this by showing that privation was form, he felt no obligation to undertake a new problem, which would be better treated, when he would consider the species of movement. (298)

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298. De Generatione et Corruptione, I, c iii. On this question of substance and contrariety see St Thomas, V Phys., lect. 3, nn. 4-6; XI Meta., lect. 12, nn. 2378-2384; J. a S. Thoma, Curs. Phil., T. II, Q. 2, art. 2, p. 44b46- p. 46b2.

Chapter VI

The Mathematician And The Physicist

Their Distinction (299)

I) Division of Treatise :

1) A New Inquiry : Is the Mathematician different from the Physicist ? (193b22)

2) The Reasonableness of This Inquiry: The two do not seem to be different, for

a) They both consider the same subject-matter (193b23-24)

b) Astronomy pertains to the Physicist and to the Mathematician (193b26-30)

3) The Answer:

a) They are distinct : (193b31-36)

i) Proof of their distinction. (b31-33)

ii) A corollary on abstraction and truth. (b33-34)

iii) A Platonic error. (b35-36)

b) In confirmation of their distinction (194a1-10)

i) we have the diverse modes of defining proper to one and the other. (a1-5)

ii) and the fact that physico-mathematical sciences are formally mathematical, and only terminatively physical. (a6-10)

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299. II Physics, c ii, 193b22-194a10.

II) Doctrinal Exposition :

Text :

"We have distinguished, then, the different ways in "which the term 'nature' is used.

"The next point to consider is how the mathematician "differs from the physicist. Obviously physical bodies "contain surfaces and volumes, lines and points, and "these are the subject-matter of mathematics.

"Further, is astronomy different from physics or a "department of it ? It seems absurd that the physicist "should be supposed to know the nature of sun or moon, "but not to know any of their essential attributes, "particularly as the writers on physics obviously do "discuss their shape also and whether the earth and the "world are spherical or not.

"How the mathematician, though he too treats of these "things, nevertheless does not treat of them as the "limits of a physical body; nor does he consider the "attributes indicated as the attributes of such bodies. "That is why he separates them; for in thought they "are separable from motion, and it makes no difference, "nor does any falsity result, if they are separated. "The holders of the theory of Forms do the same, though "they are not aware of it; for they separate the objects "of physics, which are less separable than those of "mathematics. This becomes plain if one tries to state "in each of the two cases the definitions of the things "and of their attributes. 'Odd' and 'even', 'straight' "and 'curved', and likewise 'number', 'line', and 'fi- "gure', do not involve motion; not so 'flesh' and 'bone' "and 'man' - these are defined like 'snub nose', not "like 'curved'.

"Similar evidence is supplied by the more physical of "the branches of mathematics, such as optics, harmonics, "and astronomy. These are in a way the converse of "geometry. While geometry investigates physical lines "but not qua physical, optics investigates mathematical "lines, but qua physical, not qua mathematical."

The consideration of the distinction between the mathematician and the physicist is of importance for two reasons. The first is because this distinction provides us with the formal element of the definition of the science of natural things, which definition constitutes the object of chapters i-ii of II Physics.(300) Up to this point Aristotle has succeeded in bringing out the 'ratio formalis quae' of the subject of the science, an accomplishment by no means meager, as we have indicated elsewhere. (301) But there still remains the task of determining the 'ratio formalis sub qua objectiva'(302)

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300. Cfr. Chapter III, A (The Principle of Interpretation, p. 36-38

301. Ibid, B, ii,a-2 ("Nature" Its Relation to the Definition of Natural Science), p. 49-56

302. J. a S. Thoma, Curs. Theo., Ia Pars, Disp. 2, Art. 7, par. 15, p. 579-580: (Ed. Solesmes:) "Unde oportet distinguere duplicem "hanc rationem sub qua, unam specificativam ex parte objecti, "aliam specificatam ex parte habitus. Et quidem ex parte ha- "bitus datur aliqua tendentia sub qua agit et fertur in objec- "tum, tanquam formalis ratio intrinseca habitui. Sed quia "ista intrinseca ratio habitus dependet ab extrinseca objecti, "oportet etiam ex parte objecti ponere rationem formalem, quae "objective proportionetur isti rationi formali habitus: et "haec est ratio formalis sub qua objectiva.- Nec potest dici, "quod haec ratio formalis ex parte objecti non est nisi deno- "minatio aliqua proveniens ex ipso actu intellectus: sicut ex "abstractione quae est actus intellectus, provenit objectum "esse abstractum,----- Quod vero attinet ad abstractionem, di- "cimus quod licet esse abstractum solum dicat denominationem "extrinsecam in objecto, tamen non est hoc id quod specificat "objective, sed esse radicaliter abstractum, seu immateriale: "quod non est aliud quam fundare ex se proportionem, ut ali- "quid possit tali vel tam abstracto lumine attingi, secundum "diversam immaterialitatem et abstrahibilitatem potius quam "abstractionem. Quare numquam ipse actus intellectus, vel "aliquid illi intrinsecum, potest esse prima radix specifi- "candi: quia quidquid in actu vel habitu est, specificatum "est."

by which the science of natural things is formally distinguished from all other sciences. (303) It is this which the present treatise does. The second reason for the importance of this consideration is because the actual distinction made by Aristotle has been made in turn the basis of an attack on the Aristotelian doctrine on the specification of sciences by Mansion. (304) With regard to this second reason it should be made clear that Mansion's attack on Aristotle's principle of specification does not pertain in all its fullness to such a work as a commentary on the Physics. It does, however, demand our consideration because Mansion pretends to have discovered a fundamental weakness, in the Physics, which renders totally inadequate the aristotelian method of classifying theoretical science. Mansion insists that the method fails to establish a distinction between mathematics and physics that is sufficiently real to be the basis for two specifically distinct sciences.

1) A New Inquiry : Is the mathematician different from the physicist ?

"We have now distinguished, then, the different ways in which the

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303. Cfr. Chapter III,B, ii,c (The distinction between the mathematician and the physicist and the definition of the science of natural things), p. 59 - 63

304. Op. cit., (2ième Edition), Chapter V.

"term 'nature' is used. The next point to consider is how the "mathematician differs from the physicist." (c ii, 193b22)

The second chapter opens with a remark that reflects the contentment which Aristotle feels over his successful investigation of the term 'nature'. Unlike his early predecessors, Aristotle arrived at the conclusion that form was nature. This marked a real advance in the direction of a science of natural things. The ancients, by their insistence on matter alone as nature, had built up a formidable obstacle to anything like a profound science. Their very principle, matter-nature, was not a principle of enlightenment, since it was the principle of natural things in so far as it was potential. Aristotle, however, succeeded in escaping the fate they had prepared for themselves, because he had a principle, in form, which was not potency but act, the basis of intelligibility. With such a principle he had real grounds for thinking that he could penetrate into the essences of mobile things. There is no wonder, then, that he closed this investigation of 'nature' with a sense of satisfaction.

But the end of his preliminary labors was not yet in sight. Much remained to be done before he could actually embark on his investigation of the essences of mobile things, e.g. the nature of man, of the heavenly bodies, of plants, etc. First of all he had to finish the task of defining this science, if he was to reach the

point of devising a method of procedure with regard to these objects. Realising this, Aristotle took up a question that would result in the discovery of the "ratio formalis sub qua objectiva". The question itself, as is clear from the text, concerns the distinction between the mathematician and the physicist.

2) The Reasonableness of This Inquiry: The two do not seem to be different.

a) They both consider the same subject-matter:

"Obviously physical bodies contain surfaces and volumes, lines and points, and these are the subject-matter of mathematics." (193b23-24)

What is the explanation or rather the justification for this consideration on the mathematician and the physicist ? Aristotle gives two reasons. The first reason shows the community that exists between physics and pure mathematics.

The physical body contains surfaces and volumes, i.e. it is a solid, has lines and points, and since these are in the physical body, it pertains to the physicist to treat of them. (305) But these very things are the subject-matter of mathematics and

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305. "oportet autem quod naturalis consideret de omnibus quae in-"sunt corporibus naturalibus)." St Thomas, II Phys., lect. 3, n. 2.

therefore belong to the field of the mathematician. (306) Moreover, this community of subject-matter is not something that is verified only in a generic way. Actually it amounts to this, that the surfaces, volumes, lines and point of the mathematician are entitatively the same surfaces, volumes, lines and points that the physicist considers. For, in opposition to Plato's idea that the mathematical being had an independent existence, (it was, for Plato, an intermediate reality between subsisting ideas and sensible reality) Aristotle insists that the mathematical being, qua mathematical, exists

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306. The examples mentioned here are those taken from geometry. However, Aristotle also had in mind arithmetic, that branch of mathematics which deals with numbers. See 154a4-5.

neither in sensible beings nor separately. (307) It is an existing thing only qua physical, i.e. as an accident of a sensible body. (308)

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307. "Now there are some who say that these so-called intermediates "between the Forms and the perceptible things exist, no apart "from the perceptible things, however, but in these; the im- "possible results of this view would take too long to enumerate, "but it is enough to consider such points as the following:- "It is not reasonable that this should be so only in the case "of these intermediates, but clearly the Forms also might be "in perceptible things; for both statements are part of the "same theory. Further it follows from this same theory that "there are two solids in the same place, and that the inter- "mediates are not immovable, since they are in the moving "perceptible things." III Meta., c ii, 998a7-15.

"But, again, it is not possible that such entities should ex- "ist separately. For if besides the sensible solids there are "to be other solids which are separate from them and prior "to the sensible solids, it is plain that besides the planes "also there must be other and separate planes, points and "lines; for consistency requires this. But if these exist, "again besides the planes and lines and points of the mathema- "tical solid, there must be others which are separate. - - - "Again, therefore, there will have to be, belonging to these "planes, lines, and prior to them there will have to be, by "the same argument, other lines and points; and prior to these "points in the prior lines there will have to be other points, "though there will be no others prior to these. Now (1) the "accumulation becomes absurd; for we find ourselves with one "set of solids apart from the sensible solids; three sets of "planes apart from the sensible planes-those which exist "apart from the sensible planes, and those in the mathematical "solids; four sets of lines, and five sets of points. With "which of these, then, will the mathematical sciences deal ? XII (M) Meta., c ii, 1076b13-34.

308. "Quaedam vero sunt quae quamvis dependeant a materia secun- "dum esse, non tamen secundum intellectum, quia in eorum de- "finitionibus non ponitur materia sensibilis, ut linea et "numerus: de his est mathematica." St Thomas, De Trinitate, Q. V, Art. 1; c: Cfr. also I Phys., lect. 1, nn. 2, 3.

To make clear this position of Aristotle's on the mathematical entity and existence, it is sufficient to explain it in the following manner. The mathematical being, precisely as mathematical, i.e. the pure line, the pure surface, etc., has no existence in external reality. It is the sensible line, the sensible surface that exists.

b) Astronomy pertains to the physicist and to the mathematician.

"Further, is astronomy different from physics or a department of it ? "It seems absurd that the physicist should be supposed to know the "nature of sun or moon, but not to know any of their essential attributes, particularly as the writers on physics obviously do discuss their shape also and whether the earth and the world are "spherical or not." (193b26-30)

The second reason which Aristotle puts forward as an explanation or justification for the point under consideration, is taken from the field of physico-mathematics, specifically astronomy. This science and other that he mentions later, constitute what might be called applied mathematics or the branches of mathematics more physical than mathematical. He asks whether astronomy is distinct from physics or is it a part of physics. The answer appears to be that the former does pertain to the latter. There are two arguments given to substantiate this answer. One is taken from the custom that prevailed among the writers on physics. They all discussed the question of the shape of the heavenly bodies and argued about the sphericity of the earth and the world. This argument is a de facto

one. The fact that all physicists have investigated the figure of the planets seems to argue to a connection between physics and astronomy. The other proof is based on sounder premises, the duty of the philosopher to know the nature and the proper passions of his subject. The physicist studies the sun and the other heavenly bodies and hence should be expected to study their shape, an essential attribute of them. To suppose that he should know only the one and not the other is absurd. It appears, therefore, that astronomy and physics treat of the same bodies and prove the same properties of those bodies. If This be so, it would be correct to say that astronomy is part of physics and, further, since astronomy is a branch of mathematics, that mathematics and physics are not totally different. (309)

What conclusions are we to draw from these two arguments, as parts of the present consideration ? St Thomas' conclusion from the first proof is that it appears that physics is either the same science as mathematics, or at least one is a part of the other. (310) His conclusion from the second proof is that their coalescence in the field of astronomy, which seems to be a science both mathema-

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309. "Unde videtur quod astrologia sit pars physicae; et per consequens physica non totaliter differat a mathematica." St Thomas, II Phys., lect. 3, n. 2.

310. "ergo videtur quod scientia naturalis et mathematica vel sint eaedem, vel una sit pars alterius." ibid.

tical and physical, argues that the two are not totally different. (311) Hansion notes similar conclusions. According to him, the first proof tends to establish the fact that there is a point of fusion between the two sciences, (312) and the second adduces reasons for doubting the possibility of distinguishing mathematics and physics. (313) It would be, however, a mistake to consider the two arguments in an isolated state, i.e. purely by themselves. Taken in the context they are something secondary and subordinated. Their proper function in the text is to justify this treatise on the distinction of mathematics and physics, and this they accomplish by establishing a sort of identity between the two sciences. Thus they create a need for their investigation.

A question arises about these arguments relative to the manner in which they justify the investigation of the distinction between the two sciences under consideration. Do these arguments justify the subsequent investigation of mathematics and physics by questioning both the existence and the mode of distinction, or the

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311. Cfr citation in note 309.

312. Op. cit., Chpt. V, p. 1 "C'est donc surtout la géométrie "qui paraîtrait devoir se confondre avec la physique."

313. Ibid, p. 186: "Après les arguments tirés de la géométrie, "c'est surtout à l'astronomie qu'il s'arrête, pour y trou- "ver des raisons de douter de la possibilité de mettre une "distinction entre la science de la nature et les mathéma- "tiques."

mode alone ? In other words, Aristotle's statement-"The next point to consider is how the mathematician differs from the physicist."(314) - allows for two interpretations. If the statement were put in a form of a question, it could be interpreted as warranting an investigation as to whether they two are distinct sciences and how they are distinguished; or as merely warranting the 'how they are distinguished'. A few words of explanation with regard to this second manner of justifying the treatise on the distinction between the mathematician and the physicist will help bring out its meaning. According to this second manner of justification there is no question as to their distinction, for they are admittedly distinct sciences. The two arguments justify the present treatise because, establishing the a closeness between these two sciences by reason of subject-matter, they avoid creating a misapprehension relative to the principle of specification and diversification of science. This they do by proving quite clearly that subject-matter is not the principle. More simply the two proofs justify the present matter because, by exposing the similarity that exists between the subject-matter of one and the other (both acknowledged as different sciences), they strip away from the problem of specification the excess impediments which only confuses, and reduce it to its simplest terms.

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314. II Physics, 193b22.

Lest this last explanation result in making obscure the problem, let us restate it. According to the first interpretation the two arguments justify the comparative study of the mathematician and the physicist by calling into question the very fact of their distinction. In the second interpretation the fact of the distinction between the mathematician and the physicist is not challenged and the arguments show the propriety of that study by pointing out that their examination eliminates the need of probing all the possible sources of distinction in the way we have described.

Now both interpretations offer an adequate justification for the present treatise and both find their natural term in the discovery of the specific distinction between mathematics and physics. That this last is true in the case of the second interpretation, is evident from what we have already said in exposing it. That it is likewise true in the case of the first, can be shown from the following. The question - <u>are things distinct</u>?- demands the discovery of a difference if the answer is to be affirmative, and this difference is the - <u>how they are different</u> -. But one might object, insisting that in the event that one desired to learn whether things are different, it would not be necessary to plunge directly down to the ultimate difference. Any difference is sufficient to answer the question. While in general one might concede that any difference would be sufficient for an answer to the question - <u>are things dis-</u>

tinct ? -, Such a concession cannot be tolerated here. For Aristotle's intention was to discover the formality which constitutes the ultimate reason for the distinction between the two sciences. Only that difference would give him the complete definition of the science of nature. But, though both are acceptable explanations, I think that the second is more consonant with the remainder of the treatise. When Aristotle arrives at the point where he discusses the difference between the mathematician and the physicist, he mentions briefly that the former treats of surfaces and volumes, lines and points, but not as limits of a physical body, and, furthermore, that he does not consider the attributes of physical bodies. (315) But he offers no proof for these assertions, which seems to argue to the fact that the mathematician and the physicist were admittedly different, though the fundamental difference was not known. It appears hardly likely that, were he attempting to establish that the mathematician and the physicist were, first of all, distinct from one another, Aristotle would have contented himself with a mere statement and not offered any proof of it. In that case his further study would be nothing more than an investigation of an unproven difference, scarcely appropriate grounds for discovering that difference which specifically distinguishes the two sciences, mathematics and physics.

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315. II Physics, 193b31-35.

3) The Answer :

a) They are distinct.

We now come to the difference that formally distinguishes mathematics and physics. Though Aristotle compresses the entire discussion on the distinction itself to a few lines, our commentary will be rather lengthy. This we believe necessary in order to make certain that the ultimate difference between the two sciences and why it is the ultimate difference be appreciated. Moreover this expose will serve as the basis of the critique of Mansion's attack on Aristotle's doctrine of specification of science.

i) Proof of the distinction between the mathematician and the physicist.

"Now the mathematician, though he too treats of these things, never-"theless does not treat of them as the limits of a physical body; nor "does he consider the attributes indicated as the attributes of such "bodies." (193b31-35)

Aristotle begins by leaving unchallenged the statements purporting to establish some connection between the mathematician and the physicist. In fact he admits the similarity of subject-matter, or, perhaps it would be truer to say, the identity of subject-matter. Nor is this admission to be wondered at, since the mathematical surface, line, etc., are realised in external reality only as accidents of the physical body. But this identity is by no means absolute. It is,

in truth, a restricted or 'secundum quid' identity, being confined solely to the matter of the wo sciences or, in scholastic terminology, to the 'subjectum materiale'. This becomes quite patent when one examines the mathematician's approach to these objects in contrast with the physicist's. To the former, surfaces and volumes, lines and points do not represent the limits of a physical body, which in reality they are. The mathematician considers them without any reference whatever to that body. In other words, these surfaces and volumes, lines and points are not sensible, (316) but intelligible, i.e. as objects of mathematics they are not perceptible by sense but by the intellect. For example, the silver triangle, the circle of brass are sensible objects. The lines forming the triangle and the circle are the limits of the silver triangle and the brass circle and are likewise sensible lines, thanks to the passive qualities of the silver and the brass. If, however, one were to remove the silver of the triangle and the brass of the circle, neither figure would be any longer sensible and to apprehend the figures in this case would be possible only to the intellect. There is yet another feature of the mathematician that should be noted. He does not take into account movement, for his objects are at rest. (317) These approaches are a

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316. The sensible and the physical, as used in Natural Philosophy, are synonyms.

317. "mathematics is theoretical, and is a science that deals "with things that are at rest, but its subjects cannot exist "apart." XI Meta., c vii, 1064a31-33: see also VI Meta., c i, 1026a8-10.

far cry from that of the physicist. While he too considers surfaces and volumes, lines and points, they are for him the termini of physical bodies, and therefore sensible. Again his consideration of the physical body is under its aspect of being mobile (318) and hence motion is the principal attribute with which he is concerned.

To what conclusion do these differences between the mathematician and the physicist lead us ? Since the differences Aristotle has mentioned do pertain to the respective point of view that governs the investigation of each, we can say that the two are distinguished from each other by reason of their proper 'ratio formalis quae'. (319) The fact that the mathematician studies his object without any reference to the sensible body or to motion, reveals that his consideration terminates in the study of quantity as quantity. The physicist's absorption in the sensible body and its movements manifests that his 'ratio formalis quae' is the sensible body qua mobile. But this difference is not the sole difference nor the ultimate one that can be deduced from the diversities spoken of in

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318. "The physicists, on the other hand, must take for granted that "the things that exist by nature are, either all or some of "them, in motion-which is indeed made plain by induction." I Physics, c ii, 185a12-15.

319. The 'ratio formalis quae' is that formality of the subject which terminates the consideration and is the source of all the properties of that subject as well as the medium in the first demonstration. Cfr. Chapter III, p. 55, footnote n.82.

the text. The mathematician, when he investigates his object, views it, not as it is in reality but as separated from a condition which clothes it in the order of existing things, namely sensibility. This clearly indicates that he is not concerned with sensible matter and motion which is subjected in that matter, but with intelligible matter. (Mathematics, like physics, is not concerned with what is wholly immaterial, which is the province of metaphysics, but with a form in matter. Quantity, the object of mathematics, is an accident of a corporeal substance to which it bears the relation of form to matter, (320) and without which it cannot be defined. But this matter is not matter possessing qualities but the homogeneous parts of the substance- the subject of quantity which is the order of these parts. Being substance, the matter of mathematics is perceptible only by the intellect and hence is called intelligible matter.) On the other hand, the object of physics, i.e. the physical body and its attributes, especially motion, is identical with the existing reality. However a separation is affected from the individuating notes which are part of an existing thing, but which, because they are not necessarily and per se connected with the nature (321), are per accidens to the science.

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320. "Ab illa autem materia non potest forma abstrahi per intel-
"lectum a qua suae essentiae ratio dependet. Unde, cum omnia
"accidentia comparentur ad substantiam sicut forma ad materiam,
"et cuiuslibet accidentis ratio dependeat a substantia, impos-
"sibile est aliquam talem formam a substantia separari." St Thomas, De Trinitate, Q. 5, Art. 3, c:

321. "Nam natura speciei individuatur per materiam: unde principia
"individuantia et accidentia individui sunt praeter essentiam
"speciei." III De Anima, lect. 8, n. 706.

Therefore the physicist must consider sensible matter, not individual sensible matter however, but common sensible matter.

This last difference, rather than the first which regards the diverse 'ratio formalis quae' of the mathematician and the physicist, is that which constitutes the formal distinction between their respective sciences. It is by reason of the fact that the mathematician abstracts from sensible matter, while the physicist does not, that the two sciences, mathematics and physics, are formally distinct sciences. The correctness of this position will be proved (1) by the doctrine of the Metaphysics (322) where Aristotle considers the problem of specification of science ex professo,and (2) by an argument based on the requirements for a principle of specification.

(1) The Doctrine of the Metaphysics on Specification.

After determining that the science of nature is not a practical or productive science but a theoretical one because its principle (nature) is not in the knower but in the things to be known, whereas the principle of the practical and productive sciences

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322. VI (E) Meta., c 1, 1025b19-1026a33; XI (K) Meta., c vii, 1063b36-1064b14.

is in the doer and the maker, (323) Aristotle proceeds to show that there are three theoretical sciences, physics, mathematics and metaphysics. In the field of theoretical or speculative science we must distinguish physics and mathematics. While both are theoretical, they are distinct. Physics considers things that exist separately but which are movable, (324) and mathematics deals with things which, while not capable of separate existence, are at rest or immovable. (325) The theoretical science which is metaphysics, can be identified neither with mathematics nor with physics, since it concerns objects which are eternal, immovable and separable. (326)

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323. "There is a science of nature, and evidently it must be different "both from practical and from productive science. For in the "case of productive science the principle of movement is in the "producer and not in the product, and is either an art or some "other faculty. And similarly in practical science the movement "is not in the thing done, but rather in the doer. But the "science of the natural philosopher deals with things that have "in themselves a principle of movement. It is clear from these "facts, then, that natural science must be neither practical nor "productive, but theoretical (for it must fall into some one "of these classes)." XI Meta., c vii, 1064a10-19.

324. "For physics deals with things which exist separately but are "not immovable," VI (E), Meta., c i, 1026a13.

325. "Mathematics is theoretical, and is a science that deals with "things that are at rest, but its subjects cannot exist apart." XI (K) Meta., c vii, 1064a31-32.

326. "Therefore about that which can exist apart and is immovable "there is a science different from both of these, if there is "such a substance of this nature (I mean separable and un-"movable), as we shall try to prove there is." ibid, 1064a32-36.

The diffferences upon which is founded this threefold classification of speculative science is clearly indicated. Physics is said to be different from mathematics because its objects are characterised by sensible matter and movement, while the latter's objects are not. Neither can be mistaken for metaphysics or first philosophy, whose objects are at once separable from movement and from all matter, i.e. both sensible and intelligible. (The difference between Aristotle's and Plato's theory of the classification of science should be noted here. For Plato the diversity among the sciences is due to the diverse existing things. Aristotle maintains it as due to the diverse intelligibility of things, or as St Thomas says, the diversity among the sciences does not depend upon differences founded upon things 'secundum rem', but on differences founded upon things 'secundum intellectum'. (327) This is verified by what Aristotle says in this place about the mathematical objects: "Its subjects cannot exist apart."). Therefore, according to Aristotle, physics is a distinct theoretical science because its objects, qua objects, are not separated from sensible matter and motion. Mathematics is another distinct science because its objects are separated from sensible matter and motion. Lastly metaphysics is still another distinct science, for its objects are separated from all matter and

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327. This distinction is to be found, relative to the matter at hand, in St Thomas, I Phys., lect. 1, n. 2: De Trinitate, Q. 5, Art. 1, c.

from motion. The differences mentioned in connection with each of the three sciences regards separation from matter and moyion. Nothing is said about their diverse 'ratio formalis quae' as the differentiating difference. (328) This leaves us with one conclusion, namely, for Aristotle sciences that are theoretical, are specified by the degree of separation from matter and movement proper to the object of each science.

(2) The Requirements of a Principle of Specification of Science

The text of the metaphysics, because it establishes the fact that Aristotle held the principle of specification for the theoretical sciences to be separation or abstraction from matter and movement, confirms the statement made relative to the distinction between the mathematician and the physicist. This same statement is confirmed by an argument based on the requirements for a difference to be a specifying difference in science.

Because science is a habit perfecting an operative potency, the intellect, (329) it has the same principle of speci-

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328. While the diverse 'ratio formalis quae' is not that difference which formally distinguishes theoretical sciences, it is the foundation of the diversity that does. (Cfr Chpt.III,p.

329. J. a S. Thoma, Curs. Phil., T. I, Q. XXVI, Art. 1, p. 792a23-27: "Secundo etiam potest definiri habitus scientiae, quod est 'habitus qui versatur circa conclusionem notam ex propositionibus "universalibus, necessariis et immediatis."

fication as the operative potency itself. Though the habit is not 'per se and primo' a principle of operation, but rather a principle which disposes the potency to operate well or evilly, (330) nonetheless it is specified in the same manner as the potency. Like the potency, it has the formality of being first act. (331) Now what is that principle which specifies the operative potency ? St Thomas tells us that the operative potency is specified by its act and object. (332) immediately through its act, mediately through its object. It is specified by its act because, as potency, it is ordered to act. Hence the very definition of the potency is accepted through the act, and therefore a diversity in the act diversifies the potency. (333) But the act itself is in turn specified by its object to which it is ordered. This can be either an order to the object as term or end

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330. Ibid, Q. XVIII, Art. 3, p. 615a33-37: "Specialiter autem probatur, quod etiam habitus, quando est operativus, primo et per se non est principium operandi, sed bene vel male disponendi naturam."

331. Ibid, T.III, Q. II, Art. 3, p. 79a11-17: "respondetur iuxta D. "Thomam, q. 77, cit., potentias specificari ab actibus immediate, et idem est de habitibus, quia habent rationem actus "primi, immediatus autem ordo actus primi est ad actum se- "cundum."

332. "Unde necesse est quod potentiae diversificentur secundum "actus et objecta." Summa Theo., Ia Pars, Q. 77, Art. 3, c.

333. "Dicendum quod potentia, secundum illud quod est potentia, "ordinatur ad actum. Unde oportet rationem potentiae ac- "cipi ex actu ad quem ordinatur; et per consequens oportet "quod ratio potentiae diversificetur, ut diversificatur "ratio actus." ibid.

(as is the case when the potency is an active one) or an order to the object as principle (this is the role of the object relative to the act of a passive potency, for here the object reduces the potency to act). Therefore, because of the dependence of the act on the object, the potency itself likewise receives its specification from the object, as the ultimate principle. (334) Both these principles of specification, viz, act and object, are not simply principles quoad nos, i.e. principles by which we are enabled to distinguish what is already distinct in itself. Actually they are the principles in essendo, though not intrinsic, of the distinction of the potency. The operative potency, precisely as an operative potency, bespeaks an essential order to its act and object without which it is undefinable. Hence the act and the object pertain to the very definition of the potency as a defining principle. (335) This relation of the act and object

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334. "Objectum autem comparatur ad actum potentiae passivae, "sicut principium et causa movens; color enim inquantum "movet visum, est principium visionis. Ad actum autem po- "tentiae activae comparatur objectum ut terminus et finis; "sicut augmentativae virtutis objectum est quantum perfectum, "quod est finis augmenti. Ex his duobus actio speciem reci- "pit, scilicet ex principio, vel ex fine seu termino;" ibid.

335. "Et hoc ideo, quia secundum rationem definitivam, actus et "operationes sunt priores potentiis. Potentia enim, secundum "hoc ipsum quod est, importat habitudinem quandam ad actum; "est enim principium quoddam agendi vel patiendi: Unde opor- "tet quod actus ponantur in definitionibus potentiarum. Et si "ita se habet circa ordinem actus et potentiae, et actibus "adhuc sunt priora opposita, idest objecta." St Thomas, II De Anima, lect. 6, n. 304.

to the definition of the potency shows that they are principles of specification "per modum causae formalis extrinsecae". (336) For it is always form that specifies a thing. These two, though not the intrinsic form, are extrinsic causes of the form of the potency, for its nature is proportioned to the two to which it has an essential order. (337) But of the two principles that specify the potency, the more important one is the object. Just as the potency is ordered to the act, so the act is ordered to the object. It bears the same relation to the object, that the potency bears to it. Consequently the object is the ultimate formal principle of specification of operative potencies, and likewise, of the habits which are dispositions of such potencies and consequently, in the case at hand, of the habitus of science.

Now the object of the theoretical sciences (it is with these sciences that we are concerned) is the "speculabile", i.e.

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336. J. a S. Thoma, Curs. Phil., T. III, p. 74b32-45: "Quarto denique "potest intelligi distingui potentias per actus et objecta tum- "quam per causas quidem extrinsecas - - - sed speciali ratione, "quatenus licet extrinseca principia sint, pertinent tamen ad de- "finitivum principium potentiarum, quod est induere rationem "causae formalis extrinsecae."

337. "Actus licet sit posterior potentia in esse, tamen est prior "in intentione secundum rationem sicut finis in agente. Ob- "jectum autem licet sit extrinsecum, est tamen principium vel "finis actionis. Principio autem et fini proportionatur ea, "quae sunt extrinseca rei." Summa Theo., Ia Pars, Q. 77, Art. 3, ad 1um.

something to be known and possible only to be known. Unlike the practical and productive sciences, whose principles are within the maker and the doer (338) and which are ordained to use their knowledge in making a thing or performing an action, the theoretical science finds its terminus in simple knowing. Its principle is not in the knower but in the thing. The artisan, for example, uses his knowledge to fashion and produce a work of art, because the principle of his science is within himself, namely art. On the other hand, the natural philosopher cannot make a natural thing. The most he can do is to know its nature and the reason is that the principle of the natural thing is in the thing itself and not in the knower. Therefore the "speculabile" is the principle of specification for the theoretical science as opposed to the productive and practical sciences. And consequent upon this, the differences of the "speculabile qua tale" are the principle of specification for the species of theoretical science. This is per se evident. If there are to be diverse speculative sciences, there must be differences; otherwise sciences are not diverse. Furthermore, the differences must pertain to the "speculabile qua tale". For were they not differences of the "speculabile qua tale",

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338. "For in the case of things made the principle is in the maker - "it is either reason or art or some faculty, while in the case "of things done it is in the doer - viz, will, for that which "is done and that which is willed are the same." Meta., (E), c 1, 1025b22-25.

the distinction arising from them would be merely incidental and not specific. (339)

The question immediately arises : What are these differences of the "speculabile qua tale" ? Before we can answer that question, we must seek the answer to a prior question, namely what are the characteristics of the "speculabile qua tale". Only be resolving this question will we be in a position to decide whether a difference is properly a difference of the "speculabile qua tale" or merely an incidental one.

As we had cause to mention on a previous page, (340) the speculable is a designation added to a thing by reason of its order to the intellect. In other words, it is the thing qua knowable,

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339. "Sed sciendum est, quod ex objectis diversis non diversi-"ficantur actus et potentiae animae, nisi quando fuerit dif-"ferentia objectorum inquantum sunt objecta, idest secundum "rationem formalem objecti, sicut visibile ab audibili. Si "autem servetur eadem ratio objecti, quaecumque alia diver-"sitas non inducit diversitatem actuum secundum speciem et "potentiae. Ejusdem enim potentiae est videre hominem colora-"tum et lapidem coloratum; quia haec diversitas per accidens "se habet in objecto inquantum est objectum." St Thomas, II De Anima, lect. 6, n. 307.

340. Cfr. Chapter III, p. 56-57.

i.e. as referred to the intellect as an object of knowledge. (341) Since, therefore, the speculable is such because of an order to the intellect, (342) its per se characteristics must be those which are consonant with its position as an object of thought. Now as the object of thought, the speculable must possess certain notes which are necessary to it, owing in part to the intellect, the knowing faculty, and in part to the habit of science which perfects this faculty and of which the "speculable" is the object. (343) By reason of the intellect the "speculable" must be immaterial, i.e. unfettered by corporeal matter and singular individuating material conditions. (344)

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341. J. a St Thoma, Curs. Phil., T. I, Q. XXI, Art. 4, p. 679a17-26: "Ceterum hoc vel illud cognoscibile determinatum dicimus, quod "univocum esse potest respectu subjectorum seu entium, quibus "convenit denominative per modum quarti vel quinti praedicabi- "lis, licet illa entia univoca non sint entitative, eo quod "non consequitur ad ens, ut in se absolute sumitur, sed compa- "rative ad potentiam cognoscentem."

342. We might add here, for the sake of clarity, that we use the word "speculable" in the sense of being opposed to both the "factibile" and the "agibile". Not everything is "specu- lable", but only that which is solely the object of knowledge.

343. "Speculabili autem, secundum quod est objectum speculativae "potentiae, aliquid competit ex parte potentiae intellectivae "et aliquid ex parte habitus scientiae quo intellectus per- "ficitur." St Thomas, De Trinitate, Q. 6, Art. 1, c.

344. "Intellectus autem recipit similitudinem eius quod intelli- "gitur, incorporaliter et immaterialiter." St Thomas, II De Anima, lect. 12, n. 377.

This is a necessary requirement for the "speculable". For the intellect is an immaterial faculty (345) and since knowledge takes place through this that the thing known is in some way in the knower, (346) the "speculable" must be immaterial in order to be in the intellect. Whatever is received, is received according to the mode of the recipient.(347) Again, as an object of science the "speculable" must be necessary, since science concerns only what is necessary. (348) This characteristic, however, can only be verified of that which is immobile. The necessary is that which cannot not be. (349) On the other hand, the mobile qua mobile is that which can change, can be other than it is, can 'not be',

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345. "intellectus vero est virtus immaterialis, quae non est actus "alicuius organi corporalis." ibid.

346. "Cognitio autem omnis fit per hoc, quod cognitum est aliquo mo- "do in cognoscente, scilicet secundum similitudinem. Nam cognos- "cens in actu, est ipsum cognitum in actu." ibid.

347. "Unumquodque autem recipitur in aliquo per modum sui." ibid.

348. "Consequently the proper objects of unqualified scientific "knowledge is something which cannot be other than it is." I Post. Analytics, c ii, 71b15-16.

349. "Necessarium enim dicitur, quod in sui natura habet quod "non possit non esse: contingens autem ut frequenter, quod "possit non esse. Hoc autem quod est habere impedimentum "vel non habere, est contingens. Natura enim non parat im- "pedimentum ei quod non potest non esse; quia esset super- "fluum." S. Thomas, II Phys., lect. 8, n. 4.

for it is denominated as mobile precisely by reason of its order to change. Hence what is necessary and what is mobile mutually exclude each other. If a thing is necessary, it cannot 'not be', whereas if a thing is mobile, it can 'not be'. One must, therefore, conclude that the necessary is not the mobile, nor the mobile the necessary. The "speculable", then, since it must be necessary, is immobile. (350) These two, separation from matter and motion, are, then, the essential characteristics of the "speculable" as such. (351)

Having determined the essential notes of the "speculable qua speculable", we are now in a position to consider the problem of what differences are specific differences of the same speculable. Because the "speculable" is essentially characterised by this separation from matter and motion, it follows that the differences in this separation will specifically diversify the "speculable". There can be no doubt about this, for the differences of separation from matter and motion touch the "speculable" in its very ratio, i.e. in that formality by which it is constituted as "speculable". This will become increasingly evident after we have shown precisely what that differ-

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350. "Omne autem necessarium, inquantum huiusmodi, est immobile, "quia omne quod movetur, inquantum huiusmodi, possibile est "esse et non esse, vel simpliciter, vel secundum quid, ut "videtur in X Metaph." St Thomas, De Trinitate, Q.5,Art.1,c.

351. "Sic igitur speculabili, quod est objectum scientiae specu- "lativae, per se competit separatio et a materia et a motu, "vel applicatio ad ea." ibid.

ence of separation from matter and motion really amounts to.

To understand the real meaning of the differences in separation from matter and motion, we must first note that the separation from matter and movement, which is the essential characteristic of the speculable, is not something purely negative, a simple removal of matter and movement and nothing else. Abstraction or separation is a quasi motion formally in the intellect, which performs the operation of separation or abstraction, but having as its objective foundation the abstractibility of the object itself. (352) This abstractibility of the thing is a factor of great importance to the problem of specification of science and one that we must understand. It not only constitutes a safeguard to the act of abstraction, lest that act go beyond the possibilities of the thing as an object and terminate in the creation of an object that is logical and not real, but it is the abstractibility of the object, and not the act of

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352. J. a S. Thoma, Curs. Phil., T. I, Q. XXVII, Art. 1, p. 825a2-12: "Quia in rebus materialibus, quae reduntur intelligibiles et "immateriales per separationem a materia et conditionibus ma- "terialibus, ipsa abstractio est quasi motus quidam, in quo "consideratur terminus a quo et terminus ad quem, formaliter "quidem in ipso actu abstractionis, fundamentaliter vero et "objective in ipso objecto abstrahibili."

abstraction that is the radical principle of specification. (353) What is this abstractibility ? St Thomas gives us an idea of its meaning in the De Trinitate. (354) There he tells us that there are two classes of things that are the objects of speculation. One depends on matter 'secundum esse', because the things in this class can only exist in matter. The other is independent of matter, either because the things in this class are never in matter, or because sometimes they are not in matter. (355) The first class, however, is made up of two groups. Certain things in the class depend on matter not only to be but also to be understood, e.g. the physical thing which is understandable only with sensible matter. Others in the same class do not need sen-

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353. Ibid, p. 822a36-b4: "Et notandum est, quod non sumimus hic ab-"stractionem pro actu intellectus abstrahentis neque pro denc-"minatione extrinseca ex illo consecuta; sic enim esset cir-"culus, quia diversa scientia abstrahens sumeretur ex diverso "objecto abstracto et denominato a scientia, et diversum sci-"bile ex diversa scientia abstrahente. Sed sumitur abstrac-"tio pro abstrahibilitate objectiva, quatenus in objecto est "fundamentum ad diversam immaterialitatem terminandam et re-"presentandum.": See also Curs. Theo., Ia Pars, Disp. 2, Art. 7, par. 14, p. 379.

354. Q. 5, Art. 1, c.

355. "Quaedam igitur sunt speculabilium quae dependent a materia "secundum esse, quia non nisi in materia possunt; - - Quae-"dam vero sunt speculabilia quae non dependent a materia se-"cundum esse, quia possunt esse sine materia; sive numquam sint "in Materia, et in quibusdam non, ut substantia, qualitas, po-"tentia, et actus, unum et multa et huiusmodi." ibid.

sible matter to be understood, viz. the mathematical line. (356) The fact that some things can be understood for what they are, without matter, while others cannot be understood without matter, constitutes the objective limit to the separation or abstraction from matter for each type of object. This limit is the objective abstractibility.

To return now to the discussion of abstraction as a quasi motion. Like every motion, it has a terminus a quo and a terminus ad quem. (Keep clearly in mind that it is the objective abstractibility of the object itself that is the basis for the motion in so far as it founds the terms of the motion of abstraction) By reason of its terminus a quo abstraction is considered as remotion from matter, which being of three degrees, namely remotion from individual sensible matter, from common sensible matter, from intelligible matter, constitutes the threefold genus of abstraction. (357) From the point of view of its terminus ad quem, which is the

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356. "et haec distinguuntur, quia dependent quaedam a materia secundum esse et secundum intellectum, sicut illa in quorum definitione ponitur materia sensibilis: unde sine materia sensibili intelligi non possunt:--- Quaedam vero sunt quae quamvis dependeant a materia secundum esse, non tamen secundum intellectum, quia in eorum definitionibus non ponitur materia sensibilis, ut linea et numerus." ibid.

357. J. a S. Thoma, Curs. Phil., T. I, Q. XXVII, Art. 1, p. 825a12-16: "Ex parte termini a quo habet derelictionem materiae, quae triplex est, ut supra diximus, et sic constituitur triplex genus abstractionis."

principle of specification for all movement, abstraction is considered as immateriality, which is also of three kinds or degrees; common sensible matter, intelligible matter, the totally immaterial. It is from the point of view of its terminus ad quem that we speak of the degrees of immateriality with reference to abstraction. (358) Abstraction, then, is not mere remotion from matter or movement, (359) it is also the attainment of the condition of being immaterial. Therefore the differences in separation or abstraction are differences in the condition of immateriality. This fact is quite important, as we shall see immediately.

Immateriality is the root of intelligibility, i.e. it is that by which an object becomes intelligible or proportioned to the intellect. (360) The fundamental reason explaining why immateriality is the root of intelligibility is that the knowableness of an object is proportioned to its actuality. (361) In so far as a thing is potential,

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358. Ibid, a16-20: "Ex parte termini ad quem est diversus gradus "immaterialitatis seu diversus modus spiritualitatis, quem "acquirere potest res sic abstracta."

359. We mention movement here, though we have been speaking of abstraction from matter, because movement is subjected in sensible matter and hence abstraction from that matter results necessarily in abstraction from movement.

360. J. a S. Thoma, Curs.Phil., T.I,p.825a27-30: "sed ex accessu ad "determinatum gradum immaterialitatis, quo objectum aliquod "determinate deputatur et redditur intelligibile;"

361. "Cum enim unumquodque sit cognoscibile inquantum ens actu, ut "infra in nono huius dicetur, - - ". St Thomas, II Meta., lect. 1, n. 280.

it 'is not', it is merely possible, i.e. it 'can be' and it can 'not be'. (362) For, since it 'can be', but 'is not', it must be possible both 'to be' and 'not to be'. To insist that the possible is only 'possible to be' and is not at the same time 'possible not to be', denies that the possible is possible. If the possible is that which 'can be but is not', and yet cannot 'not be', it must 'be', when it is merely possible. But if it 'is', when it merely 'can be', then the possible is not possible but actual. Therefore, since it can 'be' and can 'not be', the potential thing is indeterminate and the indeterminate, ut sic, is not knowable. Act, however, makes a thing 'to be', thereby removing its prior condition of being indeterminate and rendering it knowable. Now matter, which is potential, does not make a thing intelligible. Rather it is the principle that obfuscates. (363) In order, then, that an object be made intelligible, it is necessary that matter be removed so far as is consonant with the thing itself. In so far as matter is removed and the thing becomes correspondingly immaterial, it loses its potential aspect and becomes actual and thereby intelligible.

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362. We use the word 'possible' in the sense of 'contingent, and not in the sense of 'possible' as opposed to 'impossible'.

363. J. a S. Thoma, Curs. Phil., T. I, p. 823a10-14: "Et sic, cum "materia obumbret et impediat intelligibilitatem, illuminatur "et apparet objectum, secundum quod a materia secernitur diver-"simode."

If, then, the immaterial is the intelligible, it follows that the differences in the degrees of immateriality are actually differences in intelligibility. Things that are immaterial in the sense of being separated merely from individual sensible matter are not as intelligible as those which are immaterial either by reason of abstraction from common sensible matter or intelligible matter. Nor are these same things capable of an intelligibility similar to that proper to the things of the latter two classes, for the intelligibility of a thing is not merely the result of the intellectual act of abstraction as we have mentioned before, but of the abstractibility of the things themselves, or what we might call, their objective intelligibility. Therefore the differences in inteligibility, which are identical with those of immateriality and of remotion from matter, touch the intelligible object in its intelligibility. This they do, not merely according to "a more or less" which admits of variations that do not affect the specific identity of a thing (364) but with an absoluteness and rigidity that preclude the passage from one degree of intelligibility to another except under the penalty of the object losing its identity. For example, the thing to which the first degree of intelligibility or immateriality is proper, man as an instance, cannot have that degree of intelligibility which is characteristic of the mathematical entity, without ceasing to be man and becoming a mere surface or volume. Nor could it have that degree which is proper to

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364. Such as more or less cold, or hot, both of which remain either cold or hot despite the variations in temperature.

the immaterial thing, i.e. the thing which is independent of matter both 'secundum esse' and 'secundum intellectum', without becoming at least angelic. Since they do affect the intelligible (the object of the intellect) in such a manner, they must be specific differences and constitute diverse species under the genus 'objectum intelligibile' or 'speculabile'. But if the differences in the degree of abstractibility or immateriality are the principle of specification of the 'objectum speculabile', they must be the principle of specification of the sciences which deal with that object, since science is specified by its object.

To sum up. Since the speculative sciences are diversified or specified by their objects, any difference that is a "per se" difference of the object, will diversify science. The differences in the degree of immateriality or abstractibility are the "per se" differences of the "speculabile qua tale", because they touch this object in the very ratio whereby it is "speculabile", namely its immateriality and necessity or immobility. Therefore the speculative sciences are distinguished according to the diverse degrees of immateriality or abstractibility.

ii) A corollary on abstraction and truth.

"That is why he separates them; for in thought they are separable "from motion, and it makes no difference, nor does any falsity re- "sult, if they are separated." (193b33-34)

Having pointed out the essential difference between the mathematician and the physicist, Aristotle proceeds to vindicate the mathematician's non-consideration of the formalities which are proper to his objects 'in esse reali'. The simple fact of the matter is that, in thought, lines, surfaces, volumes and points, as well as numbers, the object of arithmetic, are independent of motion and sensible matter; hence they can be separated from these. Moreover, since the mathematical object is independent of motion and sensible matter in thought, the abstraction from these formalities does no injury to that object so far as its 'quid sit' and its properties are concerned. Further, one cannot accuse the mathematician of a distortion, for no falsity results from the consideration of abstract lines, abstract surfaces etc..

In this defense of the mathematician there are several points that require close study, if one is to fully appreciate this justification of mathematics. Firstly, there is the independence of mathematics from sensible matter and from motion, which is the foundation of mathematics' separability from these two formalities in the realm of thought. Secondly, there is the question of the truthfulness of mathematics, especially in view of the fact that every line, surface, volume, and point which exist in external reality, is a sensible line, surface, volume and point and consequently a mobile thing.

(1) Is mathematical abstraction justified ?

It would be impossible to attempt to justify mathematic's independence from motion and from sensible matter without first showing what abstraction is. Therefore, in the present section we will consider (a) the 'quid sit' of abstraction and (b) its species and (c) of mathematical abstraction we will consider what it is and how it is justified. The 'an sit' of abstraction we omit here, because we have already touched this point in our discussion of the necessity for immateriality in the object of the intellect.

(a) The 'quid sit' of abstraction.

Abstraction, as the latin word from which it is derived (abstrahere) suggests, is a separation. But because it is a separation that is made by the mind, we must first investigate, as St Thomas does in De Trinitate (365), the significance of the word 'separation' with regard to the two operations of the mind which effect the separation. This is necessary in order to obtain the exact notion of what abstraction is.

The meaning of the word 'separation' differs when used in connection with the first and the second acts of the mind. The

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365. Q. 5, Art. 3.

first operation of the intellect, that of the intelligence of indivisibles, i.e. essences, regards the very nature of the thing, by which the thing understood obtains a definite grade in the hierarchy of beings. (366) The second operation, which is the act of composing and dividing by affirmation and negation, touches upon the very existence of the thing. In composite being this existence is the result of an aggregation of the principles of the thing, while in simple substances, it accompanies the incomposite essence. (367) Now the separation that is effected by the second act is limited to things that are separated one from another 'secundum rem'. The reason for this restriction is that logical truth, which is formally found in the second act of the mind, consists in a conformity of the intellect to the thing. Were the intellect, then, to separate things things that were not separated 'secundum rem', it would be false. (368) To

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366. "Prima quidem operatio respicit ipsam naturam rei, secundum "quam aliqua res intellecta aliquem gradum in entibus ob- "tinet; sive sit res completa ut totum aliquod, sive incom- "pleta ut pars vel accidens." ibid, corp.

367. "Secunda operatio respicit ipsum esse rei, quod quidem re- "sultat ex aggregatione principiorum rei in compositis, vel "ipsam simplicem naturam rei comitatur, ut in substantiis "simplicibus." ibid.

368. "Et quia veritas intellectus est ex hoc quod conformatur rei, "patet quod secundum hanc operationem intellectus abstrahere "non potest quod secundum rem conjunctum est, quia in abstrac- "tione significatur esse separatio secundum ipsum esse rei." ibid, c.

say that a man is not a musician, which is a case of separating man and musician, is true only if he is not a musician in reality, but false, if he is one.

The separation, however, of the first operation is different. Because it terminates in the nature or essence of the thing and does not touch its existence, it is possible for the intellect, through the first act, to separate things that are united in 'esse reali'. But here too there is a limit. Some things are separable, but not all. For, since the first act of the mind attains to the essence of things, and since the essence is understandable only in so far as it is act, the intellect can know an essence in one of three ways: (1) as an act, (forms by themselves and simple substances), (2) as the act of something (composed substances are known through their form), (3) through a habitude to act (prime matter is known through its habitude to substantial form). (369) Now, if the act, which constitutes the ratio of the nature, has an order and a dependence on something else, then the nature itself is not intelligible without that something else, irrespective of the manner in which the

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369. "Cum enim unaquaeque res sit intelligibilis secundum est actu, "ut dicitur X Metaph., oportet quod ipsa natura vel quidditas "rei, intelligatur, vel secundum id quod est actus quidem, si- "cut accidit de formis ipsis, et substantiis simplicibus, vel "secundum quod id quod est actus eius, sicut substantiae com- "positae per suas formas; vel secundum id quod ei loco actus, "sicut materia prima per habitudinem ad formam, et vacuum per "privationem locati: et hoc est illud ex quo unaquaeque natura "suam rationem sortitur." ibid.

act and that something else are connected. The two might be joined together as whole and part, or as matter and form /subject and accident, or as relatives, which though separated 'secundum rem', like father and son, are not separable 'secundum intellectum'. In any case as long as one depends on the other, the nature is not understandable without both. Hence in those cases separation of things joined together is not possible. Outside of this restriction, by its first act the intellect can separate things joined together in any of the manners described, i.e. as parts and whole, as form and matter / (We exclude from possible separation those things linked together as relatives, since they can never be understood one without the other.) The reason for this is that in such cases the things connected do not pertain to the nature of each other, which is the object of the first operation, and hence they can be considered apart.

From what has been said, we can differentiate between the meanings of the word 'separation' as used in connection with the two acts of the mind. Since the second act can only separate things that are so 'secundum rem', and this under the penalty of being false otherwise, it is obvious that the word here means - "one thing is not in the other". (370) But because the first act can separate things

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370. "Sic igitur intellectus distinguit unum ab alio et aliter "secundum operationes: quia secundum illam qua componit et "dividit, distinguit unum ab alio per hoc quod intelligit "unum alii non inesse;" ibid.

that are joined together 'secundum rem', so long as their act, which constitutes the ratio of their essence, has no dependence on the things joined to them, 'separation' has a different meaning. In this instance it signifies the consideration of one thing, without the consideration of the other, either as to its presence in or absence from the essence under examination. (371)

Of the two meanings attached to the word 'separation', properly speaking only that which signifies "one thing is not in the other", is separation, for separation is formally opposed to union or continuity (372) and hence is verified only in the case of things that are not together 'secundum rem'. But if this be so, and St Thomas insists that it is, as we shall see in a moment, what about the other 'separation', i.e. 'the consideration of one thing, without the consideration of the other thing, either as to its presence in or absence from the nature under examination' ? If it is not separation, what is it ? It is, as St Thomas observes, more correctly called abstraction. (373) But even here we are obliged to make a distinction.

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371. "in operationes vero qua intelligit quid est unumquodque, dis- "tinguit unum ab alio, dum intelligit quid est hoc, nihil in- "telligendo de alio, neque quod sit cum eo, neque quod sit ab "eo separatum." ibid.

372. J. a S. Thoma, Curs. Phil., T. I, Q. II, Art. 3 (Pars 2a Logicae), p. 294a24-28: "Nam distinctio seu pluralitas vel multitudo op- "ponuntur unitati vel identitati, divisio vel separatio unioni "seu continuitati."

373. "Haec autem distinctio recte dicitur abstractio:" De Trinitate, Q. 5, Art. 3, c.

The separation that is effected by the first act of the mind is abstraction only when the thing separated is joined with others 'secundum rem' according to the mode of part and whole, or form and matter. (374) In cases where the first act separates things that are separated in 'esse physico', e.g. when it considers an animal and does not consider a stone, it is a question of separation and not of abstraction, (375) at least fundamentally, though not formally. I say fundamentally, because the stone is not in the animal 'secundum rem' and this is the basis for that formal separation which is made by the second act of the mind.

The appropriateness of designating the mind's consideration of the essence of one thing, without understanding anything about the things connected with that 'secundum rem' but not pertinent to its 'ratio', as abstraction and not as 'separation, is clearly evident from the following. Such a consideration cannot be called a separation, because this term properly means non-union, whereas there is in this case a union. But it can be called abstraction, since this designation, signifying a taking away, implies that there is a union between the thing taken away and that from which it is taken. Further, the restriction of abstraction to those instances

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374. "sed tuno tantum quando ea quorum unum sine alio intelligitur, "sunt simul secundum rem." ibid.

375. "Non enim dicitur animal a lapide abstrahi, si animal absque "intellectu lapidis intelligatur." ibid.

where the first act of the mind considers a thing, without considering the things joined to it 'secundum rem', is amply justified. If the thing considered by the act of the mind is actually separated from other things which do not enter into the mind's consideration of its object, one can hardly say that the object was taken from the others, since it never had any union with them.

Since abstraction, like separation, is a means by which the intellect distinguishes one thing from another (376) and moreover, since abstraction, unlike separation, concerns a distinction of things that are joined together 'secundum rem', we can define it in the following manner. Abstraction is an act proper to the first operation of the mind, by which the intellect distinguishes one thing from another or others to which this one is joined 'secundum rem', either as part and whole, or as matter and form / subject and accident, (377) in so far as the intellect knows the 'quid rei' of the one, while understanding nothing about the others or other, i.e. as to whether it or they be joined to or separated from the nature that is known.

(b) The species of abstraction.

"Therefore, since abstraction cannot take place, "properly speaking, unless there is conjunction of

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376. "Sic igitur intellectus distinguit unum ab alio aliter et "aliter secundum operationes:" ibid.

377. "Unde, cum omnia accidentia comparentur ad substantiam sicut "forma ad materiam," ibid.

"things objectively, according to two modes of
"conjunction referred to above, namely, according
"as part is joined to whole, or form to matter,
"abstraction is twofold: one sort by which form
"is abstracted from matter; the other, by which the
"whole is abstracted from its parts." (378)

This citation from the De Trinitate reveals two things: (1) that abstraction is diversified by the differences of the modes by which things are joined together, and (2) that there are only two species of abstraction. The first point is easily established, once we call to mind that abstraction is an act. Because it is an act, its principle of specification must be the object with which it is concerned. (379) Now the object of abstraction is a thing connected with other things 'secundum rem', which the intellect considers without considering the others. If, therefore, there are 'per se' differences of such an object, these will diversify abstraction. What are the differences of the object of abstraction ? The sole difference of this object, taken in its widest sense, is to be discovered in the differences of the mode of conjunction by which the thing considered and the things not considered are joined 'secundum rem', for some are

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378. "Unde, cum abstractio non possit esse, proprie loquendo, nisi "conjunctorum secundum rem, secundum duos modos conjunctionis "praedictos, scilicet qua pars et totum conjunguntur, sive "forma et materia; duplex est abstractio: una qua forma abstra-"hitur a materia, alia qua totum a partibus." De Trinitate, ibid.

379. See p.

united as part and whole, others as matter and form /subject and accident. But the mere fact that there are differences in the mode of conjunction is not sufficient grounds for postulating them as principle of specification for abstraction. What is necessary, is to show whether they are differences of the object of abstraction qua object. Are they such ? The answer is affirmative.

The differences in the mode of conjunctions are differences of the object of abstraction qua object because they affect it in its conjunction with other things, which is the formality that makes the object an object of abstraction and not of separation. Moreover, the fact that the thing which is abstracted, might be joined to another as whole and part, or as matter and form / subject and accident, results in diverse formalities that pertain to the thing in virtue of the peculiar type of connection that it has with others. Things that are joined as matter and form, have the formality of potency and act, while those connected as whole and part have the formality of superior and inferior, of universal and particular. (380) Since the differences are per se differences of the object of abstraction, it follows that diversity in the mode of conjunction distinguishes the species of abstraction.

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380. The exact effect of these diverse formalities will be treated when we come to describe the difference between formal and total abstraction.

The second point made by St Thomas, which concerns the number and identity of the species of abstraction, offers a difficulty. If the diverse modes of conjunction are the basis for the types of abstraction and there are two modes : whole and part, matter and form: why are there not four instead of two species, total and formal, partial (by which a part is considered and not the whole) and material (by which matter is abstracted from form) ? To answer this question requires information that can best be obtained through a study of the two recognized species, total and formal. Hence we will first consider total and formal abstraction and then return to the problem of why there are only two species and not four.

(I) Formal and Total Abstraction.

Formal abstraction is defined as that by which "what is formal is abstracted from what is material", (381) or more explicitly, "that by which form is abstracted from matter, act from potency, the essential and proper from what is extraneous and foreign." (382) Total abstraction is that "by which a totum universale

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381. Cajetan, De Ente et Essentia, Proœmium, n. 5, circa primum (p. 6, Editio Laurent): "Ad horum planiorem intelligentiam "nota quod sicut est duplex compositio, scilicet formae cum "materia, et totius cum partibus, ita duplex est abstractio "per intellectum, scilicet qua formale abstrahitur a materiali,"

382. J. a S. Thoma, Curs.Phil., T. I (II Pars), Q. 5, Art. 2, p. 356b6-9: "Vocatur abstractio formalis, qua forma abstrahit a "materia, actus a potentia, essentiale et proprium ab extraneo "et alieno."

is abstracted from its subjective parts." (383) Now the two types of abstraction have a certain common feature and certain differences. We will first treat the common feature.

The community that exists between total and formal abstraction.

Since the intellect, even in its first operation, cannot separate or abstract all the things that are joined together 'secundum rem', but only certain things (384), both formal and total abstraction have a limit. Only when the things joined together do not depend upon each other for the intelligibility of the essence of at least one of them, can abstraction be made. As applied to formal abstraction it means that not every form can be abstracted from matter. Substantial form cannot be abstracted from the matter that corresponds to it, since the formality of being an act of something, namely matter, pertain to its definition. Nor can accidental forms be separated from their subject, the substance, for the very 'ratio' of the accident depends on substance as its subject of inherence, since an accident is that to which it pertains to be in another as in a subject. (385)

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383. Cajetan, De Ente et Essentia, (ut supra): "et qua totum universale abstrahitur a partibus subjectivis."

384. See p. 240-241.

385. "Ab illa materia non potest forma abstrahi per intellectum a "qua suae essentiae ratio dependet. Unde, cum omnia accidentia comparentur ad substantiam, sicut forma ad materiam, impossibile est aliquam talem formam a substantia separari." De Trinitate, Q. 5, Art. 3, c. (St Thomas)

What forms can be abstracted, we will reserve for a later consideration As in the case of the form, not every totum can be abstracted from its parts. To understand this it is necessary to distinguish the parts of a totum. There are two types of parts, the 'partes speciei' and the 'partes materiae'. (386) The 'partes speciei', so denominated because they pertain, secundum se, to the totum in so far as it has a certain essence (387), are either constituent parts, i.e. they are the parts upon which the essence of the totum depends (388a), or parts necessary for the proper act of the species (388b). Such parts as matter and form with regard to composed substances, the letters of the alphabet relative to words, the elements of a mixture with respect to the mixture, are 'partes speciei' in the sense of constituent parts. The principal parts of man's body, such as the heart, the brain, etc., are 'partes speciei' in the sense of parts necessary for the proper operation of the species 'man'. The 'partes materiae', so named because, in contrast to the 'partes speciei', they do not pertain, secundum se, to the totum in so far as it has a certain essence (389), are parts

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386. "et tales partes dicuntur speciei, et formae, --- Et hae partes "dicuntur partes materiae," ibid.

387. "Hoc enim dixit ad speciem pertinere, quod secundum se inest unicui- "que speciem habenti;" St Thomas, VII Meta., lect. 9, n. 1475.

388a. "Sunt enim quaedam partes a quibus totius ratio dependet; quando "scilicet hoc est esse toti tali quod ex talibus partibus componit; "sicut se habet syllaba ad litteram, et mixtum ad elementa: et tales "partes dicuntur speciei et formae, sine quibus totum intelligi non "potest, cum ponantur in eius definitione." De Trinitate, Q.6, Art. 3, c.

388b. "Sed quaedam partes sunt, quae licet non sint priores toto animali hoc "modo prioritatis, quia non possunt esse sine eo, sunt tamen secundum "hanc considerationem simul; quia sicut ipsae partes non possunt esse "sine integro animali, ita nec integrum animal sine eis. Huiusmodi autem "sunt partes principales corporis, in quibus prime consistit 'forma' "scilicet anima; scilicet cor, vel cerebrum." St Thomas, VII Meta., lect. 10, n. 1489.

"Unde oportet quod partes tales quae sunt necessariae ad perficiendum "operationem speciei propriam, sint partes speciei; tam quae sunt ex "parte formae, quam quae sunt ex parte materiae." ibid, lect. 11, n.1519.

389. "Sed id quod est materiale ad speciem, nunquam dicendum est secundum "se de specie." ibid, lect. 9, n. 1473.

that "happen to the species" or totum (390), since they are not constitutive of its essence or necessary for the proper operation of the species, but merely accidental. Examples of such parts are the hand, the finger, the foot of man. None of these enter into the construction of man's essence, or are necessary for his proper operation. Also reduced to the 'partes materiae' are all signate or individual parts, such as this soul, this body, this flesh. (391) The reason for this is because individual differences are outside the essence of a thing (392). The 'partes speciei', because they are either constituents or parts necessary for the proper operation of the species, are prior to or simultaneous with the species or totum. Hence the totum is defined through the 'partes speciei'. The 'partes Materiae', however, are posterior to the totum to which "they happen", and therefore do not define it but rather are defined through it. E.G. The eye is defined as an organ of an animal, 'this man, John' is defined through man. With these distinctions in mind, we can now examine the statement about the impossibility of abstracting every totum from its parts.

No totum can be abstracted from its 'partes speciei', for the totum is either constituted by such parts or necessarily demands them for its proper operation. Since they are required either to have the totum at all, or to have the proper operation of the totum, it is impossible to have the

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390. "ad materiam vero quod accidit speciei." ibid, n. 1476.

391. "Et hae partes dicuntur partes materiae, quae non ponuntur in defini-"tionibus totius, sed magis e converso, et ita se habent ad hominem omnes "partes signatae, sicut haec anima, et hoc corpus et hoc os, et huius-"modi. Has enim partes sunt partes materiae, quae quidem sunt partes So-"cratis et Platonis, non tamen hominis in quantum homo:" De Trinitate, Q. 5, art. 5, c.

392. "Hoc autem contingit in omnibus habentibus formam in materia, quia in "eis est aliquid praeter principia speciei. Nam natura speciei individu-"atur per materiam: unde principia individuantia et accidentia individui "sunt praeter essentiam speciei." St Thomas III De Anim. lect 8 n. 726

totum without having these parts. For example, one cannot abstract man from his constitutive parts, animality and rationality, and still have man. Nor can one abstract from the parts required for the minimum organisation necessary for man as a living being, and still have the totum man. But the totum can be abstracted from the 'partes materiae', because they are posterior to the essence of the totum and furthermore are not simultaneous as are the principal parts of the body. Hence they are not required for the intelligibility of the totum. One need not think of man's foot or of his hand, or about this man or that man, in order to understand the totum 'man'. Therefore total abstraction is possible only with regard to a totum and its 'partes materiae', but not with regard to a totum and its 'partes speciei'.

The differences between formal and total abstraction.

We have, at this point, sufficient information to show, as St Thomas does in the De Trinitate, why the species of abstraction are limited to two, total and formal. For the sake of unity, however, we shall postpone this consideration until we have completed the discussion on the differences between formal and total abstraction.

We now come to the differences between formal and total abstraction. This discussion is of more importance than that regarding the similarity between the two, because, whereas their similarity has its foundation in the fact that both belong to the genus of abstraction, their differences are founded in what is proper to each as a distinct species. Cajetan (395) lists four differences that exist between

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395. De Ente et Essentia, Prooemium, n. 5. (p. 6, 7 - Editio Iaurei et

total and formal abstraction; differences regarding the concept of the thing abstracted and the thing from which it was abstracted, differences in the attributes proper to the thing abstracted, differences in the knowability of the thing abstracted, and differences in the role of each type of abstraction relative to science. We will examine briefly each of these differences and point out their various foundations. It might be added here that this examination of these differences and their foundations will confirm the position we took on a previous page (394) regarding the diverse modes of conjunction and the diversification of abstraction.

1) Differences regarding the concept :

The first difference noted by Cajetan between formal and total abstraction regards the concept of the thing abstracted and that of the thing from which the abstraction was made. In formal abstraction, after the abstraction has been accomplished, there remain two complete concepts, one of which does not contain the other. (395) When 'surface' is abstracted from sensible matter, there are two complete

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394. See p. 376

395. "Primo, quia in abstractione formali secorsum uterque conceptus "completus habetur: eius scilicet quod abstrahitur, et eius a "quo abstrahitur, id est, formalis et materialis, its quod con- "ceptus alter alterum non includit." Cajetan, De Ente et Essentia, p. 6.

concepts, one of 'surface' and one of sensible matter. The 'surface qua surface' has its own definition which does not include sensible matter, for a 'surface' is a magnitude of two dimensions. Likewise there is a complete concept of sensible matter since its definition does not include 'surface', for sensible matter is defined through sensible qualities. The situation is not the same in the case of total abstraction. Here there are no longer two complete concepts after abstraction, one of the whole, one of the parts, but only one, namely that of the abstracted whole. (396) When man is abstracted from individual man, say Peter, there is only one complete concept, that of the totum' man '. There is a complete concept of this totum because it does not depend on the individual, since the individual is outside the nature. But there is no complete concept of the individual from which the totum 'man was abstracted. The reason is because the individual cannot be defined without recourse to the nature of which it is an individual instance. Since the nature has been abstracted, the individual is left without a means of being defined.

The foundation for this difference between formal and total abstraction is to be discovered in this, that the latter takes

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396. Ibid, "In abstractione vero totali non remanet secrsum uter-
"que conceptus completus, ita quod alter alterum non inclu-
"dat ; sed unus tantum eius scilicet quod abstrahitur.

place through the consideration of something that pertains to the nature of the inferior, and the removal or non-consideration of that element which belongs to the very ratio of the inferior as inferior. (397) If we cast an eye back to the example used, this last statement will become clear. In abstracting 'man' a totum, form the individual man, the mind considers 'man' the abstracted whole, which pertains to the ratio of the individual man in so far as he is a particular instance of that nature, but does not consider his individuality, which belongs to individual man in so far as he is an individual. What is left after the abstraction is nothing but the individual qua individual, which is not definable save through the nature that has been removed. Therefore there can be no complete concept of that from which the whole is abstracted, in so far as the thing left unconsidered is taken by itself. Formal abstraction, on the other hand, does not take place in this way. It takes place through the separation of those things that have an aspect of form from those which have an aspect of matter. (398) In other words, the thing from which another is abstracted as from

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397. Ibid. "Fundamentum huius differentiae est quod illa (totalis) "abstractio fit per considerationem alicuius, quod est de ra- "tione inferioris, et per remotionem, id est non considera- "tionem alicuius, quod est de rationis illiusmet inferioris."

398. Ibid: "Illa autem abstractio (formalis) non fit per considera- "tionem alicuius quod sit de ratione materiae, et non per con- "siderationem alicuius, quod sit de illius ratione: sed potius "fit per separationem eorum quae sunt de ratione formalis, ab "his quae sunt de ratione materialis, et e converso, ut exem- "plum datum ostendit."

matter, while it has a material aspect relative to the thing abstracted, nonetheless is in itself an actual thing, whose actuality does not depend on the thing abstracted. This becomes evident when we recall that formal abstraction is restricted to those cases where neither the form nor the matter have an essential dependence upon each other. This means that if the form is the act of the matter and the matter the corresponding subject of the act, there can be no abstraction. The result of this is to restrict formal abstraction to such forms that are not the sole and exclusive form of that matter from which it is separated, and to such matter (that is not absolutely potential, but only relative to the form that is abstracted. Consequently, since matter is not totally potential, it has some actuality when considered aside from the abstracted form. Because of this actuality, it too, like the form abstracted, can be defined. The example used by Cajetan will help manifest this. The line has the aspect of form with regard to sensible matter, in so far as it is a limit. But, because it is not the form of sensible matter qua sensible, it can be abstracted. Again, the sensible matter of the line is not potentially sensible, but potentially limited, i.e. it is potential to the line as a limit. Therefore, after the abstraction of the line has taken place, matter remains sensible. It continues to possess that actuality of being sensible, because being sensible does not depend on the line but on sensible qualities. Since it retains that actuality, even after the line has been abstracted, sensible matter is capable of being defined

and hence of a complete concept just as the line, which is not the form of sensible matter but merely a form in sensible matter, is capable of being defined without sensible matter and, consequently, of a complete concept.

ii) Differences in the attributes proper to the abstracted thing.
iii) Differences in the knowability of the abstracted thing.

Though they are listed separately, we propose to combine the second and third differences between formal and total abstraction into one consideration. The reason for this procedure is that the third difference is a corollary of the second, as is clearly indicated by the fact that Cajetan gives one and the same foundation for both. (399)

In this second and third difference we are no longer concerned with the thing from which something is abstracted, but concentrate our entire attention on the thing abstracted. The object that is abstracted through formal abstraction, has, in virtue of the abstraction, the following properties : actuality, distinctness and intelligibility. (400) The object which is the fruit of total

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399. De Ente et Essentia, Procemium, C. 1, p. 7 (Editio Laurent) "Tertio differunt..."

400. Ibid: "Secundo differunt, quia per abstractionem formalem ori-"tur in eo quod abstrahitur actualitas, distinctio et intel-"ligibilitas."

abstraction is characterized by the confusion of potentiality and less intelligibility. (401) Furthermore, the two types of abstraction differ from each other from the point of view of their limits. The more abstract the object of formal abstraction, the more known it is by nature. (402) It is the inverse of this in the case of total abstraction. The more abstract the object of total abstraction, the more known it becomes for us, (403) and, consequently, less known by nature. The connection that exists between 'more known for us' and 'less known by nature' will be shown when we examine the foundation of these differences.

The reason behind these differences is to be found in the very process of abstraction. Formal abstraction proceeds by removing matter. In doing this it leaves behind all that obfuscates and retains only the form which is act. (404) By formal abstraction,

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401. Ibid: "In abstractione vero totali oritur in se quod abstrahi-
"tur potentialitatis confusio, et minor intelligibilitas."

402. Ibid: "Tertio differunt, quia in abstractione formali quanto
"aliquid est abstractius tanto est notius naturae." The mean-
"ing of the phrase "notius naturae" is explained in I Phy.,
"lect. 1, n. 7, where St Thomas says : "Non ergo dicit notiora
"naturae, quasi natura cognoscat ea; sed quia notiora sunt
"secundum se et secundum propriam naturam."

403. De Ente et Essentia, ibid : "In abstractione vero totali quanto
"est abstractius tanto est notius nobis."

404. Ibid: "Fundamentum harum differentiarum est quia abstractio for-
"malis fit per separationem a materialibus potentialibus et
"huiusmodi."

then, one attains to the form which, because it is act, has the characteristics of actuality, distinctness and intelligibility. Because its object possesses these qualities, it follows that by becoming more abstract one attains to an object that is more actual, more distinct and more intelligible. This is so, because the higher one goes in the order of formal abstraction, the form becomes becomes correspondingly freer from matter and potentiality and hence more and more actual. But the object that is more actual, is the object that is more known by nature, for, since entity is the basis of knowableness and the thing that is more actual has more entity, such a thing is more knowable according to its nature. (405) Total abstraction, on the other hand, proceeds by removing from the abstracted totum the parts. By this removal there is left behind those specific or individual actualities (depending on whether the totum abstracted is a generic or specific totum) by which nature is determined to be this nature or that nature, to be the nature of this one instead of that one. (406) For example, in abstracting animal from its species, one must relinquish the specific actualities which make animal to be either rational or irrational. The same is true in abstracting the nature of

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405. I Phys., lect. 1, n. 7: "Sunt autem secundum se notiora, quae "plus habent de entitate: quia unumquodque cognoscibile est in- "quantum est ens. Magis autem entia sunt, quae magis in actu: "unde ista maxime sunt cognoscibilia naturae."

406. Cajetan, De Ente et Essentia, ut supra : "Abstractio totalis "fit per separationem a specificis actualitatibus."

man as a totum from individual man. In doing this we must sacrifice those individual actualities that make the nature to be John's nature, or James's nature. In stripping the totum of these actualities one is left with that which is common, hence potential and, since act is the principle of intelligibility, a less intelligible thing. As a consequence of the procedure of total abstraction, the further one goes in this order of abstraction, the more potential and less intelligible is the object that he attains. (407) This is not too difficult to see. To become more abstract in the order of total abstraction is possible on the condition that one divests the thing of more and more of its actualities and thereby arrive at a thing more and more potential, since the thing's universality is proportioned to its potentiality. The thing that possesses determinations is less applicable than the thing without determinations. Yet, by becoming more and more abstract in this order of total abstraction, one attains to objects which, while they are less knowable by nature, are more knowable for us. They are less knowable by nature, because they are more potential than actual and act is that by which a thing is intelligible or knowable. Their very potential condition, however makes them objects more intelligible for us, for, since our intellect is pure potency in the order of intelligible things, the object that is proportioned to it, is not the

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407. Ibid: "a quibus quanto est abstractius, tanto est potentialius, "cum genus potestate contineat inferiora; et tanto est minus "intelligibile, cum actus secundum se notior potentia."

thing intelligible by nature, i.e. removed from matter and potentiality, but the object which is a mixture of potentiality and actuality. (408) The greater the predominance of potentiality in the object, the more proportioned it is to the intellect. It is, of course, to be understood that some act must be present, since there is no intelligibility whatever, where there is nothing but potency. Hence the most abstract thing in the order of total abstraction is the most intelligible for us.

iv) Differences in the role assigned to each type of abstraction relative to science.

Regarding this fourth and last difference Cajetan merely mentions the difference. He says that it is formal abstraction, according to its diverse modes, which is the principle of specification for the theoretical sciences, (409) while total abstraction is common to all sciences. (410) It is not difficult to discover the reasons why these two species of abstraction fulfill a different role in science. We have just seen that formal abstraction clothes the abstracted object

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408. "Secundo oportet considerare quod intellectus noster de "potentia in actum procedit. Omne autem quod procedit de "potentia in actum, prius pervenit ad actum incompletum "qui est medium inter potentiam et actum, quam ad actum "perfectum." Summa Theo., Ia Pars, Q. 85, Art. 3, c.

409. Cajetan, De Ente et Essentia, Procemium, Q. 1, n. 5, "Quarto "differunt,- -", p. 7 (Editio Laurent): Quarto differunt, quia "penes diversos modos abstractionis formalis scientiae spe- "culativae diversificantur, ut patet VI Metaph.."

410. Ibid: "Abstractio autem totalis communis est omni scientiae,--"

actuality, distinctness and intelligibility, and that the more abstract that object becomes, the more intelligible it is. We have also seen in our discussion on the principle of specification of the theoretical sciences that the differences in intelligibility are per se and specific differences of the "speculabile". They are, there-fore the principles which differentiate the sciences which have the "speculabile" as object. But these differences in intelligibility are nothing other than the differences in the degrees of formal abstraction (i.e. the diverse degrees in the abstractibility of form) and hence formal abstraction according to its diverse degrees is the principle of specification for speculative science.

Total abstraction is not the peculiar feature of any one science, but the common property of all sciences. Consequently no one science is differentiated from any other by reason of the fact that it considers the whole and not the part. Science '<u>in communi</u>' treats of things that are necessary, i.e things that cannot be otherwise than they are, seeking out their causes and their per se properties. Now, essences are necessary, but the individual who possesses the essence, is not necessary. He can be otherwise, since he can be and can not be. Nor does his singularity pertain per se to his essence, for the individual is not such by reason of the essence but by reason of matter signed by quantity. (411) Hence all sciences, since their

411. "Hæc natura speciei individuatur per materiam: unde principia "individuantia et accidentia individui sunt præter essentiam "speciei." III De Anima, lect. 8, n. 706.

object is the necessary, abstract from the individual and consider only the universal essence. (412) But the universal essence is the fruit of total abstraction which separates the nature from the individuals possessing that nature. Therefore total abstraction is common to all science.

(II) Why there are only two species ?

Having shown the similarity and the differences between formal and total abstraction, we now turn to the question of why there are only these two species of abstraction. St Thomas unhesitatingly refuses to countenance any additional species. He says : "there are not found abstractions opposed to these, by which a part is abstracted from the whole, or matter from form." (413) His reasons are compelling. Let us first examine first why he insists that there is no abstraction of part from whole.

There are, as we have said, two types of parts, the 'partes materiae', which do not pertain to the constitution of the 'ratio' of the whole but are subsequent to it, and the 'partes' 'spe-

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412. "Tertia secundum compositionem universalis a particulari: et "haec competit etiam physicae, et est communis omnibus sci- "entiis: quia in omni scientia praetermittitur quod est per "accidens, et accipitur quod est per se." De Trinitate, Q.5, Art. 3, c. (circa finem)

413. "Non autem inveniuntur abstractiones eis oppositae, quibus "pars abstrahitur a toto, vel materia a forma: " ibid.

ciei', which are constituents of the whole. If we consider the 'partes materiae', e.g. the finger, or the hand of man, there can be no abstraction of such parts from the whole. The reason is because such parts depend on the whole for their definition, hence without the whole they are undefinable. The finger is a man's finger and without this order to man it is not a finger. (414) Nor can the 'partes speciei' be abstracted from the whole. The reason for this, however, is not the same as in the previous case. The 'partes speciei', since they constitute the 'ratio' of the whole, are prior to the whole and do not depend upon it in definition. For instance, the line which enters into the constitution of the triangle in so far as a triangle is a figure bounded by three lines, is not defined through triangle but rather defines triangle. Now, because they are prior to the whole, the 'partes speciei' can be understood apart from the totum. But this solitary consideration of the part aside from the whole, is not abstraction but separation. Abstraction is proper only in cases where the things are joined 'secundum rem', while separation pertains to instances where things are not joined together 'secundum rem'.(415) But the line and the class of 'partes speciei', of which the line is

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414. "Digitus autem non potest esse sine homine, quia digitus ab-
"scisus non est digitus," VII Meta., lect. 9, n. 1466.

415. See p. 242-243.

an example, can be without the whole whose constituent it is. (416) For not every line is necessarily part of a triangle since 'secundum rem', it can be separated from the triangle. This consideration of the line without the triangle is not abstraction but separation, for in things that are able to be divided, the distinction of one from the other is separation, since there is no union between the two. (417) Abstraction, however, presupposes and demands a union. Therefore while there is a separation of a certain type of parts from the whole, there is no abstraction.

Nor is it possible to have a species of abstraction by which matter is abstracted from form. One cannot speak of matter being abstracted from either substantial form or from accidental form. Certainly not from substantial form, for prime matter has an essential dependence on substantial form, since it can only be defined through that form which is its proper act. (418) With regard to matter and the accidental form we must distinguish between sensible matter and

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416. "vel potest etiam sine toto esse, si sit de partibus speciei, "sicut linea sine triangulo, vel littera sine syllaba, vel "elementum sine mixto." De Trinitate, Q. 5, Art. 3. (Circa finem)

417. "In his autem quae secundum esse possunt esse divisa, magis "habet locum separatio quam abstractio." ibid.

418. "Similiter autem cum dicimus formam abstrahi a materia, non "intelligitur de forma substantiali, quia forma substantialis "et materia correspondens dependent ab invicem, ut unum sine "alio non potest intelligi, eo quod proprius actus in propria "materia fit." ibid.

such forms as quantity or figure, and between prime matter and those same forms.

Sensible Matter and Quantity or figure

With regard to sensible matter there can be no abstraction of that matter from either quantity or figure, which is a species of quality and is defined as a mode resulting from the termination of quantity. (419) This mode can be either intrinsic, i.e. it is the mode of the quantity considered in itself, as the figure of the hand, or it can be extrinsic and in this case it is the result of the position in which the quantity is found. (420) For example, the figure of the clenched fist or the extended hand is not the result of the hand as hand, but of a position assumed by the hand. This extrinsic figure is called "figura situalis". The reason given by St Thomas why sensible matter cannot abstract from either quantity or figure, is because the sensible qualities by which matter becomes sensible, cannot be understood unless quantity (and figure, though St Thomas does

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419. J. a S. Thoma, Curs. Phil., T. I, (II Pars Logicae), Q. XVIII, Art. 3, p. 620a39-43: "Figura sumitur dupliciter: - -"Secundo pro modo resultante ex terminatione quantitatis."

420. Ibid, a43-48: ""et haec vel potest esse intrinseca, sicut fi-"gura manus in se, et sic est qualitas; vel extrinseca et si-"tualis. Sicut eadem manus complicata vel dilatata diversam "figuram situalem exhibet."

not explicitly state this) be first understood. (421) The explanation of this is to be found in the manner in which the sensible qualities move the sense. The sensible qualities move the sense "corporaliter et situaliter" (422) in so far as the greatness or smallness of the sensible object and its closeness or distance from the sense affect the mode of action of the sensible object. (423) Now, quantity and figure are intimately bound up with both the "corporaliter et situaliter" whereby the sensible quality moves the sense. Quantity is indispensable to the "corporaliter", since a body is great or small by reason of quantity. Figure, i.e. taken in the extrinsic sense, cannot be separated from the "situaliter", since a magnitude is near or far from the

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421. "sed intelligitur de forma accidentali, quae est quantitas et "figura, a qua quidem materia sensibilis per intellectum non "potest abstrahi, cum qualitates sensibiles non possunt in- "telligi, non praeintellecta quantitate, sicut patet in super- "ficie et colore: " De Trinitate, Q. 5, Art. 5, c. (circa finem)

422. "Qualitates enim sensibiles movent sensum corporaliter et "situaliter." II De Anima, lect. 13, n. 394. (St Thomas)

423. "Quaedam vero alia faciunt differentiam in transmutatione "sensuum, non quantum ad speciem agentis, sed quantum ad "modum actionis. Qualitates enim sensibiles movent sensum "corporaliter et situaliter. Unde aliter movent secundum "quod sunt in majori vel minori corpore, et secundum quod "sunt in diverso situ, scilicet vel propinquo vel remoto, "vel eodem vel diverso. Et hoc modo faciunt circa immuta- "tionem sensuum differentiam sensibilia communia." ibid.

sense by reason of its position, which position gives rise to the "figura situalis". Therefore, since the sensible qualities do depend on quantity and figure, sensible matter cannot be understood without them and cannot, consequently, be abstracted from them.

But there is an objection against this connection between sensible matter and quantity or figure. Cajetan in his De Ente et Essentia says : "and, conversely, the sensible matter of the line has in a complete manner its own definition, not including anything of the line in so far as it is a line." (424) If the sensible matter of the line is capable of being defined without reference to the line, which is quantity, then there does not exist an intimate and necessary connection between them. In response to this statement of Cajetan's we must distinguish. The sensible matter of the line has its own definition independent of the line in so far as line is here taken as a certain species of quantity, namely a magnitude of one dimension, I concede. The sensible matter of the line is independent of the line in its definition, when the line is taken in the sense, not of a species of quantity, but of quantity itself, I deny. The conclusion is distinguished in the same manner. The explanation is that the sensible qualities do not depend, "quantum ad transmutationem sensuum",

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424. Cajetan, Prooemium, q. 1, n. 5, ("Prima differentia"), p. 6: "et e converso, materia sensibilis linese habet complete "suam definitionem non includentem aliquid linese, in eo "quod linea:"

on only one species of quantity such as a line, for there are also sensible surfaces and sensible bodies as well as sensible lines. What these qualities do depend on, as we have shown, is quantity, in so far as quantity, because it is the order of the parts of a substance, extends the object. This function does not pertain to quantity in so far as it is exclusively a line, or surface or body. In other words sensible matter depends on quantity by reason of its generic character and not by reason of those specific differences which constitute the species of quantity. This is the explanation of why Cajetan declares sensible matter to be independent of the line, adding the qualifying phrase, "in so far as it is a line".

Prime Matter and Quantity or Figure

Can prime matter be abstracted from quantity or from figure ? St Thomas' answer is that prime matter can be separated from quantity or from figure, but not abstracted. The reason he gives is that "the substance which is matter, can be intelligible without quantity; whence to consider substance without quantity pertains more to the genus of separation than abstraction." (425) At first glance

425. "Substantia autem quae est materia, intelligibilis esse "potest sine quantitate: unde considerare substantiam sine "quantitate, magis pertinet ad genus separationis quam "abstractionis." De Trinitate, Q. 5, Art. 3 (circa finem)

this seems hardly adequate. If matter's capacity to be understood without quantity is the reason why such a consideration pertains to separation and not to abstraction, why cannot the same be said of the consideration, say, of quantity without sensible matter ? Like prime matter relative to quantity, quantity is intelligible without sensible matter. Why, then, should not this be called separation rather than abstraction ? (426) The resolution of this difficulty is to be found in the different reasons why, on one hand, prime matter is intelligible without quantity and hence without figure, and, on the other hand, why quantity is intelligible without sensible matter. Quantity is intelligible without sensible matter not because it is separated '<u>secundum rem</u>' from sensible matter (quantity is a form in sensible matter, to which it has the relation of form to matter), but because quantity does not depend on sensible matter in its definition. Hence the separation of the two is not a separation strictly and formally taken, but abstraction, which properly functions among things that are joined together '<u>secundum rem</u>'. Prime matter, however, is intelligible without quantity because, considered in itself, it is separated '<u>secundum rem</u>' from quantity. Quantity is not a passion '<u>secundum rem</u>' of prime matter, for prime matter is '<u>ens in potentia</u>' and cannot be the source from which an act emanates, even though that act be an accidental

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426. "Et de his abstractis est mathematica, quae considerat quantitates, et ea quae quantitates consequuntur, ut figuram et huiusmodi." ibid, (circa finem)

one, such as quantity. Quantity is, however, a passion of the 'corpus', which is a composite of prime matter and form. Therefore, when one considers prime matter by itself, he is dealing with a thing that, 'secundum suam entitatem', is not joined to quantity. But separation is the proper designation for the distinction of things which are not connected 'secundum rem'. Therefore, there is no abstraction of prime matter from quantity or from figure, though there is a separation.

(c) Mathematical abstraction and its justification.

The abstraction that is proper to mathematics as a distinct theoretical science, is formal abstraction in the 2nd degree, whereby the form of quantity is abstracted from sensible matter, for, as Aristotle tells us, the mathematician does not consider lines and points, surfaces and volumes as limits of sensible bodies. (427) In other words, he does not treat the physical body as physical, but as pertaining to the genus of quantity. (428) Can he do this ? We have already shown that it is possible for the mind, under certain conditions, to consider one thing and not consider the others which are joined to that one 'secundum rem'. It remains for us to see whether the mathema-

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427. II Physics, c ii, 193b31-32.

428. "Non enim mathematicus considerat corpus quod est in genere "substantiae, prout pars eius est materia; sed secundum quod "est in genere quantitatis tribus dimensionibus perfectum;" De Trinitate, Q. 5, art. 3, ad 2um.

tician's abstraction of quantity from sensible matter fulfills the necessary condition, namely that it is independent of the thing, secundum definitionem, from which it is abstracted.

There is a certain order in which accidents come to the substance. (429) This order, which implies a priority and a posteriority, as does all order, is based on the fact that certain accidents pertain more immediately to the subject than others by reason of the closer conformity which these have to the 'ratio' of the subject. Hence they function, these accidents which are prior, either as a disposition for other accidents or as the reason why others pertain to the subject. (430) E.G. Man's intellect is the reason which explains the presence of the will. (431) With regard to the corporeal substance the first accident is quantity. (432) This is the first because it is the property or passion which is in closest conformity with the

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429. "Sed accidentia adveniunt substantiae quodam ordine." Ibid, Q. 5, Art. 3, c. (circa medium)

430. J. a S. Thoma, Curs. Phil., T. II, (Pars III, Phil. Nat.), Q. IX, Art. 1, p. 759a43-48: "quatenus inter ipsa accidentia est "ordo, ita quod omnia non aeque immediate conveniunt substantiae, "sed unum est dispositio ad aliud, vel ratio, quare unum conve- "niat subjecto."

431. Ibid, a48-b4: "sicut propriae passiones, quae inter se habent "ordinem, una est ratio, quare altera dimanet, sicut voluntas "rationis intellectus."

432. "Ad decimumoctavum dicendum, quod quodlibet esse generis vel "speciei consequuntur propria accidentia illius generis vel "speciei; unde quando iam materia intelligitur perfecta se- "cundum rationem huius generis quod est corpus, possunt in ea "intelligi dimensiones, quae sunt propria accidentia huius ge- "neris;" St Thomas, De Spiritualibus Creaturis, Q.Unica,Art.3, ad 18um.

'ratio' of such a subject. (433) Because it is corporeal, this substance is ordained to be extended. Of itself, however, the corporeal substance is not extended. For extension, which is the result of the union of parts joined together by their extremities, (434) demands parts with extremities, and the material substance, considered in itself, lacks parts with extremities. (435) It is quantity which gives such parts to the substance and thus makes it to be extended. This quantity does not do by being the cause of the parts of the substance "quoad entitatem", for entitatively the parts are substantial. It does it by taking away the confusion of parts present in the substance

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433. "Nam primo advenit ei quantitas," De Trinitate, Q. 5, Art. 3 (circa medium)

434. J. a S. Thoma, Curs. Phil., T. I (IIa Pars Logicae), Q. XVI, Art. 1, p. 545b5-16: "Et probatur, quia extensio partium in "toto non est quacumque unio earum inter se, sed unio penes "extremitates tantum, ita quod non uniatur una pars alteri "se tota, ita ut in illa penetretur et imbibatur, sicut unio "formae cum materia, quae pure substantialis est. Nam si una "pars unitur cum alia in ipso toto penetrative et secundum "omnem sui partem, non unitur extensive, hoc est una extra "aliam."

435. Ibid, b29-37: "Hoc enim ex vi ipsius substantiae provenire "non potest, cum substantia ex se non habeat partes cum ex- "tremitatibus, quia extremitates non habentur nisi per in- "divisibilia, substantia autem indivisibilia non habet ex se, "v.g. lineam, superficiem, et puncta, quia haec sunt species "propriae quantitatis."

anterior to quantity, because it is order of parts according to prior and posterior. (436) Prior to quantity, the substance has parts that are not formally but only radically extended. That is, the substance has parts which are united together according to their totality, so that they penetrate one another. These parts, however, have the capacity to be so ordered, one outside the other, that they would become formally extended. (437) Quantity formally extends these parts because, through the indivisibles which are proper to quantity as its species, namely the point, the line and the surface, it permits a union of parts of the substance only according to extremities. Thus it prevents a penetration or a union of parts according to totality. Through the union of parts according to extremities one part is outside the other, touching that other in its indivisible or extremity. Hence the body is extended. Since quantity is the accident by which the parts of the substance are formally extended, it is the accident that most immediately agrees with the corporeal substance. After

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436. Ibid, p. 545b46-544a5: "Quod ergo asserimus, est, quod quan-
"titatis formaliter, ut quantitas, non constituit partes sub-
"stantiae quantum ad earum entitatem et intrinsecam rationem,
"sed quantum ad ordinationem, quae tollit confusionem."

437. Ibid, p. 547a33-39: "habet tamen partes radicaliter, id est
"capacitatem ad recipiendum illam ordinationem et distinc-
"tionem partium quae sine quantitate manent penetratae et se
"totis unitae, quod est non habere partes extra partes."

quantity come the sensible qualities, actions and passions, and motion. (438) All these depend on quantity, not as a principle sustaining them, but as the medium through which they agree with the corporeal substance. (439) We have already shown how sensible qualities depend on quantity, when we discussed the question of whether sensible matter could be abstracted from quantity. (440) Regarding action, passion and motion we see that all these depend on quantity in so far as they require sensible qualities, for it is sensible qualities that make these three accidents sensible. They can also be said to depend on quantity because in the material substance action, passion and motion take place through contact (441) and contact, i.e. body touching body,

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438. "Similiter autem inter accidentia omnia quae adveniunt sub-
"stantiae, primo advenit ei quantitas, et deinde qualitates
"sensibiles et actiones et passiones, et motus consequentes
"sensibiles qualitates." St Thomas, II Phys., lect.3,n.5 (par.3)

439. J. a S. Thoma, Curs. Phil., T. II (III Pars), Q. IX, Art. 1,
p. 759 a35-48: "respondetur, quod quantitas non est principium
"tamquam radix ad recipiendum accidentia, et ita proprie non
"est principium quo recipiendi, sed medium, quia videlicet
"quantitas non est principium subsstandi, quod pertinet ad ra-
"tionem subjecti inhaesionis, sed dicitur esse medium recipi-
"endi, quatenus inter ipsa accidentia est ordo, ita quod omnia
"non aeque immediate conveniunt substantiae, sed unum est dis-
"positio ad aliud, vel ratio, quare unum conveniat subjecto."

440. see p. 366+sq

441. "Non accidit ei ex hoc quod movet, sed ex hoc quod movet tan-
"gendo: quia movere est agere ad hoc quod aliquid moveatur;
"id autem quod sic a movente patitur, movetur. Sed hoc quod
"est agere facit tactu; nam corpora tangendo agunt:" St Thomas,
III Physicorum, lect. 4, n. 5.

is through quantity.

Since quantity is the first of the accidents that come to the material substance, it is related to all the rest as prior to posterior. Now the posterior does not pertain to the understanding of that which is prior, for if a thing is before another, it can be understood without that other. (442) Therefore quantity does not depend upon any of the subsequent accidents 'secundum intellectum', since, being posterior to quantity, they do not enter into the constitution of its nature. Concretely, quantity can be abstracted from sensible qualities, actions and passions, and motion and therefore the mathematician is justified in his consideration of quantity without sensible matter and motion.

It should be noted that the quantity of the mathematician is an abstract quantity, that is, a quantity which is not sensible but intelligible. (443) This is important, for Mansion, apparently confusing physical and mathematical quantity, insists that the latter is also sensible. (444) He claims that Aristotle, in refusing to denominate

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442. "Manifestum autem est quod posteriora non sunt de intellectu "priorum, sed e converso: unde priora possunt intelligi sine "posterioribus, et non e converso." St Thomas, II Phys., lect. 5, n. 5.

443. "Intelligibilis vero materia est, quae est in sensibilibus, "non inquantum sunt sensibilia, sicut mathematica sunt. Sicut "enim forma hominis est in tali materia, quae est corpus car- "neum, ita forma circuli vel trianguli est in hac materia, "quae est continuum vel superficies vel corpus." St Thomas, VII Meta., lect. 10, n. 1496.

444. Op. cit., Chpt. 5, Section 3, pp. 166-170.

the quantity of the mathematician as sensible, while according this denomination to the objects of physics, is guilty of an abuse of words. (445) Here the word 'sensible', as used by Aristotle, is restricted in its signification to 'sensibile proprium', whereas the word also means 'sensibile commune', of which quantity is a type.

This position of Mansion arises, as we have said, from a confusion between the quantity that is physical and the quantity that is mathematical. Quantity 'secundum rem' is a 'per se sensibile', not proper but common. It is a 'per se sensibile' because quantity does effect a difference in the alteration of the sense, (446) in so far as it supplies the condition with which the sensible object must be clothed in order to be perceived. (447) The external sense perceives

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445. Ibid, p. 169: "Dès lors leur refuser la qualification de "sen-"sible", quand on les universalisant on les prend comme des "déterminations mathématiques, et prétendre par là distinguer "celles-ci des objets physiques, qui, eux, auraient nécessaire-"ment des attaches avec le sensible, entendez avec les sensi-"bles propres, - c'est manifestement faire un abus de mots."

446. "Quidquid igitur facit differentiam in ipsa passione vel al-"teratione sensus, habet per se habitudinem ad sensum, et dici-"tur sensibile per se." St Thomas, II De Anima, lect. 13, n. 393.

447. J a S. Thoma, Curs. Phil., T. III, Q. IV, Art. 2, p . 112a43-b6: "Ratio primae partis est quia sensibile commune ita pertinet "ad plures sensus, quod tamen conducit ut res aliqua sentiri "possit, ita quod sine illo non possit sentiri, aut nisi per "illud modificetur, ut tali modo sentiatur, sicut v.g. sine "quantitate seu magnitudine non potest res aliqua sensibili et "corporeo modo videri."

things that are extended. Were there no extension in the object, there would be no perception by the sense. (448) This influence, however, of quantity on the alteration of the sense is not specificative or distinctive of the sense, but only modifying. It modifies the action of the proper sensibles, but does not constitute a distinct sense. The reason for this is that quantity is not a proper sensible, which is one that can be perceived 'per se' by one sense, (449) but a common sensible, that is, one which is perceptible by more than one sense. While color can only be seen, sound only heard, sweet and bitter tasted, odors smelled, smoothness or roughness, lightness or heaviness felt, the magnitude can be seen, heard, and felt.

Though it is a 'per se sensibile', quantity is not the immediate object of the external sense. It is merely a modification of the proper sensible so that this latter can exercise its alterating influence on the sense. It is not the immediate object because it is impossible that a potency be moved by a thing except under that

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448. Ibid, p. 113a25-36: "Et tamen ex aliqua parte conducunt per se "et necessario ad hoc, ut propria et specificativa objecta, in "exercitio moveant sensus, sicut dictum est, quia praebent "aliquas conditiones vel modificationes, sine quibus non potest "corporaliter et sensibili modo ista transmutatio exerceri, "quia sine quantitate, figura, motu, vel quiete non inveniuntur "corporales et sensibiles transmutationes."

449. "Et dicit quod sensibile proprium est quod ita sentitur uno "sensu, quod non potest alio sensu sentiri, et circa quod non "potest errare sensus: "St Thomas, II De Anima, lect.13,n.384.

formality which is distinctive of the potency. (450) That which formally specifies and distinguishes the sense is the proper sensible, since it is this sensible that is exclusively proper to one sense and not to any other. Hence the modification of the proper sensible which is quantity, is a mediate object of sensation. It moves the potency, not by its own formality, but by being clothed with the formality of the proper sensible. (451) The magnitude is visible, not because it is a magnitude but because it is colored. Likewise it is the object of touch because of its smoothness or roughness, heaviness or lightness, all of which are proper to the tangible. (452) Therefore as an object of sensation, the common sensible depends on the proper sensibles. (453) When, then, one abstracts from the sensible qualities,

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450. J. a S. Thoma, Curs. Phil., T. III, p. 113b24-30: "Ex quo sumitur fundamentum conclusionis, quia impossibile est moveri "aliquam potentiam ab aliquo nisi ratione proprii specificativi "vi talis potentiae, siquidem impossibile est, quod specificatum transeat limites et adaequationem sui specificativi."

451. Ibid, b41-45: "Ergo ut sensibile commune moveat specificative "aliquem sensum oportet, quod non moveat ratione sui, sed ratione sensibilis proprii et induendo rationem formalem illius;"

452. "Et ideo sensibilia communia non movent sensum primo et per "se, sed ratione sensibilis qualitatis, ut superficies ratione "coloris." Summa Theo., Ia Pars, Q. 78, Art. 3, ad 2um.

453. J. a S. Thoma, Curs. Phil., T. III, Q. IV, Art. 2, p. 114a10-18: "Itaque sicut modificatio seu modus non potest poni seorsum a "re, cuius est modus, ita sensibile commune, quod modificat prius, non potest seorsum a sensibili proprio, cuius est modus, "representari, praesertim cum ex istis modificationibus dependeat singularitas sensibilis proprii."

which are the proper sensibles, quantity is no longer perceptible by sense, but only by the intellect. Hence it is no longer sensible, but intelligible. But such quantity is not quantity 'secundum rem', but quantity 'secundum intellectum'. This is the quantity of the mathematician. His consideration does not fall on physical quantity which is per se sensible, but on abstract quantity, quantity separated from sensibility because it has been separated from sensible matter.

(2) Abstrahentium non est mendacium :

If it is proper for the mathematician to abstract quantity from sensible matter and movement, does this not result in a non-conformity between things as they are and the mathematical concept of them ? In reality all lines, points, surfaces, volumes are sensible things, i.e. they have sensible matter, and furthermore, are subject to movement. Aristotle himself admits this for he denies that the mathematical qua mathematical exists. (454) Therefore mathematics is false, since it does not conform to things as they are.

In considering this difficulty St Thomas answers by saying that the mathematician does not treat his objects other than

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454. Meta., (B), c ii, 998a7-15; Meta., (M), c ii, 1076b13; see p. 207

they are. (455) At first glance this statement appears to be quite contrary to what is an admitted fact. All lines, etc., are sensible lines. To understand St Thomas' response we must first call to mind that the mathematician abstracts quantity, but does not separate it. This is of tremendous importance, for abstraction involves neither the affirmation nor the negation of a connection, while separation involves a definite negation of any connection. (456) Now, in abstracting quantity the mathematician does not say that it is separated from sensible matter and movement, for this is patently false. Abstraction, since it pertains to the first act of the mind, does not involve a judgement, but only the understanding of the essence. What the mathematician does by abstracting is to consider one thing and not another. He considers quantity without considering sensible matter or motion, neither as to what they are nor as to whether they are connected with quantity. This is possible because quantity, 'secundum rem', is prior to the other two and hence is intelligible without them. Therefore, in treating quantity without sensible matter or motion, the mathematician is not according the object a consideration which is not proper to it by reason of its objective independence, quantum ad suam definitionem, from both sensible matter and motion. It is, however, an

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455. "Ad primum igitur dicendum quod mathematicus abstrahens non "considerat aliter quam sit." St Thomas, De Trinitate, Q. 5, Art. 3, ad lum.

456. see p.

incomplete treatment because quantity is actually joined, 'secundum rem', to both these. An incomplete treatment is not a false one, unless it be put forth as complete. Abstraction, than, is no lie.

iii) A Platonic error.

"The holders of the theory of Forms do the same, though they are not "aware of it; for they separate the objects of physics, which are "less separable than those of mathematics. (1235b35-36)

In connection with the mathematician and abstraction Aristotle observes that the Platonists likewise make use of abstraction, though they were not aware of doing this. Unlike the mathematician, however, the Platonist were guilty of a grave error in their use of abstraction. Before pointing out the error, we should first explain how it happened that the Platonists abstracted without being aware of it.

The Platonists' use of abstraction is fairly easy to establish. The forms of physical things, which are the objects of their consideration, are, de facto, forms which have their 'esse' in matter and they can, then, only be separated from matter by abstraction, since abstraction is the operation by which the intellect separates things that are connected together in reality. Their failure to recognise that they were using abstraction has its foundation in an inability to understand how the intellect can separate

things that are joined together 'secundum rem'. (457) To them the only possible foundation for a separate consideration of objects was the actual separation of the same objects 'secundum rem'. For example. It was possible for the Platonist to treat "Homo universalis" without any reference whatever to "homo individualis", because "homo universalis" was a thing that existed apart from the individual man. In a word, according to their theory the Platonists did not recognize such a thing as abstraction, which presupposes a union of things 'secundum esse', but only separation, which is a denial of any union 'secundum esse'. But 'de facto' the objects considered by the Platonists were the result of abstraction since they were joined with others 'secundum esse'. This, then, is the explanation of Aristotle's charge that the proponents of the theory of Forms abstracted their objects from matter but were unaware of doing it.

The theoretical error of the Platonists is serious, to be sure. However, the objects which are abstracted, lead to an even more serious error. In the Platonists' consideration physical objects become abstract after the fashion of the mathematical objects. Because the individual is not an object of science, and further, because not,

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457. "Quia enim latebat eum quomodo intellectus vere posset ab-
"strahere ea quae non sunt abstracta secundum esse, posuit
"omnia quae sunt abstracta secundum intellectum, esse ab-
"stracta secundum rem." St Thomas, II Phys., lect. 3, n. 6.

not potency, is intelligible, they abstracted the forms of physical things not only from individual sensible matter, but also from common sensible matter. Just as the quantity of the mathematician is an abstract quantity, so too the forms of the Platonists are abstract forms. This, however, is a serious error, for physical forms are less capable of abstraction than quantity. Quantity can be abstracted from both individual and common sensible matter 'secundum intellectum', because it does not depend on sensible matter in its definition. Physical forms, though, are not independent of sensible matter 'in communi' even secundum intellectum, because they are essentially forms that are the act of matter. They depend, therefore, on matter for their definition and cannot, then, be abstracted from it without becoming unintelligible.

It is of supreme importance that we keep in mind Aristotle's insistence on this fact of physical forms being by essence the act of matter and therefore inseparable from it even secundum intellectum. It will serve as a precaution against a possible grave error with regard to the treatise on the human soul. Because it is capable of an existence apart from matter, one might be tempted to conceive the human soul after the manner of those substances that are, by essence, separated from matter. Such a concept of the soul can only result in the destruction of the whole of Aristotelian psychology and is especially ruinous of Aristotle's theory of knowledge. Both

those have, as their foundation, the doctrine that the soul is the form of a physical being and hence is a 'forma corporis', incapable of being abstracted from common sensible matter.

b) Certain arguments in confirmation of the distinction between the mathematician and the physicist.

i) Argument taken from diverse modes of defining.

"This becomes plain if one tries to state in each of the two cases "the definition of the things and their attributes. 'Odd' and 'even', "'straight' and 'curved', and likewise 'number', 'line', and 'figure', "do not involve motion; not so 'flesh' and 'bone' and 'man' - these "are defined like 'snub nose', not like 'curved'." (194a1-5)

The role of these and the subsequent lines (458) which concern the evidence to be garnered from the consideration of the branches of mathematics that are more physical than mathematical, is not explained in the same manner by such commentators as St Thomas, Ross and Hamelin. According to HAmelin lines 194a1-11 are formally directed against the Platonists. It is Hamelin's contention that the two proofs contained in the lines in question were introduced into the text by Aristotle in order to show that the proponents of the

458. II Physics, c ii, 194a6-11.

theory of Forms were wrong. (459) Ross partially agrees with this opinion, for he too thinks that lines 194a1-5 at least constitute a

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459. Aristote Physique II, Traduction et Commentaire, p. 65 : " (193b35) (194b12). Les "partisans des idées appliquent, sans qu'ils s'en aperçoi- "vent, le même procédé aux choses physiques qu'aux choses "mathématiques: Ils les séparent de leurs sujets comme "des nombres et des figures. Or les choses physiques sont "inséparables de leurs sujets, ainsi qu'on s'en rendra "compte par deux considérations. D'abord, tandis qu'on peut "définir les attributs des choses mathématiques (" 194a3), impair, pair, droit, courbe ou ces cho- "ses elles-mêmes (ib.) nombre, ligne, figure, sans fai- "re entrer dans la définition le concept de leurs sujets "(on définira par le cercle une figure plane enveloppée par "une ligne unique, le nombre pair un nombre divisible par "deux, sans parler aucunement de la matière dans laquelle "le cercle est découpé ni des sujets nombrés par le nombre. "Cf. Philop., 224,15), la définition d'une chose physique "contient la matière de la chose. Le courbe se définit en "lui-même; mais la chose physique est comme le camus qui "suppose immédiatement un nez, puisque le camus est une con- "cavité dans un nez. 'Si je veux définir la chair, je dirai, "par exemple, que c'est un corps chaud et humide, sanguino- "lent, mou, ayant telles fonctions, et en parlant ainsi j'in- "dique immédiatement la matière qui lui sert de sujet.' "(Philop., 224, 28; cf. Bs., Ind., 672b9 et 25). En second "lieu, si, partant des mathematiques pures, on veut passer "aux sciences mathématiques de la nature, astronomie, optique, "acoustique, on s'apercevra qu'il faut ajouter aux notions "géométriques celle d'un sujet matériel dans lequel sont ve- "nues se réaliser ces notions. Pour aller du physique au "mathématique on fait abstraction de la matière; inversement, "pour revenir du mathématique au physique on rend concrète "la donnée géométrique par l'addition d'un sujet matériel."

proof against the Platonic position. (460) But he parts company with Hamelin with regard to the function of 194a6-11. These lines, he insists, are primarily incorporated as a confirmation of the solution originally offered by Aristotle to the problem of how the mathematician and the physicist were distinguished. (461) According to St Thomas' view lines 194a1-11 serve one and the same purpose, to add confirmation to the distinction made by Aristotle in 193b31-33. (462) Of the three interpretations I believe that St Thomas' is the correct one. In the first place, the distinction between the mathematician and the physicist found in 193b31-33, where Aristotle showed that the former did not take into account sensible matter or movement, while the latter

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460. Op. cit., p. 507: "35-194a7. While "the abstraction of the mathematician is justified (Aristotle "says), that of the Platonists is not. The entities studied "by mathematics are inseparable in fact, but can be profit- "ably studied as if they were separable from physical bodies. "But among the Ideas are included Ideas of things like flesh, "bone, and man, in the very definition of which a reference to "physical bodies capable of movement is implied."

461. Ibid; "7-12. This, while it is brought for- "ward as a confirmation of Aristotle's view about the main "question, what is the difference between physics and mathe- "matics (193b22-3), serves also as an answer to the question "whether astronomy is part of physics."

462. "Deinde cum dicit: 'Fiet autem utique manifestum etc., manifes- "tat positam solutionem dupliciter: primo quidem per differen- "tiam definitionum quas assignat mathematicus et naturalis; "secundo per scientias medias, ibi: Demonstrant autem et quae "magis etc." II Phys., lect. 3, n. 7.

did, is a sufficient proof to establish the error of the Platonic procedure. The very fact that the naturalist must take into consideration sensible matter and movement because his object is the physical body, whereas the mathematician, because his interest is not the physical body, can abstract from both of these, adequately exposes the error of treating physical forms as separated from such matter and movement. In other words, the error of the theory of Forms is not introduced into the text of the Physics as something that must be proved, but rather as something already shown to be incorrect. It is nothing more than a parenthetical remark made in connection with a point that has been established. Secondly, if we were to grant, for the sake of argument, that the original distinction between the mathematician and the physicist (193b31-33) was not adequate to show the fallacy of the theory of Forms, we would have all the more reason for insisting that the proof from the mode of defining, as well as that from the comparison of pure and applied mathematics, were both inserted to establish that distinction. If, as Hamelin and Ross say, the error of the Platonists requires proof, this can only rise from the fact that the original distinction is not sufficiently evident. Now, Aristotle's principal intention in this part of the second chapter was not to show the mistake of the Platonists. Rather it was to bring out the formal distinction that differentiates mathematics and physics. If, then, we accept the hypothesis of the insufficiency of the argument in

193b31-33 to establish this formal distinction, would it not be more consonant with his purpose to see in the two subsequents proofs Aristotle's attempt to place his position beyond dispute ? The endeavor to expose an error, was at most a secondary matter.

What motivated Aristotle's selection of the argument from the mode of definition as a medium for verifying the distinction he had made ? The reason for the choice is not difficult to discover. It is simply that the mode of definition is ideally suited to the task at hand. There are two conditions that must be satisfied by any element which is cast in the role of medium of proof, whether it is to prove by way of establishing or merely confirming. Both are per se evident and need only be mentioned. The first condition is that the element which is to serve as the medium of proof must be a known quantity. The second is that it must be pertinent to the problem. If we measure the argument from the mode of definition by the yardstick furnished us in these two conditions, we will see how well suited it is to the task of functioning as a medium of proof.

That the definition is a known factor, is amply certified by the universal acceptance of its position in science. Every demonstration owes its certitude to definition. This is so, because the definition signifies the "quod quid est" of a thing (463) and is,

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463. "Sic igitur concludit quod illa quae dicta est, est una defi-"nitio definitionis, scilicet, quod definitio est ratio ipsius "quod quid est." St Thomas, II Post. Anal., lect. 8, n. 6.

therefore, the ultimate reason for all the attributes that belong 'per se' to the thing. (464) The fact of its pertinence to the problem of verification of the distinction between the mathematician and the physicist and the reason underlying this fact are clearly brought out in the Metaphysics and Posterior Analytics. In the former Aristotle acknowledges the fact by warning us that in the quest after the distinction between the theoretical sciences, it is useless to proceed unless one has taken cognizance of the mode of the being of the essence and of its definition. (465) Of great importance is the text from the Posterior Analytics, where Aristotle gives us the reason for the need of paying heed to the mode of defining. It is because "one science differs from another when their basic truths have neither a common source nor are derived those of one science from those of the other." (466) In other words the differences in definition, which is the basic truth of science, (467) formally diversify the sciences.

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464. "Videtur hic Aristoteles dicere quod definitio passionis sit "medium in demonstrationo. Sed considerandum est quod defi- "nitio passionis perfici non potest sine definitione subjec- "ti. Manifestum est enim quod principia, quae continet de- "finitio subjecti, sunt principia passionis. Non ergo de- "monstratio resolvet in primam causam, nisi accipiatur ut me- "dium definitio subjecti." ibid, lect. 1, n. 9.

465. "Now, we must not fail to notice the mode of the being of the "essence and of its definition, for, without this, inquiry is "but idle." Meta., (E) c 1, 1025b28-30.

466. I Posterior Analytics, c xxviii, 87a39-b1.

467. See note 464.

To understand why this is so, we should note that by differences in definition is not meant merely different definitions, but differences in the mode of defining. Different things naturally have different definitions but do not thereby necessarily belong to diverse sciences. For example, man, horse, sun and stone have definitions that are different and yet all four pertain to one science, Natural Philosophy. The reason why mere different definitions are not, of themselves, sufficient to diversify science, is because the differences they express, while distinctive of things in 'esse reali', may be mere material differences of those same things as constituted in 'esse scibili'. (468) This will be a bit clearer if we examine the case of man and horse. The two are essentially different as things, since their formal principles are diverse, viz., rationality and a specific type of irrationality. Despite this, however, both follow an identical pattern in so far as they are defined through matter and form. Man and horse meet on common ground, for the forms of both, though specifically distinct, are knowable only when joined to matter. Because of this community between them, the two belong to the same class or genus in the order of 'esse scibile', which order is formally

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468. "Et ideo quantumcumque sint aliqua diversa scibilia secundum suam naturam, dummodo per eadem principia sciantur, pertinent ad unam scientiam; quia non erunt diversa in quantum sunt scibilia. Sicut patet quod voces humanae multum differunt secundum suam naturam a sonis inanimatorum corporum, eadem est scientia musicae, quae de utrisque considerat." St Thomas, I Post. Anal. , lect. 41, n. 11.

constituted by immateriality (469) and in which is to be found the object of science. Hence their different definitions are simply material differences relative to the classification of man and horse as objects of science. But differences in the mode of defining are quite another matter. There are three modes of defining; with common sensible matter, with intelligible matter, totally without matter; and they are nothing other than the diverse degrees of immateriality.(470) Since science is diversified according to the diverse degrees of immateriality, the mode of defining, in so far as it indicates the immateriality of the defined, is the principle of specification of science. This fact, namely that the mode of definition is the principle whereby sciences are formally differentiated, reveals its supreme fitness as a medium to test Aristotle's position on the formal difference between the mathematician and the physicist being that the latter considers sensible matter, the former does not consider sensible matter.

To confirm his distinction between the mathematician and the physicist (471) Aristotle takes some fundamental mathematical

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469. J. a S. Thoma, Curs.Phil., T.I, (IIa Pars) Q. XXVII, Art. 1, p. 823a2-10: "Supponit enim D. Thomas pro fundamentali prin-"cipio, quod unaquaeque res in tantum intelligibilis in quantum "est a materia separabilis, eo quod intelligibile idem est quod "spirituale et immateriale, principium autem spiritualitatis est "denudatio a materia."

470. ibid a40-47: "siquidem radix intelligendi rem aliquam est immateri-"alitas, et diversimode intelligendi diversa immaterialitas, ergo "etiam diversimode intelligendi quidditatem, quod est definire. Et "sic diversus modus definiendi seu intelligendi quidditatem est di-"versa immaterialitas."

471 Relative to the principle of specification of science it should be noted that both abstractibility of things and diverse modes of defining are the principle of specification, though with a distinction. Abstractibility of things is the radical principle, the diverse modes of defining constitute the formal principle of

(Turn over)

entities and attributes and compares their mode of definition with the mode of defining used in connection with such physical beings as flesh, bone and man. How are number, line, figure defined ? and odd and even, straight and curved ? Number is plurality or multitude measurable by one. (472) Line and figure are magnitudes divisible according to one dimension for the line, according to two or three dimensions for the figure, depending whether the figure is a surface or a body. (473) Odd and even, attributes of numbers, are defined through divisibility by 2. Straight and curved, predicates of the line, are defined through it. A straight line is a line such that any part of it, however placed on any other part, will lie wholly in that part, if its extremities lie in that part. A curved line is a line no part of which is straight. In defining all these mathematical objects we discover the absence of sensible matter. No number, line, figure, no attribute of these is defined as bright or dull, light or heavy, hot or cold, soft or hard,

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471. (Continued) specification of science. The object of science is not merely the intelligible but the scibile, i.e. an object that is knowable only through inference from principles to conclusions. Therefore what specifies science formally as science is the immateriality which is found first in the principles and descends to illuminate the conclusions. Since the definition is the first principle, hence the diverse modes of definition are the formal principle of specification. Cfr. J. a S. Thomas, Curs.Theo., T.I, Disp. 2, art. 7, p. 373, par.2; p.380, par.16; Curs.Phil., T.I, p. 822a 22 et seq.

472. "Sciendum vero est, quod pluralitas sive multitudo absoluta quae "opponitur uni quod convertitur cum ente, est quasi genus numeri; "quia numerus nihil aliud est quam pluralitas et multitudo mensurabilis uno." S.Thomas,X Meta., lect. 8, n. 2090.

473. "Linea vero est quod est divisibile secundum unam dimensionem "tantum: superficies vero secundum duas. Corpus autem est om- "nibus modis divisibile secundum quantitatem, scilicet secundum "tres dimensiones." ibid, Meta., V, lect. 6, n. 874.

qualities by which matter becomes perceptible by sense. Of course there is a matter that is included in the mathematical definition, for the mathematical object is quantity, which being an accident, demands a subject. But the matter which is the subject is intelligible matter. When we turn, however, to physical objects, as flesh, bone, man, we find introduced the notion of sensible matter. Flesh is not defined as a surface but as a soft substance and bone is a hard substance. When we come to define man, we define him as a being composed of body and soul.

How does this argument contribute to the strengthening of Aristotle's position ? Since the definitions of the mathematician do not include sensible matter, we must necessarily conclude that in the pursuit of his objects the mathematician does not consider such matter. This conclusion is forced upon us. The mathematical definition is no way embraces in its scope the sensible order and since it is the instrument of demonstration in mathematics, it builds an effective barrier between the mathematician and the sensible. So long as he remains a mathematician, he must omit from his consideration the sensible, having no instrument at his disposal whereby he can include it in his field. By the same token it is clear that the physicist does consider sensible matter. The same necessity that precludes the admission of sensible matter into the domain of mathematics, demands its inclusion in the field of physics, the mode of defining.

All physical definitions contain this matter as one of the components of the defined. This confirms what Aristotle had already remarked as the distinction between the mathematician and the physicist, namely "How the mathematician, though he too treats of these things, nevertheless does not treat of them as the limits of a physical body; nor does he consider the attributes indicated as the attributes of such bodies." (474)

ii) Argument taken from the field of mathematical-physics.

"Similar evidence is supplied by the more physical of the branches of "mathematics, such as optics, harmonics and astronomy. These are in a "way the converse of geometry. While geometry investigates physical "lines but not qua physical, optics investigates mathematical lines, "but qua physical, not qua mathematical." (194a6-11)

The second argument which Aristotle invokes to substantiate his claim relative to the distinguishing feature between the mathematician and the physicist, does not approach the task with the directness of the first argument. Rather its approach is indirect in this sense that it proves the Stagirite's position through a comparison of the differences between mathematics and mathematical-physics or what St Thomas calls the "scientiae mediae", i.e. sciences which apply

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474. II Physics, c ii, 193b31-33.

abstract mathematical principles to sensible matter. (475) As we did in the case of the argument from the mode of definition, we shall first explain the aptness of mathematical-physics as an instrument of verification and then show how it supports Aristotle's contention.

(A) The aptness of mathematical-physics as an instrument of verification.

The aptness of mathematical-physics for purposes of verifying the distinction between mathematics and physics is based on its character of being a subalternated science. This becomes evident upon considering what subalternation is and what type of subalternation is proper to mathematical-physics.

(I) Subalternation, Its Nature.

A subalternated science is one which is subordinated to another science, depends upon it, applies the principles of the other science to its own subject. But subordination, dependence, application of the principles of another science do not express completely the nature of subalternation. To be sure, it includes these. Yet the fact of

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475. "Deinde cum dicit: Demonstrant autem etc., probat idem per "scientias quae sunt mediae inter mathematicam et naturalem. "Dicuntur autem scientiae mediae, quae accipiunt principia "abstracta a scientiis pure mathematicis, et applicant ad "materiam sensibilem." St Thomas, II Phys., lect. 3, n. 8.

subordination, of dependence, of application of extraneous principles does not, of itself, necessarily mean subalternation. Subalternation signifies a subordination, a dependence between formally distinct sciences, and an application of the principles of one science to the subject of another with regard to the manifestation of truth. Moreover the subordination, the dependence and the use of the principles of another science must be necessary for the manifestation of the truth of the subalternated science. That one science is superior, another inferior, that one depends upon another by applying on occasion the principles of that other science to prove a conclusion, this is not sufficient to constitute subalternation. What is demanded is that the subordinated science be dependent on the superior science in so far as it lacks self evident principles with which to manifest the truth of its conclusions and hence is forced to borrow the principles of the superior science in order to guarantee a scientific character to its conclusions. It is in this essential relation of dependence in the order of manifesting the truth of the principles of the subalternated

science that the true notion of subalternation consists in. (476)

(II) The Types of Subalternation.

John of St Thomas lists three types of subalternation, subalternation by reason of end, of principle, of subject. (477) Of the three those with regard to principles and subject are proper instances of subalternation. Subalternation by reason of end, which

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476. Joannes a S. Thoma, Curs. Theo., Ia Pars, Disp. II, Art. 6, p. 369, par. 4, (Edition Solesmes): "Et advertendum, quod non fa-"cit subalternationem simpliciter hoc quod est mutuari aliquod "principium ab aliis scientiis, ad procedendum ex illo tamquam "ex principio extraneo et mutuato. Ratio est, quia subalterna-"tio propria et simpliciter, requirit quod aliqua scientia ex "propriis principiis et intrinsecis non possit resolvere in "principia per se nota: sed pro evidentia suorum principiorum "necessario debeat recurrere ad aliquam aliam scientiam, quae "talem evidentiam faciat. Si autem utitur principiis aliarum "scientiarum tamquam extraneis et mutuatis et in illis solum "recurrit ad scientiam extraneam pro illorum evidentia: non "manet subalternata intrinsece; quia quantum ad propria et in-"trinseca principia non accipit evidentiam ab alia scientia, "sed solum quoad principia extranea. Et ex hoc judicanda est "subalternatio propria et intrinseca: scilicet an inveniatur "in principiis intrinsecis et propriis alicuius scientiae, an "solum in externis et mutuatis."

477. J. a S. Thoma, Curs. Phil., T. I, Q. XXVI, Art. 2, p. 795a39-41: "Quaedam enim subalternantur ratione finis, quaedam ratione "principiorum, quaedam ratione subjecti."

occurs in practical sciences and in the arts, is subalternation in a less perfect sense, because frequently this subalternation is not ordered to the manifestation of truth but to use, to command, to control.(478) For instance the military science is said to be subalternated by reason of end to the science of politics. Its subordination to political science is not for the purpose of manifesting the truth of its principles but to the end that it come under the direction of political science. But because there are instances where one science employs the principles of another science to manifest the truth of some conclusion, where the subject of a science is contained under the subject of another science and yet do not involve subalternation, it is necessary that we examine the requisites for true subalternation in respect to principles and to subject. (479)

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478. Ibid, p. 795b50-54; b57-62: "Ex his tribus modis subalternationis "primus est improprius, quia non semper ibi subalternatio pres- "bet manifestationem veritatis, sed solum ministerium et impe- "rium." - - - "aliud est autem subici secundum imperium, aliud "secundum subalternationem, quia subalternatio dicit dependen- "tiam in manifestatione veritatis."

479. On occasion metaphysical and logical principles are employed in other branches of philosophy, yet do not result in a subalternation of the branch of philosophy to metaphysics or logic. The reason is because the principles of metaphysics or logic are here being used as extrinsic proofs and are not invoked to make evident the principles of the science using them. Again 'ens animatum' comes under 'ens mobile', without, however, the science of ens animatum being subalternated to the science of ens mobile. The reason is because subalternation requires sciences that are in diverse 'genera scibilium' and this is not verified of ens mobile and ens animatum, which differ as genus and species, not as genus and genus.

Subalternation with respect to principles.

To have true subalternation of one science to another by reason of principles, the subalternated or inferior science must be lacking in self evident principles to which it must resolve its demonstrations, if it is to be a science in the aristotelian sense, and therefore is obliged to borrow the principles of the superior science. (480) The use, then, of principles of another science by a science which possesses self evident principles, does not result in a true subalternation of the borrowing science to that from which it borrows. For example, if the science of nature should employ metaphysical or logical principles to manifest some truth, it is not by that borrowing subalternated to metaphysics or logic, though in the instance in which it employs these principles, the manifestation of the truth of the conclusion does depend on the science whose principles are used. (481) This dependence in respect to the manifestation of the

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480. J. a S. Thoma, Curs. Phil., T. I, Q. XXVI, Art. 2, p. 795b45-796a3: "Secundus modus subalternationis proprius est; sed tunc "invenitur simpliciter, quando simpliciter una scientia non ha- "bet principia nisi manifestata ab alia scientia, ita quod ex se "non resolvat in principia per se nota, qua ratione Theologia "nostra subalternatur scientiae beatae, ut statim dicemus."

481. There is a certain dependence between metaphysics and the other branches of philosophy in so far as their principles come under the influence of metaphysical principles. This is by reason of the fact that metaphysics is the most universal and most basic of all sciences. The dependence, however, is not in the line of manifesting the truth of the principles of other sciences (these principles are per se evident) in an 'a priori' manner, but in a negative and 'a posteriori' manner, i.e. through the process of "reductio ad impossibile". In a word the other sciences look to metaphysics for the defense of their principles, not for the truth of the principles.

truth of some conclusion falls short of the essential requirement for true subalternation, the dependence on the principles of another science must not be occasional but constant. In such cases nothing more is involved than a substitution of the principles of one science for those of another and while this permits us to denominate the use of substitute principles a subalternation secundum quid, (482) it is not sufficient for true subalternation. True subalternation in respect to principles is not a matter of substitution (this presupposes the existence of a proper set of per se evident principles) but a real dependence caused by the total lack of self evident principles. The example of subalternation in respect to principles given by John of St Thomas will help bring out what we have just said. (483) The science of theology is subalternated to the science of the blessed, not because of subject, but by reason of principles. There is no distinction of subject between these two sciences but rather an identity, for both regard the same subject, though under diverse formal ratios, that is, theology regards God as virtually revealed, while the science of the blessed regards God clearly seen. (484) However there is a very definite dependence of

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482. J. a S. Thoma, Curs. Phil., T.I, Q. XXVI, Art. 2, p. 736a3-9: "Si autem aliqua scientia resolvat in principia per se nota, ta-"men aliquando accipiat aliquod principium ab aliqua scientia, vel "ad probandum simpliciter vel ad defendendum erit subalternatio "secundum quid."

483. Curs. Phil., T. I, p. 797a19-44; Curs. Theol. Ia Pars, Disp. 2, art. 5, p. 565-566, pars 5-11.

484. Curs.Phil.,ibid, a32-43: "Non tamen habet nostra Theologia omnes "conditiones requisitas ad subalternationem ex parte subjecti, "quia revera non habet aliud subjectum a scientia beata, et sic "ex parte subjecti non est subalternatio, sed identitas, et con-"sequenter non addit differentiam accidentalem ad subjectum sub-"alternantis, sed respicit idem subjectum sub diversa formali ra-"tione, id est ut virtualiter revelatum, scientia vero beata ut "clare visum."

theology on the science of the blessed in respect to principles. The science of theology does not resolve its demonstrations to principles that are self evident to the theologian. The principles of theology, which are accepted by the theologian on faith, have their intrinsic evidence in the science of the blessed. Hence it is in the science of the blessed that the principles of the science of theology find the manifestation of their truth. Consequently the science of theology, since it lacks self evident principles, is subalternated to the science of the blessed.

Subalternation with respect to subject.

Subalternation in respect to subject is called by John of St Thomas subalternation in the most perfect sense. (485) The reason for this denomination is because the science that is subalternated by reason of its subject, fulfills in the most perfect way the fundamental condition of all subalternation. Subalternation requires that there be a formal distinction between the sciences which have a relation of subalternated to subalternating. Now the science which is subalternated in respect to subject is not only formally

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485. J. a S. Thoma, ibid, p. 756a10-15: "Tertius modus tunc inducit "propriissimam subalternationem, quando subjectum inferioris "scientiae addit accidentalem differentiam ad subjectum "superioris, non essentialem vel propriam passionem."

distinct from the subalternating science by reason of formal object (this is the case of the science subalternated merely by reason of principles, as can be seen in the case of theology) but it is also formally distinct by reason of the formal subject. Hence subalternation by reason of subject makes for the greatest possible distinction between the science subalternated and the science subalternating, without, however, separating the two to the extent of not having any relation of dependence in the order of manifesting the truth.

St Thomas tells us in I Posterior Analytics, lesson 25, (486) that there are two ways in which the subject of one science comes under the subject of another science. The subject of one science comes under the subject of another when it is a species of the subject of the superior science. Vis. the science of animated being falls under the science of mobile being because its subject, animated being, is a species of the subject mobile being. Or the subject of one science comes under the subject of another, not as a species of the superior subject, but as material to formal. The first way is insufficient for subalternation with respect to subject, for there is lacking that formal distinction

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406. "Sed intelligendum est unam scientiam esse sub alia dupli-
"citer. Uno modo, quando subjectum unius scientiae est
"species subjecti superioris scientiae; sicut animal est
"species corporis naturalis, et ideo scientia de animalibus
"est sub scientia naturali. Alio modo, quando subjectum
"inferioris scientiae, non est species superioris scientiae;
"sed subjectum inferioris scientiae comparatur ad subjectum
"superioris, sicut materiale ad formale."

between the sciences dealing with both subjects which is required for subalternation. Since science proves its subject not only by definition but also by division, those subjects which are related as species and genus are not sufficiently distinct to constitute the basis of subalternation in respect to subject. Actually it pertains to the same science to consider the species of the genus with which it is concerned. (487) Therefore only when the subjects of the two sciences are related as material to formal can there be subalternation in respect to subject. This relation of material to formal between an inferior and a superior science is possible only on the following conditions.

Since in subalternation in respect to subject the subject of the inferior science is compared to that of the superior science as material to formal, it is necessary that subalternated science's subject add to and contract the subject of the superior science. (488) The difference which is added and which contracts the subject of the superior

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487. J. a S. Thoma, Curs. Phil., T. I, Q. XXVI, Art. 2, p. 796a20-27: "Species autem essentialis non reddit subjectum extraneum a sub-"jecto generico, nam eadem scientia, quae agit de aliquo genere, "agit de speciebus illius; explicat enim subjectum suum per "divisionem sicut per definitionem."

488. Ibid, a47-b5: "Ex quibus colliguntur conditiones, quae re-"quiruntur ad subalternationem scientiarum, quae reduci pos-"sunt ad tres: Prima, quod subjectum subalternatae contrahat "et superaddat ad subjectum subalternantis."

science, cannot be a property or passion of the subalternating science's subject but must be a difference that is accidental and extrinsic to that subject. (489) For example the addition of 'straight' and 'curved' to line contract that subject and results in two specific subjects "straight line" and "curved line". But these differences do not constitute a subject that is extrinsic to the subject 'line', for 'straight' and 'curved' are proper passions of the line. However the addition of 'visual' to line does result in subject that is extrinsic to the subject 'line', for the difference 'visual' is accidental and extraneous to line. Besides being extrinsic and accidental, the difference must also be the source of special properties. (490) Otherwise no benefit will accrue from the study of such a subject.

From a study of these conditions we can describe the subject of a subalternated science as a composed thing made up of the subject of the subalternating science plus an extrinsic accidental difference. The science which considers this type of subject is truly

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489. ibid, p. 796b3-6: "Secunda, quod superaddat differentiam accidentalem et quod reddat extraneam materiam subalternantis."

490. ibid, b7-15: "Tertia, quod addat differentiam accidentalem, "quae in tali materia sit principium specialium passionum "et veritatum scibilium, sicut aliquae passiones inveniuntur in linea visuali, quae non inveniuntur in linea calida "vel frigida, et ideo illa constituit distinctam scientiam "subalternatam, non ista."

a 'scientia media', for its formal subject is made up of elements which involve two different levels of intelligibility. Since its subject is made of a combination of the superior science and an addition of a difference that is accidental and extraneous, the subalternated science, besides being subalternated in respect to subject, is also subalternated in respect to principles. This necessarily follows upon the fact that its subject contains the subject of the superior science. In order to treat its own formal subject and prove its properties, the subalternated science must have recourse to the principles of the superior science.

The fact that the formal subject of a subalternated science is compounded of two elements, the subject of the superior science and an accidental and extraneous difference, brings up a difficulty which constitutes an admirable means for precising the true nature of the formal subject of the subalternated science.

The addition of an accidental and extraneous difference to the subject of another science results in a mere aggregate, an ens per accidens. But it is not possible to have a science of an ens per accidens, for such a science lacks a oneness of definition and hence a principle of demonstration. (491)

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491. Ibid, p. 797b2-15: "Et ad idem reducitur, quod alii dicunt, quod "subjectum subalternatae est unum per accidens in esse rei, sed "per se in esse scibili, quod est clare fateri de ente per acci- "dens posse dari scientiam. Sed hoc est contra ipsam rationem "entis per accidens, quia tale ens non constat ex unico genere "et differentia, et consequenter nec unica definitione. Defini- "tio autem, cum sit principium scientiae, ex unitate illius de- "pendet unitas scientiae, ut dicemus quaest. seq., de quo plura "diximus supra q. 5, et 7.

We must admit that the conjunction of the subject of a superior science and a difference that is accidental and extrinsic does not produce an ens per se, only an ens per accidens. This admission is necessary if we are to preserve the character of the subalternated science as a distinct science. Were the conjunction of the two composing elements to produce an ens per se, we would no longer have a relation of material to formal between the two sciences, but one of species to genus, which, as we have seen, is insufficient for subalternation. However, the admission in no way militates against the possibility of such a thing as a subalternated science. Though its formal subject is composed of elements such as we have described, the subalternated science does not have the aggregate as such for its formal subject. Furthermore, while the union of the two elements is per accidens, the two componants are per se related to each other. John of St Thomas clearly explains this in the following citation.

> "It is answered therefore that the subalternated science "does not have as a subject that aggregate, as it is an "ens per accidens, constituted of an accidental differ- "ence and the subject of a superior science, but regards "one of these per se, not however absolutely, but as "modified and connoted by the other. For example. "Perspective treats of the visual, in so far as it is "modified and connotes line. And thus it is not in- "convenient that some subject be per se scibile and be "the basis of necessary truths, though to be the "foundation of these it requires something accidental "connotatively and in oblique. For there are many "properties or proportions which do not agree with a "thing absolutely, but only when considered under some "condition or in some state, which, though accidental "to it, is necessarily required in order that such a

"property flow, just as rest does not follow upon a "stone taken absolutely, but in so far as it is in the "center. Thus certain properties or proportions follow "upon the visual or upon sounds, not absolutely, but "upon the visual as it is in the line, and upon sounds "as they are in number. And so they do not agree with "the aggregate per accidens, but with one per se as "connoting the other." (492)

Before quitting this discussion on subalternation of science in respect to subject, we should say a word about the 'ratio formalis sub qua' of this type of science. The fact that its formal subject participates, by reason of its components, in two different levels of intelligibility, raises the question of the abstraction proper to subalternated science. Does a subalternated science make

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492. ibid, p. 797b16-45: "Respondetur ergo scientiam subalternatam "non habere pro subjecto illud aggregatum, ut est ens per ac- "cidens, constitutum ex accidentali differentia et subjecto "superioris scientiae, sed respicit unum illorum per se, non "tamen absolute, sed ut modificatum et connotatum per aliud. "V.g. Perspectiva agit de visuali, quatenus modificatur et "connotat lineam. Et sic non est inconveniens, quod aliquod "subjectum sit scibile per se et fundet veritates necessari- "as, licet ad fundandum illas requirat tanquam de connotato "et in obliquo aliquid accidentale. Plures enim sunt propri- "etates vel proportiones, quae non conveniunt alicui rei ab- "soluto, sed supposito aliquo sta u vel conditione, sibi quidem "accidentali, sed per se requisita, ut talis proprietas dimanet, "sicut ad lapidem non sequitur quies absolute, sed prout in "centro. Sic aliquae proprietates vel proportiones sequuntur "ad visuale vel sonorum, non absolute, sed ad visuale ut est "in linea, et sonorum ut est in numero. Et ita non conveniunt "constituto et aggregato per accidens, sed uni per se cum con- "notatione alterius."

use of a twofold abstraction to harmonize with one and the other of its subject's components ? According to John of St Thomas (493), and this is necessary to safeguard the unity of the subalternated science, (494) the abstraction proper to subalternated sciences is not dual but one. If we examine the principles employed by the subalternated science, we discover that they are the conclusions of the subalternating science, (495) but with an important difference. The application of these principles to matter of a diverse level of intelligibility makes them less abstract than they are when viewed as conclusions of the superior science and hence they pertain to a diverse species in the order of

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493. Curs. Phil., T. I, Q. XXVII, Art. 1, p. 627a44-b11: "Quod vero "additur de Musica et aliis scientiis subalternis, respondetur "in illis non esse duplicem abstractionem, sed unicam, quatenus "principia superioris scientiae ex applicatione ad talem mate- "riam redduntur minus abstracta et consequenter pertinentia ad "diversam speciem in genere scibilis, et illa abstractio, quam "induunt in tali materia, unica est, et ideo tales scientiae "nec sunt pure mathematicae nec philosophicae, sed aliquid par- "ticipant de utrisque, unica tamen abstractione, sicut medium "unum existens dicitur participare ab extremis."

494. ibid, p. 622a22-28: "Generaliter loquendo unitas et distinctio "scientiarum in esse scibilis sumitur ex diversa immaterialita- "te et abstractione, prout primo invenitur in principiis seu "mediis demonstrandi et inde derivatur ad illuminandas diver- "so modo conclusiones."

495. J. a S. Thoma, Curs. Theol., Ia Pars, Disp. 2, Art. 2, p. 560b (par. 4): "praeterquam quod scientia subalternata non utitur "principiis aliarum scientiarum, sed conclusionibus: assumit "enim principia quae probantur a scientia superiori tamquam con- "clusiones, non autem principiis superioris scientiae utitur "resolvendo usque ad principia per se nota."

the knowable. They are less abstract than the purely mathematical principle, but more abstract than the purely physical principle. The abstraction, proper to such principles is a special intermediary abstraction which is identified with neither mathematical nor physical abstraction but participates in the nature of both.

II) Mathematical-Physics, A Science Subalternated to Mathematics in Respect to Subject.

The sciences of optics, harmonics, astronomy, which Aristotle claims supply evidence in support of his distinction between the mathematician and the physicist, are definitely "scientiae mediae" or mathematical-physical sciences. Their object is not purely mathematic nor purely physical, but is an intermediate between the objects of mathematics and physics. It shares in both objects without being exclusively identified with one or the other, in so far as physics furnishes its object's sensible material aspect, mathematics the formal non sensible aspect. (496) This object is a product of a composition by reason. Reason unites the object of mathematics to that of physics

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496. Eugène Babin, L'Intuition sensible selon Kant, Laval Theologique et Philosophique, 1945, Vol. I, No 1: "Il suit de là que "l'objet de la physique mathématique à ceci de tout à fait "particulier qu'il n'est, comme tel, ni exclusivement physique "ni exclusivement mathématique, mais constitue un objet inter- "médiaire entre l'objet de la physique et celui de la mathé- "matique. Il tient à la fois des deux sans être l'un ou l'au- "tre dans sa nature même d'objet. Tandis que la physique lui "fournit son aspect matériel sensible, la mathématique lui "fournit son aspect formel non sensible."

to form a composite whose unity is the effect of reason. (497) The basis for the unification of the object of mathematics and the object of physics, objects which pertain to specifically diverse orders of knowability, is the conformity which exists between mathematical and physical entities. Scientific investigation has shown that the conformity is not as rigid as was supposed by Aristotle. The quantitative determinations of physical bodies do not realise the perfection that pertains to mathematical quantity. Hence the application of mathematical principles to physical entities can only result in conclusions that are approximations of the truth of physical being. Yet, despite their dialectical character, mathematico-physical sciences contribute an addition to the sum total of our knowledge of natural things, for they permit the application of the freer and more rigorous elaboration allowed by mathematical quantity to physical being.

A close examination of the subject of mathematical-physics shows that this type of science is subalternated to mathematics in respect to subject. Though from a material consideration the subject of mathematical-physics is an aggregate of the mathematical and the physical, it is not so formally. In reality the formal subject of such a

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497. ibid., "En un mot, l'objet de la physique mathématique est un "certain composé accidentel dont chacun des deux éléments com- "posants, pris séparément, est le fruit d'une abstraction (phy- "sique pour l'élément matériel, mathématique pour l'élément "formel); mais en tant même que composé, il est le résultat "d'une composition postérieure de la raison, et son unité de "composé lui vient de la raison composante, et non de la raison "abstractive."

science is the physical element of the composite, i.e. of the combination of the objects of mathematics and physics. It differs, however, form the formal subject of physics in so far as its subject is the physical element as connoting the mathematical element by which it is modified and informed. Now one science is subalternated to another in respect to subject, when its subject is a contraction of the subject of the other, having a relation to that other of material to formal. The subject of mathematical-physics is a contraction of the subject of mathematics in so far it is a composite of the subject of mathematics plus a difference which is accidental and extraneous to that subject and is moreover, when joined to the subject of mathematics, a source of new properties. Therefore mathematical-physics is subalternated to the science of mathematics in respect to subject.

It would be well to offer here an explanation of a statement made by St Thomas in II Physics, lesson 3, anent the character of mathematical-physics. Though mathematico-physical sciences are subalternated to mathematics in respect to subject and consequently in respect to principles (498) and on St Thomas' own

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498. On the subalternation in respect to principles as a consequence of subalternation in respect to subject, see p. 307.

admission have more of an affinity to mathematics than to physics,(499) the Angelic Doctor seems to contradict himself. In the physics cited above St Thomas thus describes the character of the mathematico-physical sciences :

> "Sciences of this type, however, though they are "midway between natural science and mathematics, are "nonetheless said here by the Philosopher to be "rather natural than mathematical, because each thing "is denominated and has its species from the term: "hence, because the consideration of these sciences "is terminated in natural matter, although they "proceed by means of mathematical principles, they "are rather natural than mathematical." (500)

What is the explanation for calling mathematical physics more mathematical than physical, and again, more physical than mathematical ?

The explanation for this seeming contradictory characterisation of mathematical-physics is to be found in the double

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499. "Quaedam vero sunt media, quae principia mathematica ad res "naturales applicant, ut musica et astrologia, quae tamen "magis sunt affines mathematicis, quia in eorum considera- "tione id quod est physici, est quasi naturale: quod autem "mathematici, quasi formale: sicut musica considerat sonos "in quantum sunt secundum numeros proportionabiles, et sic "est in aliis:" St Thomas, De Trinitate, Q. V, Art. 3, ad 6um.

500. "Huiusmodi autem scientiae, licet sint mediae inter scienti- "am naturalem et mathematicam, tamen dicuntur hic a Philoso- "pho esse magis naturales quam mathematicae, quia unumquod- "que denominatur et speciem habet a termino: unde, quia harum "scientiarum consideratio terminatur ad materiam naturalem, "licet per principia mathematica procedant, magis sunt natu- "rales quam mathematicae." II Phys., lect. 3, n. 5.

approach with which mathematical-physics can be examined and which gives rise to the diversity in characterization. In the Physics St Thomas views this type of science from the point of view of its formal subject. As we have already seen, the formal subject of mathematical-physics is per se the physical element and only connotatively the mathematical element. It is the physical element that the mathematical-physicist wishes to know. Therefore by reason of its term mathematical-physics is more natural than mathematical. In the De Trinitate St Thomas adopts a different point of view. There he approaches mathematical-physics from the point of view of the formal object. Since the formal object of mathematical-physics is mathematical in character (mathematical-physics proves its conclusions through mathematical principles), this type of science has a closer affinity to mathematics than to physics.

(B) How mathematical-physics supports Aristotle's position.

If we compare the procedure of pure mathematics and that of mathematical-physics, we discover that their respective processes are the inverse of each other. Mathematics considers physical lines but does not treat them as physical but as abstract that is, separated from sensible matter. In mathematical-physics the consideration bears on the mathematical entity but does not rest there. The interest of the mathematical physicist centers in the physical aspect of his

subject as connoting the mathematical aspect. Therefore mathematical-physics takes the mathematical aspect and preserving its abstract character applies it to the physical aspect. For example, in the science of Perspective the mathematical-physicist conserving the abstract character of the mathematical line, applies it to the visual or sensible line. It is this application of the mathematical aspect to the physical that distinguishes mathematics and mathematical-physics, just as it is the mathematical character of its principles that distinguishes mathematical-physics from physics. Therefore the physical distinguishes mathematics, mathematical-physics and physics. The The distinction, then, between the mathematician and the physicist established by Aristotle in 193b31-33 is confirmed, namely the mathematician differs from the physicist in so far as the former abstracts from sensible matter, the latter considers sensible matter.

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