this beginning about being and non-being cannot be tested by seeing whether its consequences are contradicted or not for that procedure proceeds from the impossibility of something both being and not being. Some thinkers deny this beginning because something seems to contradict it. And this is to say that it is not so because it is so.

When Aristotle sees that the natural philosophers before him are all saying the same thing proportionally, we see another major example of the role of proportion in our knowledge. It might be good here to elaborate a bit the extremely important role of proportion in our knowledge. We are taking the word *proportion* here in the sense of a *likeness of ratios*, not in the sense of a ratio. A ratio is the order or relation of one thing to another. This can be seen not only in numbers, but also in other things; just as four is to six as two is to three, so also seeing is to the eye as hearing is to the ear.

The ability to see a proportion is the greatest part of the fourth tool of the dialectician which is useful for inductions, hypothetical or if-then syllogisms, and definitions. Here is a translation of Aristotle's words on the fourth tool:

> One should consider the likeness of things in other genera; as this is to that, so something other is to another; for example, as knowledge is to the knowable, so sensation is to the sensible; and as this is in that, so something other is in another; for example, as sight is in the eye, so understanding is in the soul; and as calmness is in the sea, so stillness is in the air.
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> One ought to be exercised especially in those far apart, for we will be able to see with ease the likeness in other cases.
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> One should also consider things which are in the same genus, to see if something the same belongs to all; for example, to man and horse and dog. For to the extent that the same belongs to these, they will be in that way alike...

> The consideration of the like is useful for inductive arguments and for hypothetical syllogisms and for the rendering of definitions.[8]

Aristotle considers proportion among the ways of investigating why in the *Posterior Analytics:*

> Further, another way is to select by proportion. For it is not possible to take something one which pounce and spine and bone ought to be called. But something will follow these, just as if they were one nature.[9]

Thomas comments on this passage:

> Then...he shows how to investigate the reason why, by reducing to something common by analogy; and he says that another way of investigating the reason why is to select something common by analogy; that is, by proportion. For it is possible to take something proportionally one which is not the same in species or genus, as the pounce of the cuttlefish and the spine of fish and the bones of land animals. For all these agree by proportion because spines are to fish in the same way as bones to land animals. And some things follow this analogous community because of the unity of proportion, just as if they had one common nature of genus or species, as to be covered with flesh.[10]

Proportion is not only useful in reasoning and defining, but also for understanding a difficult to understand ratio by a like, but more easily grasped ratio.

Pierre Duhem, besides being a physicist, is famous for his studies in the history of physics and the method of physics. Listen to these words of his about *analogy* which is the Greek word for proportion:

> The history of physics shows us that the search for analogies between two distinct categories of phenomena has perhaps been

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[8] Aristotle, *About Places* (misleadingly "translated" usually as the *Topics*) Book I, Chapters 17-18, The Fourth Tool of Dialectic

[9] Aristotle, *Posterior Analytics*, Book II, Chapter 13

[10] Thomas Aquinas, *Commentary on Posterior Analytics*, Book II, Lectio XVII, n. 563

> the surest and most fruitful method of all the procedures put in play in the construction of physical theories.[11]

Einstein, in his book giving the history of some of the main theories of physics, states:

> It has often happened in physics that an essential advance was achieved by carrying out a consistent analogy between apparently unrelated phenomena. In these pages we have often seen how ideas created and developed in one branch of science were afterwards successfully applied to another.[12]

Seeing proportions is important many times in this First Book of *Natural Hearing,* as it is in all of Aristotle's books. The First Reading in this book, for example, required the seeing of many proportions. The general is to the particulars, as a whole is to its parts. The general is to the particular as the confused is to the distinct, etc. And in this Reading, it helps us to see how the early natural philosophers are in some way saying the same, despite all their disagreements.

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[11] Pierre Duhem, *The Aim and Structure of Physical Theory* , Princeton University Press, 1954, p. 95

[12] Albert Einstein, *The Evolution of Physics*, Simon and Shuster, N.Y., p. 270