NOTE FOR BOOK ONE, READING NINE

In this reading, Aristotle recalls the arguments by which Anaxagoras arrived at his position about matter. He then reasons against that position by eight arguments.

It is interesting to note that those studying elementary particles in the twentieth century arrived at a position similar to that of Anaxagoras and for similar reasons. They saw in their experiments that out of any elementary particle you can eventually get all the others. And they thought that you cannot get something out of nothing. So the well known formula among them was, as Heisenberg says, “every elementary particle is composed of all the rest.”

One can group the arguments of Aristotle against the position of Anaxagoras somewhat differently than Thomas does in his division and order of them.

The eighth, fifth and first arguments have something in common in that they are all based on the beginning or principle of fewness. This beginning of natural philosophy can be stated thus: fewer beginnings or causes are better if they are enough. Nature is modest, as Shakespeare said, and does not affect the pomp of superfluous causes, as Newton said, and many other before and after them.

This is most clear in the eighth argument. Empedocles and Anaxagoras both try to explain how things can keep on coming to be forever in this world. But Empedocles explains it with a limited multitude of causes: the four elements and love & hate. Love brings them together and hate separates them. This can go on forever because what love joins, hate can always separate. And what hate has separated, love can always join again. But instead of this circle, Anaxagoras has only the greater mind separating things out of the one matter forever; and to do this, there must be an infinity of things in matter to be separated out.

The fifth argument shows how far Anaxagoras has departed from fewness. For in saying universally that inside of everything there is an infinity of infinitely small pieces of everything else, he must also say that inside of each one of those infinitely small pieces there is an infinity of infinitely small pieces of everything else, and inside of each one of these the same and so on infinitely. There are infinite multitudes inside of infinite multitudes inside of infinite multitudes and so on infinitely, One could hardly depart more from fewness (or simplicity as some say).

In the first argument, the beginning of fewness is also implied. Aristotle says that if matter is composed of an infinity of different things, then we could never know it; just like we could never know a word that has an infinity of letters. But someone might say what does this prove. Maybe man is unable to know things. But man has a natural desire to know things and Anaxagoras especially exemplifies this since he gave his life to the study of the natural world. But if nature is modest and does nothing superfluous, it does not give man a natural desire for the impossible. And we see also that for other natural desires like hunger and thirst there is an object to satisfy them. So the beginning or principle of fewness also underlies the first argument.

It is interesting to note also that these three arguments have something in common with the whole development of the physical sciences in modern times. For Galileo, Kepler and Newton stated this beginning of fewness (which some call the principle of simplicity) and this has been a guiding beginning all the way down to the present as Heisenberg and Einstein and others tell us.

The second, third and fourth arguments should also be considered together. For what is shown in the second argument is used in the third and fourth arguments.

In the second argument, Aristotle reasons against the position that the parts of animals, plants etc can be infinitely small or fall below any size, as Anaxagoras maintains. Aristotle uses an if-then syllogism. If the parts can fall below any size, then the whole can fall below any size (for the whole is composed of the parts). But the whole (animal, etc) cannot fall below any size (for we see in our experience of animals and plants, that there are limits as to how big or small they are). Therefore, the parts cannot fall below any size, but there must be a smallest size or piece of each.

From the conclusion of the second argument, Aristotle reasons in the third argument to the overthrow of another position of Anaxagoras. If there is a smallest piece of flesh and bone etc., anytime flesh or bone comes from something, at least that amount must be taken out. But if the same *amount* is continually taken out of a finite or limited body, eventually that body will be exhausted. For there cannot be an infinity of the same *amount* in a limited of finite body. Thus things would eventually stop coming to be which is contrary to the opinion of Anaxagoras and the other Greek natural philosophers.

If one could take the same *ratio* each time, one could go on forever. One could take half of the whole and then half of the half remaining and so on forever. But the piece being taken would get smaller and smaller without end. But if there is a smallest piece (as shown in the second argument), a smallest amount, one cannot take the same ratio forever, but, at least, that smallest amount. So eventually a finite body would be exhausted and things would not come to be forever out of it.

In the fourth argument, Aristotle reasons from the conclusion of the second argument to overthrow yet another position of Anaxagoras. If there is a smallest piece of flesh, for example, there cannot be any bone in that smallest piece of flesh. For if there were, only part of the smallest piece of flesh would be flesh and then there would be a piece of flesh smaller than the smallest, which is obviously impossible.

It can be seen that Aristotle overthrows the positions of Anaxagoras in the reverse order in which they were arrived at.

The second, third and fourth arguments have something in common with the physics of the twentieth century as distinguished from that of the 17th, 18th and 19th centuries. For both quantum theory and special relativity theory, the two foundations of the physics of the twentieth century, are based upon there being limits to the quantity of natural things.

And in particular, there is a likeness to quantum theory which involves a limit in the direction of the small, the quantum of action or energy (while special relativity involved a limit in the direction of the large, the speed of light being the maximum speed possible in the universe).

The sixth and seventh arguments are more particular in their critique of the position of Anaxagoras.

The sixth argument points out that Anaxagoras has not clearly distinguished between substance and accident. The greater mind would be trying to move apart, not only one substance from another, but also accidents from substance. Now although it is possible to separate the bone of the chicken from its skin and place them apart, it is not possible to do so with the bone and its color.

The difficulties Anaxagoras is led into in arguments 2,3 & 4 and also in 8, 5 and 1 follow from his inability to distinguish between ability and act or from his

trying to put actually into matter everything that it is able to become. But we can see from the sixth argument that he has also not seen clearly the other distinction of what is, the distinction between substance and accident. The first distinctions of being as such in things are between substance and accident and between act and ability:

> Statim enim in prima entis divisione invenitur hoc quidem perfectum, scilicet ens per se et ens actu: aliud vero imperfectum, scilicet ens in alio et ens in potentia.[1]

The critique of Parmenides and Melissus also proceeded in large part from pointing out their ignorance of these distinctions. Although the consideration of these distinctions as such belongs to wisdom (whose subject is being as being), they enter into the difficulty of understanding matter and motion.

The seventh argument from the distinction of the ways that things come to be can be expanded by the induction in the twelfth reading from the many common ways that things come to be.

One could ask why Aristotle considers more at length the position of Anaxagoras on matter than that of the other natural philosophers. He says elsewhere that, if we listen to what Anaxagoras is trying to say rather than what he actually says, we will see that he is close to the truth about matter. But it seems to me also that the difficulties, which Anaxagoras (and others) would be in who falsely imagine that everything that can come to be out of matter to be actually in there, force reason to begin to see that these things can be in matter only in ability.

In the Twelfth Reading of the First book of *Wisdom* or *First Philosophy* (the *Metaphysics*), Aristotle speaks of Anaxagoras as being close to an understanding of matter, but not quite able to understand it by his mixture of what is in the ability of matter. Thomas comments there on the likeness and difference of these two:

> Et haec est vera natura materiae, ut scilicet non habeat actu aliquam formam, sed sit in potentia ad omnes; quia et ipsum mixtum non habet in actu aliquid eorum quae in eius mixtionem conveniunt, sed potentia tantum. Et propter hanc similitudinem

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[1] *Summa Contra Gentiles*, Liber II, Capitulum XCV

> materiae primae ad mixtum, videtur posuisse mixtionem praedictam, licet aliqua differentia sit inter potentiam materiae, et potentiam mixti.
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> Nam miscibilia, etsi sint in potentia in mixto, tamen non sunt in eo in potentia pure passiva. Manent enim virtute in mixto. Quod ex hoc potest patere, quia mixtum habet motum et operationes ex virtute corporum miscibilium, quod non potest dici de his, quae sunt in potentia in materia prima.
>
> Est et alia differentia: quia mixtum etsi non sit actu aliquid miscibilium est tamen aliquid in actu: quod de materia prima dici non potest. Sed hanc differentiam videtur removere Anaxagoras ex hoc, quod non posuit particularium aliquam mixtionem, sed universalem omnium.[2]

The parts of animals and plants are closer to being in act than are the elements in a mixed body:

> Omne enim quod est in actu, oportet esse ab aliis distinctum, quia res una dividitur ab alia per suum actum et per formam...Quando autem ea, quae ponuntur partes, fuerint separata abinvicem dissoluto toto, tunc quidem sunt entia in actu, non quidem ut partes, sed ut materia existens sub privatione formae totius. Sicut patet de terra et igne et aere, quae quando sunt partes corporis mixti, non sunt actu existentia, sed potentia in mixto; cum vero separantur tunc sunt in actu existentia, et non partes. Nullum enim elementorum 'antequam digeratur', idest antequam per alterationem debitam veniat ad mixtionem, et fiat unum mixtum ex eis, est unum cum alio, nisi sicut cumulus lapidum est unum secundum quid, et non simpliciter. Quamvis enim omnes partes sint in potentia, tamen maxime poterit aliquis opinari partes animatorum et partes animae esse propinquas, ut fiant actu et potentia, idest ut sint in potentia propinqua actui. Et hoc ideo, quia corpora animata sunt corpora organica habentia partes distinctas secundum formam; unde maxime sunt propinqua ad hoc quod sint in actu. Et hoc ideo quia habent principium motus ab aliquo determinato, cum

[2] *In I Metaphysicorum*, Lectio XII, n. 196

> una pars moveat aliam...Sed tamen quamvis istae partes...animatorum sunt propinquae actui, nihilominus sunt omnia in potentia, quando totum fuerit unum et continuum per naturam...Ante enim quam surculus insertus uniatur plantae, est in actu; postea vero est in potentia.[3]

Anaxagoras puts into matter actually all that it is able to be. Hence, coming to be is for him only a change of place. The distinction of things by the greater mind is a separation of them by a change of place. Thomas himself says that the distinction of things is most of all shown through the change of place by which they are separated:

> Distinctio autem aliquorum maxime manfestatur per motum localem, quo ab invicem separantur.[4]

And indeed the word in logic for difference in Latin and in Greek (diaphora) has the etymology of *carry apart*.

Connected with this is that Anaxagoras, like Empedocles, and perhaps all the early natural philosophers, think that the only kind of change is change of place. Thomas gives a reason why we use names belonging to change of place in talking about other kinds of change:

> Quia enim motus localis sit naturaliter primus motuum, ut probatur in VIII Physicorum, utimur nominibus pertinentibus ad motum localem, in alteratione et in omnibus motibus: sicut etiam nomen distantiae derivatum est a loco ad omnia contraria, ut dicitur in X Metaphys.[5]

But it would seem even more so that we name things as we know them. And because change of place is more known and understood by us than any other change, we carry over names from it to other kinds of change. We speak of *becoming* or *coming to be* and something *becoming hot* and something *coming into* existence or *going out* of existence. But the words *coming* and *going* seem to pertain first to change of place. People speak of something being made *out*

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[3] Thomas Aquinas, *In VII Metaphysicorum*, Lectio XVI, nn. 1633-1636

[4] *Summa Theologiae,* Prima Pars, Q. 70, Art. I, c

[5] *Summa Theologiae*, Prima Pars, Q. 67, Art. 2, Ad 3

of matter and the first meaning of *out* corresponds to the first meaning of *in* which pertains to place. If things are imagined to come out of matter as if out of a place, they would be actually in the matter, they would be actual in the matter. When Aristotle defines matter, he says that it is *that from which something comes to be, existing within it.* But place does not exist in that which comes to be out of it. Rather the reverse was true. The thing that came out of a place was in that place and is no longer in it. We can see or imagine something in a place, but we can neither sense nor imagine something to be in the ability of matter. If we imagine something to be in matter, we imagine it to be actual there. Ability is known only by its relation or order to act and it is reason that knows one thing in relation or order to another. We can understand with difficulty the ability of matter, but we can neither sense nor imagine that ability.

Perhaps it would be good to pause here and look at the before and after in our consideration of change.

The consideration of change would seem to come before every other consideration of our mind. Since sensing comes before understanding in our knowledge, things sensed come before all other things in our knowledge. And since, as Shakespeare says, "things in motion sooner catch the eye than what not stirs", it would seem that change and changing things are considered by our mind before anything else.

But *within* our consideration of change, there is a before and after. We can begin to look at this before and after from the following statement: Change of place is *before* every other kind of change *in our knowledge*.

One sign of this is that many who studied change of place denied there was any other kind of change or tried to reduce all other apparently different kinds of change to change of place. This is true both of ancient thinkers such as Empedocles, Anaxagoras and Democritus, and also of modern mechanists. But we do not find the reverse; that is, men asserting other kinds of change, but denying the existence of change of place.

Another sign of this is the science of mechanics. Mechanics which considers change of place, was the first part (in time) of modern science to be perfected, and it can be without the other parts, but they cannot be without it.

A third sign is that names from change of place are carried over and placed upon other kinds of change; for example, *going from* cold *to* hot, *coming*

into existence and *going out* of existence, quantum *jumps* and so on. And we name things in the order that we know them.

If change of place is the only kind of change, the whole of natural science would be about change of place. There would be no part before or after the study of change of place. But if change of place is not the only kind of change, one should consider change in general *before* change of place and other kinds of change *after* change of place.

Actually men are sure there are other kinds of change besides change of place (for example, death), but they deny this in words because of the great difficulty in understanding how any other kind of change is possible. No other kind of change is possible without the ability which Aristotle was the first to bring out clearly (so far as the nature of ability admits of being known) and which was not seen in modern science until perhaps quantum theory.

An interesting account of a conversation touching upon the limits of natural quantities between Count Harry Kessler and Einstein is recorded by the former:

> En route Kessler asked if relativity applied to atoms. He recorded their conversation in his diary:
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> > Einstein said no: size (the minuteness of the atom) comes into it here.
> >
> > So size, measurement, greatness and smallness, must be an absolute, indeed almost the sole absolute that remains, I said.
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> > Einstein confirmed that size is the ultimate factor, the absolute that cannot be got away from. He was surprised that I should have hit on this idea, for it is the deepest mystery of physics, the inexplicabilty and absoluteness of size. Every atom of iron has precisely the same magnitude as any other atom of iron, no matter where in the universe it may be. Nature knows only atoms, whether of iron or

> hydrogen, of equal size, though human intelligence can *imagine* atoms of varying magnitude.[6]

Thomas gives a somewhat unique reason for this limit in divisibility of natural quantity as distinguished from the abstract mathematical continuous quantity:

> ...si partes in parvitate superabundantes, separantur a toto, rationabiliter videtur quod non possunt permanere propter parvitatem virtutis conservantis, quia virtus corporalis dividitur secundum divisionem magnitudinis, ut patet in septimo *Physicorum;* et ideo minima separata convertuntur in corpus continens, puta aërem vel aquam, sicut patet de aliquo liquore saporoso, qui infunditur in mari.
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> Et ex hoc patet, quare corpus mathematicum est divisibile in infinitum, in quo consideratur sola ratio quantitatis in qua nihil est repugnans divisioni infinitae.
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> Sed corpus naturale, quod consideratur sub tota forma, non potest in infinitum dividi, quia, quando iam ad minimum deducitur, statim propter debilitatem virtutis convertitur in aliud. Unde est invenire minimam carnem, sicut dicitur in primo *Physicorum:* nec tamen corpus naturale componitur ex mathematicis.[7]

Thomas also thought that there was a limit to how far a natural body could be rarified:

> ...sit certus terminus rarefactionis ad quem naturale corpus pervenire potest, qui est raritas ignis...[8]

The following very subtle text of Thomas casts some light on the difficulties in the position of Anaxagoras and how he got into them (as well as many other things):

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[6] *Einstein, A Life*, by Denis Brain, John Wiley & Sons, Inc., N. Y. , 1996, Chapter 17, p, 118

[7] *In Librum De Sensu et Sensato Commentarium,* Lectio XV, n. 220

[8] In II *De Anima*, Lectio XX, n. 494

Dicendum, quod multis error accidit circa formas ex hoc quod de eis iudicant sicut de substantiis iudicatur.

Quod quidem ex hoc contingere videtur, quod formae per modum substantiarum signantur in abstracto, ut albedo, vel virtus, aut aliquid huiusmodi; unde aliqui modum loquendi sequentes, sic de eis iudicant ac si essent substantiae.

Et ex hinc processit error tam eorum qui posuerunt latitationem formarum, quam eorum qui posuerunt formas esse a creatione. Aestimaverunt enim quod formis competeret fieri sicut competit substantiis; et ideo non invenientes ex quo formae generentur, posuerunt eas vel creari, vel praexistere in materia;

non attendentes, quod sicut esse non est formae, sed subiecti per formam, ita nec fieri, quod terminatur ad esse, est formae, sed subiecti. Sicut enim forma ens dicitur, non quia ipsa sit, si proprie loquamur, sed quia aliquid ea est; ita et forma fieri dicitur, non quia ipsa fiat, sed quia ea aliquid fit: dum scilicet subiectum educitur de potentia in actum.

Sic autem et circa augmentum qualitatum accidit; de quo aliqui locuti sunt ac si qualitates et formae substantiae essent. Substantia autem augeri dicitur, in quantum ipsa est subiectum motus quo pervenitur de minori quantitate in maiorem qui motus augmenti dicitur.

Et quia augmentum substantiae fit per additionem substantiae ad substantiam; quidam aestimaverunt, quod hoc modo caritas, sive quaelibet virtus infusa, augeatur per additionem caritatis ad caritatem, vel virtutis ad virtutem, aut albedinis ad albedinem: quod omnino stare non potest.

Nam non potest intelligi additio unius ad alterum nisi praeintellecta dualitate. Dualitas autem in formis unius speciei non potest intelligi nisi per alietatem subiecti. Formae enim unius speciei non diversificantur numero nisi per subiectum.

Si igitur qualitas additur qualitati, oportet alterum duorum esse: vel quod subiectum addatur subiecto, ut puta quod unum album

addatur alteri albo; aut quod aliquid in subiecto fiat album, quod prius non fuit album, ut quidam posuerunt circa qualitates corporeas; quod etiam improbat Philosophus in IV *Physicorum*. Cum enim aliquid fit magis curvum, non curvatur aliquid quod prius curvum non fuit, sed totum fit magis curvum. Circa qualitates autem spirituales, quarum subiectum est anima, vel pars animae impossibile est etiam hoc fingere.

Unde quidam alii dixerunt caritatem, et alias virtutes infusas, non augeri essentialiter; sed quod dicuntur augeri, vel in quantum radicantur fortius in subiecto, vel in quantum ferventius vel intensius operantur.

Sed hoc quidem dictum aliquam rationem haberet, si caritas esset quaedam substantia habens per se esse absque substantia; unde et Magister Sententiarum [lib. I *Sentent*., dist. 17], aestimans caritatem esse aliquam substantiam, scilicet ipsum Spiritum sanctum, non irrationabiliter hunc modum augmenti posuisse videtur.

Sed alii, aestimantes caritatem esse qualitatem quamdam, penitus irrationabiliter sunt locuti.

Nihil enim est aliud qualitatem aliquam augeri, quam subiectum magis participare qualitatem; non enim est aliquod esse qualitatis nisi quod habet in subiecto. Ex hoc autem ipso quod subiectum magis participat qualitatem, vehementius operatur; quia unumquodque agit in quantum est actu; unde quod magis est reductum in actum, perfectius agit.

Ponere igitur quod aliqua qualitas non augeatur secundum essentiam, sed augeatur secundum radicationem in subiecto, vel secundum intensionem actus, est ponere contradictoria esse simul.

Et ideo considerandum restat quomodo aliquae qualitates et formae augeri dicuntur; et quae sunt quae augeri possunt.

Sciendum est ergo, quod cum nomina sint signa intellectuum, ut dicitur I *Periher*.; sicut ex magis notis cognoscimus minus nota, ita ex magis notis minus nota nominamus.

Et inde est quod, quia motus localis est notior inter omnes motus, ex contrarietate secundum locum derivatur nomen distantiae ad omnia contraria inter quae potest esse aliquis motus; ut dicit Philosophus X *Metaph*.

Et similiter, quia motus substantiae secundum quantitatem est sensibilior quam motus secundum alterationem; inde est quod nomina convenientia motui secundum quantitatem derivantur ad alterationem. Et inde est quod, sicut corpus quod movetur ad quantitatem perfectam dicitur augeri, et ipsa quantitas perfecta dicitur magna respectu imperfectae; ita illud quod movetur de qualitate imperfecta ad perfectam, dicitur augeri secundum qualitatem; et ipsa qualitas perfecta dicitur magna respectu imperfectae. Et quia perfectio uniuscuiusque rei est eius bonitas; ideo Augustinus dicit, quod in his quae non magna mole sunt, idem est esse maius quod melius.

Moveri autem de forma imperfecta ad perfectam, nihil est aliud quam subiectum magis reduci in actum; nam forma actus est; unde subiectum magis percipere formam, nihil est aliud quam reduci magis in actum illius formae. Et sicut ab agente reducitur aliquid de pura potentia in actum formae; ita etiam per actionem agentis reducitur de actu imperfecto in actum perfectum.

Sed hoc non contingit in omnibus formis, propter duo.

Primo quidem ex ipsa ratione formae; eo scilicet quod id quod perficit rationem formae, est aliquid indivisibile, puta numerus. Nam unitas addita constituit speciem: unde binarius aut trinarius non dicitur secundum magis et minus; et per consequens non invenitur magis et minus neque in quantitatibus quae denominatur a numeris, puta bicubitum vel tricubitum, neque in figuris, puta triangulum et quadratum; et in proportionibus, puta duplum et triplum.

Alio modo ex comparatione formae ad subiectum; quia inhaeret ei modo indivisibili.

Et propter hoc forma substantialis non recipit intensionem vel remissionem, quia dat esse substantiale, quod est uno modo: ubi

enim est aliud esse substantiale, est alia res; et propter hoc Philosophus, VIII *Metaphys.*, assimilat definitiones numeris.

Et inde est etiam quod nihil quod substantialiter de altero praedicatur, etiam si sit in genere accidentis, praedicatur secundum magis et minus; non enim dicitur albedo magis et minus color.

Et propter hoc etiam qualitates in abstracto signatae, quia signantur per modum substantiae, nec intenduntur nec remittuntur; non enim dicitur albedo magis et minus, sed album.

Ad decimum dicendum, quod omnibus qualitatibus et formis est communis ratio magnitudinis quae dicta est, scilicet perfectio earum in subiecto.

Aliquae tamen qualitates, praeter istam magnitudinem seu quantitatem quae competit eis per se, habent aliam magnitudinem vel quantitatem quae competit eis per accidens; et hoc dupliciter.

Uno modo ratione subiecti; sicut albedo dicitur quanta per accidens, quia subiectum eius est quantum; unde augmentato subiecto, augmentatur albedo per accidens. Sed secundum hoc augmentum, non dicitur aliquid magis album, sed maior albedo, sicut et dicitur aliquid maius album; non enim aliter praedicantur ea quae pertinent ad hoc augmentum, de albedine, et de subiecto ratione cuius albedo per accidens augeri dicitur. Sed hic modus quantitatis et augmenti non competit qualitatibus animae, scilicet scientiis et virtutibus.

Alio modo quantitas et augmentum attribuitur alicui qualitati per accidens, ex parte obiecti in quod agit: et haec dicitur quantitas virtutis; quae magis dicitur propter quantitatem obiecti vel continentiam; sicut dicitur magnae virtutis qui magnum pondus potest ferre, vel qualitercumque potest magnam rem facere, sive magnitudine dimensiva, sive magnitudine perfectionis, vel secundum quantitatem discretam; sicut dicitur aliquis magnae virtutis qui potest multa facere. Et hoc modo quantitas per accidens potest attribui qualitatibus animae, scilicet scientiis et virtutibus.

Sed tamen hoc interest inter scientiam et virtutem: quia de ratione scientiae non est quod se extendat in actum respectu omnium obiectorum: non enim est necesse quod sciens omnia scibilia cognoscat. Sed de ratione virtutis est quod in omnibus virtuose se agat. Unde scientia potest augeri vel secundum numerum obiectorum, vel secundum intensionem eius in subiecto; virtus autem uno modo tantum.

Sed considerandum est, quod eiusdem rationis est quod aliqua qualitas in aliquid magnum possit, et quod ipsa sit magna, sicut ex supradictis patet; unde etiam magnitudo perfectionis potest dici magnitudo virtutis.[9]

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[9] *Quaestio Disputata de Virtutibus in Communi*, Art. 11, corpus & Ad 10