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FOREWORD

In order that man may proceed correctly in a science, it is necessary that he understand the mode of procedure proper to that science. However, since it is difficult to attend to two things at the same time, man should be instructed in the mode of a science before he proceeds in the investigation of the science itself. Besides the mode proper to the individual sciences there is the mode common to all sciences. Man should be instructed in both of them before he enters on the particular sciences. It is logic which teaches the common mode. Each science should treat its proper mode in the beginning.

> Dicit ergo primo, quod quia diversi secundum diversos modos veritatem inquirunt; ideo oportet quod homo instruatur per quem modum in singulis scientiis sint recipienda ea quae dicuntur. - Et quia non est facile quod homo simul duo capit, sed dum duo attendit, neutrum capere potes; absurdum est, quod homo simul quaerat scientiam et modum qui convenit scientiae. Et propter hoc debet prius addiscere logicam quam alias scientias, quia logica tradit communem modum procedendi in omnibus aliis scientiis. Modus autem proprius singularum scientiarum, in scientiis singulis circa principium tradi debet. (1)

It shall be the purpose of this thesis to make certain considerations on the common mode of knowledge and on the proper mode of natural science which will add some knowledge to the modern discussion on the meaning of the philosophy of nature.

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(1) - St. Thomas, In II Metaphysicorum, lect. 5(edit. Marietti), n. 335.

INTRODUCTION

One of the major tasks to which the scholastic philosophers have applied themselves since the revival of Thomism with the encyclical Aeterni Patris of Pope Leo XIII has been that of understanding and determining the precise meaning of the philosophy of nature. It has been in large part the seeming contradictions between the findings of modern science and those of the philosophy of nature which have occasioned this earnest application. In the climate of opinion proper to our age, it is impossible to speak of the philosophy of nature without taking into consideration modern science. Thus the scholastic philosophers have reflected on and investigated the methodology both of the philosopher of nature and of modern science.

However, it has not only been the scholastics who have been forced to a study of methodology but scientists themselves ever since they have seen their 19th century mechanical theories come tumbling down, have been forced to reflect on the meaning of the knowledge we have of the physical world.(1)

(1) - For a brief resume of the scholastic reflections on the philosophy of nature see Benedict Ashley, O.P., "The Role of the Philosophy of Nature in Catholic Liberal Education", Proceedings of American Catholic Philosophical Association (1956), pp. 73-85.

One of the most fundamental problems with which scholastic philosophy of nature has been confronted due to the rise of experimental science is the problem of what we shall call the 'starting point of the philosophy of nature'. Modern scientific knowledge has succeeded admirably in helping man control and effectively use nature. This knowledge from its beginning is rather detailed and is expressed in precise mathematical formulas. The philosophy of nature, however, which cannot boast of this tremendous success in the practical order has been traditionally founded on a general and what we shall call here without defining for the moment, a confused knowledge. The philosophy of nature has spoken in terms of general principles. It has begun with general principles. Thus we have the general doctrine of matter and form, the definitions of place, time and motion.

The twentieth century man raised in the climate of opinion of detail and mathematization will have either one of two reactions to this philosophy of nature. Either he will gently respect it and raise it to the level of metaphysics and thus be rid of it or he will accept it as a generally natural science but demand that it wait on the findings of modern science before it dare enunciate its theories. In this second case, the philosophy of nature will find its 'starting point' not in the general and confused knowledge but in the detailed and precise knowledge of modern science. It will then be free to proceed to its own proper philosophical reflection.

The order followed by Aristotle and St. Thomas in their study of nature is quite different. For them the 'starting point' is a general and confused knowledge which by a process of concretion approaches the particular and the distinct. It shall be the purpose of this thesis to explain and defend their position.

In the brief foreword above, we mentioned that it would be the purpose of this thesis to make some considerations on the common mode of human knowledge and on the mode proper to the philosophy of nature. Here we have made that purpose more precise by saying that we would determine the starting point of the philosophy of nature and the procedure to be followed. In what way does the determination of the starting point and of the procedure belong to the study of the mode. We shall answer this question by analyzing the text of the Metaphysics to which reference was made in the Foreword.

It is in Chapter Three of the Second Book of the Metaphysics that Aristotle discusses the mode proper to the consideration of truth. In the first part of this chapter, he discusses the different ways in which men consider truth. This he does by showing the importance of custom in the attainment of truth and by indicating the various ways in which men accept truth. There are some men who by custom will accept nothing which is not proved with mathematical accuracy. Others always demand sensible examples. Still others will be convinced only by the authority of great poets.

> The effect which lectures produce on a hearer depends on his habits; for we demand the language we are accustomed to, and that which is different from this seems not in keeping but somewhat unintelligible and foreign because of its unwontedness. For it is the customary that is intelligible. The force of habit is shown by the laws, in which the legendary and childish elements prevail over our knowledge about them owing to habit. Thus some people do not listen to a speaker unless he speaks mathematically, others unless he gives instances, while others expect him to cite a poet as witness. And some want to have everything done accurately, while others are annoyed by accuracy, either because they cannot follow the connexion of thought or because they regard it as pettifoggery. For accuracy has something of this character, so that as in trade so in argument some people think it mean. (1)

In the second part of the chapter, Aristotle shows that the mode which is proper to the consideration of the truth, depends on the subject of inquiry. Before one studies a science one must be acquainted with the mode proper to the science. Each science differs. We are not to expect mathematical accuracy in all sciences. The subject of the philosophy of nature is immersed in matter and consequently certitude is often lacking. Thus it is that before we study each science we must study its mode. It is difficult enough to understand the mode and the science but the two studies should not go together. Thus it is that before we study the science of nature, we

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(1) - Aristotle, Metaphysics, II, c. 3, 994b 31 - 995a 11. In this thesis we shall cite Aristotle in the English translation edited by Richard McKeon, Random House, New York (1941). At times we shall add the Latin translation of William of Moerbeke on which St. Thomas based his commentary. We shall do this when we think it necessary for understanding either St. Thomas or Aristotle. St. Thomas will always be cited in Latin.

must determine the meaning of nature and the causes by which this science demonstrates.

> Hence one must be already trained to know how to take each sort of argument, since it is absurd to seek at the same time knowledge and the way of attaining knowledge; and it is not easy to get even one of the two.
>
> The minute accuracy of mathematics is not to be demanded in all cases, but only in the case of things which have no matter. Hence its method is not that of natural science; for presumably the whole of nature has matter. Hence we must first inquire what nature is : for thus we shall also see what natural science treats of (and whether it belongs to one science or to more to investigate the causes and the principles of things. (1)

In his commentary on this passage, St. Thomas points out two things which are not explicitly mentioned in the text. First of all, he mentions that before we study a science we must not only have studied the mode proper to the science but also the mode common to all science, namely logic.(2) Secondly he points out that it is in the Second Book of Physics that Aristotle determines the mode proper to Natural Science.

> Et quia, in scientia naturali non convenit iste certissimus rationis modus, ideo in scientia naturali ad cognoscendum modum convenientem illi scientiae, primo perscrutandum est quid sit natura : sic enim manifestum erit de quibus sit scientia naturalis. Et iterum considerandum est, "si unius scientiae", scilicet naturalis, sit omnes causas et principia considerare, aut sit diversarum scientiarum. Sic enim poterit scire quis modus demonstrandi

(1) - Aristotle, Metaphysics, II, c. 3, 995a 11 - 995a 20.
(2) - St. Thomas, In II Metaphysicorum, lect. 5 (edit. Marietti), n. 335. In this thesis in citing St. Thomas' commentary on the Metaphysics, we shall always use the Marietti edition.

> conveniat naturali. Et hunc modum ipse observat in secundo Physicorum, ut patet diligenter intuenti. (1)

From what has been said, it seems evident that the word 'mode' as used in the context of Chapter Three of Book Two of the Metaphysics refers to the certitude and type of argument which one will use in each science. In this sense, it would seem that the mode proper to natural science is sufficiently indicated in the Second Book of the Physics. There is, however, a more common sense of the word according to which the mode of natural science is also indicated in the First Book of the Physics. In this more general sense the word 'mode' would apply not only to the certitude and type of argument but also to the order of procedure. Before studying nature it is not only necessary to define nature but it is also necessary to know the order in which we should study the subjects of the science. It is this order which is indicated in the Proemium to the Physics and it is the study of this order which shall be the major work of this thesis.

The study of nature should, then, be preceded by a study of the common mode of human knowledge, which study we call logic; by a study of the order of procedure and finally by a study of the proper mode as proposed in Book Two of the Physics. Although it is the second of these which is of interest to us here, nevertheless some

(1) - St. Thomas, In II Metaphysicorum, lect. 5, n. 335.

considerations of the first and third will be necessary if we are fully to understand the implications of the second. In Chapter One we shall study the first and third. Chapters Two to Seven shall be a study of the order of procedure.

Now, wherever there is order there is some notion of that which is prior and that which is posterior.[1] Priority and posterity, however, imply that there is a principle, a starting point.[2] Thus wherever there is order there is a principle. The two notions go hand in hand. In this thesis we shall study the order of procedure in the philosophy of nature.[3] The emphasis, however, shall be on the principle of this order, that is, on the starting point of the philosophy of nature. There will necessarily be some consideration of the steps in procedure but our main interest will be in the principle, the starting point.

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(1) -"Respondeo dicendum, quod ordo in ratione sua includit tria, scilicet rationem prioris et posterius..." (St. Thomas, In I Sententiarum, dist. XX, Qu. I, Art. III, Quaestiuncula II.)

(2) - "The words 'prior' and 'posterior' are applied (1) to some things (on the assumption that there is a first, i.e. a beginning, in each class) because they are nearer some beginning..." (Aristotle, Metaphysics V, c. 11, 1018b 8.)

(3) - In this thesis we shall use the expressions 'philosophy of nature' and 'natural science' interchangeably as does St. Thomas.

CHAPTER ONE

NATURAL SCIENCE.

If the philosopher is to proceed in an orderly way in a science, he must first possess the instrument of all science, logic, and he must determine the subject of the particular science which he intends to investigate. He must possess all of logic for deficiency of knowledge in any part of logic will detract from the perfection of his knowledge.[1] There are, however, certain considerations from logic which are especially related to the order of procedure of natural science and which consequently we shall discuss briefly in this chapter. First of all, we shall explain the meaning of science and demonstration as proposed in the logic of Aristotle. Secondly, we shall determine the subject of natural science according to logical and natural considerations.

Science may come under the consideration of the logician, metaphysician or moral philosopher. The metaphysician, for example, will give us the ultimate division of science.[2] The moral philosopher will discuss science as an intellectual virtue.[3] None of these con-

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(1) - "Intendentibus primum de logica, considerandum est qualis scientia sit logica, et an sit aliqua pars Philosophiae, et ad quid necessaria, et cujus utilitatis : deinde autem de quo est, et quae divisio ipsius : ut habitis omnibus partibus ipsius sciatur quando est perfecte vel imperfecte tradita vel descripta." St. Albert, De Praedicabilibus, Tract. I, c. 1.

(2) - Aristotle distinguishes the sciences one from the other in Metaphysics, VI, c. 1.

(3) - Aristotle discusses the intellectual virtues in the Nicomachean Ethics, VI, cc. 3 & 4.

siderations interest us here. What interests us is the knowledge of science with which the human mind must be equiped as it approaches the study of nature. This knowledge is the knowledge proper to the logician. Consequently our study of science here shall be according to logical considerations.

Once the meaning of the word 'science' has been determined, we shall be able to proceed to a discussion of the subject of natural science. Here, too, logical considerations must precede for it is logic which teaches the general mode of distinguishing the sciences. Logic, however, dealing with second intentions does not determine the subject of particular sciences.(1) Nor does the science itself do this. The reason for this is that a science by definition, as we shall see, demonstrates conclusions beginning from the definition of its proper subject. Consequently, a science must presuppose its subject. It cannot demonstrate it. It is sense knowledge or a subalternating science which presents us with the subject of a particular science.(2)

(1) - "Et sicut nulla scientia particularis determinat quod quid est, ita etiam nulla earum dicit de genere subjecto, circa quod versatur, est, aut non est. Et hoc rationabiliter accidit : quia ejusdem scientiae est determinare quaestionem an est, et manifestare quid est. Oportet enim quod quid est accipere ut medium ad ostendendum an est. Et utraque est consideratio philosophi, qui considerat ens inquantum ens. Et ideo quaelibet scientia particularis supponit de subjecto suo quia est, et quid est, ut dicitur in primo Posteriorum; et hoc est signum, quod nulla scientia particularis determinat de ente simpliciter, nec de aliquo ente inquantum est ens." St. Thomas, In VI Metaphysicorum, lect. 1, n. 1151. Cf. also In I Posteriorum, lect. 17 (edit. Marietti), n. 4; In VIII Physicorum, lect. 5 (edit. Pirotta), nn. 2106-2108.

(2) - In VI Metaphysicorum, lect. 1, n. 1149.

Ultimately it is the science of metaphysics which will clearly distinguish for us the subject of the individual sciences. This is precisely what Aristotle does in the Sixth Book of the Metaphysics. However, the philosophy of nature must precede metaphysics. In fact, if we were not able to prove in the philosophy of nature, the existence of immobile being, there would be no metaphysics. Physics would be the first science.(1) This raises a question. How are we to proceed from logical considerations to proper considerations of the subject of a science, if this can be done only by metaphysics which follows the particular science ? In other words, when we have completed the logical and common considerations on the subject of a science, what considerations follow ?

The considerations at the beginning of a science according to which we determine the subject of the science do not really belong to the science, They are metaphysical in character. However, they do not demand the complete resolution such as found in metaphysics. These considerations do not presuppose the existence of immobile being. They have a critical and metaphysical character but they treat reality as found in the physical and natural world. We may, I think, call these considerations natural. Thus, as we shall see there is a difference between the division of sciences as proposed in the Second Book of the Physics and that proposed in the Sixth Book of the Metaphysics. It is the former which we call a natural consideration.

(1) - "Secundo solvit, dicens quod si non est aliqua alia substantia praeter eas quae consistunt secundum naturam, de quibus est physica, physica erit prima scientia." In VI Metaphysicorum, lect. 1, n. 1170.

A. - Science and Demonstration.

The logical treatment of science is found in the Second Chapter of Book One of the Posterior Analytics[1] where Aristotle first discusses the meaning of the word. To do justice to his treatment of the word 'science', we shall have briefly to situate this chapter in the ensemble of the logical treatises.

Man endowed as he is with intellect wonders about the things which he knows through his senses and his intellect. This wonder leads to inquiry into the nature of these things. This inquiry takes the form of a comparison between these things, of a comparison between what is known and what is unknown. Thus man proceeds from a knowledge of the known to knowledge of the unknown. There is a motion from one to the other. This motion we call discourse and the faculty of this discourse we call reason.[2] This reason proceeds according to different modes in different sciences. Nevertheless there is a mode common to all sciences. Now, it is the science of logic which studies this common mode.

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(1) - Posterior Analytics, I, c. 1.

(2) - "Ex hoc enim quod homo intellectualis est et intelligentiae stratum, in quo sternuntur formae intellectuales, et per intellectivum compositivus est unius formae cum alia per compositionem vel divisionem, fit homo admirativus eorum quae comprehendit accipiendo per sensum et intellectum vel per intellectum solum. Per hoc autem quod admirativus est, suspenditur ad inquisitionem, et per inquisitionem comparat unum alteri. Per comparationem autem unius cum altero, ab eo quod est notum deducitur ad ignoti notitiam. Et sic hic logicae modus a natura quidem incipit : perficitur autem arte, et usu et exercitio recipit perfectionem." St. Albert, De Praedicabilibus, Tract. I, c. 1.

Logic, then, is the science which studies the common mode by which the human intellect proceeds from the known to the unknown. Logic, however, is not only a science but it is also an art which directs this act of the reason. The intention of this art is to direct this act of the reason so that it may proceed in an orderly fashion, easily and without error in its passage from the known to the unknown.[1]

It is on this intention of the art of logic that is founded the division of logic into its parts.[2] The intention is to teach man how to proceed from the known to the unknown. There are, however, two kinds of unknown : the incomplex and the complex. The first part of logic will teach how man is to proceed from the known to the incomplex unknown. The incomplex unknown is the definition and the first part of logic teaches the art of definition. The second part of logic will teach the art of proceeding from the known to the complex unknown, namely to the conclusion. This is the art of argumentation.

In its discourse, the human intellect uses certain instruments which we call second intentions. It is the function of logic to study these instruments. For this reason the corpus of Aristotle's logical works is called the Organon (ὄργανον). Organon is the Greek word for instrument. The instrument which is the subject of the second part of logic is the syllogism. The form of the syllogism is

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(1) - St. Thomas, In I Posteriorum, Proemium, n. 1.

(2) - St. Albert, De Praedicabilibus, Tract. I, c. V.

studied in the Prior Analytics; the matter in the Posterior Analytics and the Topics. The enthymeme and metaphor which are also forms of discourse are studied in Rhetoric and Poetics. All of these last four mentioned treatises are interested in the process of the human mind from the known to the complex unknown. They differ in so far as the matter which they treat is more or less susceptible of leading to certain knowledge.

The Posterior Analytics studies that particular type of syllogism which leads to certain knowledge, namely, the demonstrative syllogism. Probable knowledge and the dialectical syllogism are studied in the Topics.

In the first chapter of the Posterior Analytics, Aristotle shows the necessity of the demonstrative syllogism. In the second he begins his study of it by defining if from its material and final causes. Defined in terms of its final cause, demonstration is a syllogism productive of science. It is here that Aristotle comes to the point which particularly concerns our discussion, namely the meaning of 'science'.

At this point, Aristotle does not give us a strict definition of science but rather manifests the quid nominis.[1] He tells us what men commonly mean when they say that they know something scientifically.

(1) - St. Thomas, In I Posteriorum, lect. 4, n. 36.

> We suppose ourselves to possess unqualified scientific knowledge of a thing, as opposed to knowing it in the accidental way in which the sophist knows, when we think that we know the cause on which the fact depends, as the cause of that fact and of no other, and, further, that the fact could not be other than it is.(1)

The Greek word for science is ἐπιστήμη and the verb of which Aristotle here gives the nominal definition is ἐπίστασθαι. This verb is derived from ἵστασθαι which mean to stand still or come to a stop. The intellect has science when it is perfectly satisfied; when it comes to a stop.[2]

For perfect scientific knowledge, three things are required. First of all, the intellect must know the reason or cause why something is or is so. Secondly, it must know the cause of the effect precisely in so far as it is the cause of the effect; it must know the application of the cause to the effect. Thirdly, in order that the mind may be at rest, the object of scientific knowledge must be necessary.

Having defined science which is the final cause of demonstration, Aristotle may now continue his discussion of demonstration and the premisses which are necessary if we are to have science. At this point, we shall not enter on a long study of the premisses as does Aristotle in the Posterior Analytics. It will suffice here to point out that in order to have strict demonstration, demonstration of

(1) - Posterior Analytics, I, c. 2, 71 b 8 - 71 b 15.
(2) - "The terms 'knowing' and 'understanding' imply that the intellect has reached a state of rest and come to a standstill." Physics, VII, c. 3, 247b 10.

the reasoned fact (demonstratio propter quid), the premisses must be the proper principles of the subject about which we will make our conclusions. Demonstration proceeds from a definition of the subject and it concludes to accidents which necessarily inhere in the subject.

If we are not in possession of the proper principles of the subject, we can not have demonstration of the reasoned fact. We may, however, have another type of demonstration, namely, demonstration of the fact (demonstratio quia). In this second type we do not demonstrate from cause to effect but rather from effect to cause. Further, if we are not in possession of proper principles, we may argue from common principles, and then our syllogism will be dialectic. The dialectical syllogism is the subject of the Topics which follows immediately on the Posterior Analytics.

Having located the notions of science, demonstration and dialectic in the whole of the Aristotelian corpus, we may now proceed to see how he determines the subject of that particular science which is called natural.

B. - The Subject of the Philosophy of Nature.

It is the task of the logician not only to explain the general nature of science but also to lay down general rules for distinguishing sciences one from the other. Before the philosopher of nature is able to determine precisely the subject of his own science, he must be acquainted with the general method of determining and distinguishing

the subject of a science. In this section, it will be our purpose to approach more closely the philosophy of nature first by examining what logic tells us about determining the subject of a science and then indicating how and in what sense the philosopher of nature determines the subject of his own science.(1)

1. - Logical Considerations.

In Book One of the Posterior Analytics, after a careful study of demonstration and after comparing different kinds of demonstration one with the other, Aristotle begins to compare sciences among themselves and to distinguish science from other forms of knowledge. He compares one science to another in two steps. In the first, he compares sciences from the point of view of their certitude. In the second he compares them according to their unity and plurality. It is the second step which interests us here. First we shall study that which constitutes the unity of a science and secondly that which constitutes its diversity from other sciences. Since the text of Aristotle is rather cryptic we shall rely heavily on the commentary of St. Thomas.

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(1) - In this chapter, we shall prescind from metaphysical considerations and this for a purpose which shall be more manifest in the last chapter. We wish to clearly distinguish the philosophy of nature from metaphysics. Here we do it not by abstract discussion but by showing how the philosophy of nature arises antecedently to metaphysics.

It will be well, however, at the beginning to quote in full the text of Aristotle on unity and diversity. We shall then follow the analysis proposed by St. Thomas.

> A single science is one whose domain is a single genus, viz. all the subjects constituted out of the primary entities of the genus - i.e. the parts of this total subject - and their essential properties.
>
> One science differs from another when their basic truths have neither a common source nor are derived those of the one science from those of another. This is verified when we reach the indemonstrable premisses of a science, for they must be within one genus with its conclusions : and again this is verified if the conclusions proved by means of them fall within one genus - i.e. are homogeneous. (1)

(a) - Unity.

The scientific process is as it were a movement of reason from a principle to a term. (2) Now every movement is specified by its term. Science then will be specified by the term of its movement. The term, however, of a speculative science is knowledge of its subject genus.

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(1) - Posterior Analytics, I, c. 27, 87a 37 - 87b 3. The Latin translation here helps manifest the thought of Aristotle. "Una autem scientia est, quae est unius generis : quaecumque ex primis componuntur; et partes aut passiones eorum sunt per se. Altera autem scientia est ab altera, quarumcunque principia neque ex eisdem neque ex alterutris sunt. Hujusmodi autem signum est cum in indemonstrabilia veniant; oportet enim ipsa in eodem genere esse hic quae demonstrantur. Signum autem hujus est, quando demonstrabilia per ipsa in eodem genere sunt et congenea."

(2) - "Cujuslibet autem motus unitas ex termino principaliter consideratur, ut patet in V Physicorum, et ideo oportet quod unitas scientiae consideretur ex fine sive ex termino scientiae." St. Thomas, In I Posteriorum, lect. 41, n. 362.

What is sought in science is knowledge of its subject genus. The conclusion of a scientific demonstration is a proposition in which the subject is the subject genus and the predicate is some passion necessarily attributed to that subject. The unity of the science is found not in the passions for these may be many, but in the subject genus about which the conclusions are made. The first requirement for the unity of a science is that its subject genus be one.

What is meant by the term 'subject genus' ? It should be noted that Aristotle uses the term 'genus' (γένος). It is St. Thomas who uses the term 'subject genus'. The subject genus is that of which we may predicate many different properties in the conclusion of a syllogism. It is called 'subject' in so far as it is the subject of the properties which are predicated of it. It is called 'genus' in so far as it is the principle and necessary cause of these properties. (1)

Thus in the syllogism : All rational animals are capable of laughter. But man is a rational animal. Therefore man is capable of laughter. The subject genus is man. Man is subject in so far as it is the subject of the conclusion. It is genus in so far as man is the first subject of able to laugh and is the cause and principle of it. The word genus added to subject manifests the close connection there is between subject and properties.

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(1) - For some helpful considerations on the meaning of the term 'subject genus' see Sheila O'Flynn, The First Two Meanings of "Rational Process" according to the Expositio in Boethium de Trinitate, Librairie Philosophique M. Doyon, Québec, 1954, pp. 55-56.

The unity of a science is rooted in the unity of its subject genus. It is the subject genus as we have just described it which is the root of the unity of a science. We may have many different demonstrations with many conclusions, but if the subject genus of these conclusions is the same, all of these conclusions form one science. However not every subject genus about which we can predicate something is capable of unifying a distinct science. For a subject genus to be the subject of a science, it must fulfill two conditions.(1)

First of all, the principles proper to this subject genus must be known. Science by definition is knowledge from principles. If proper principles are not known previously to the intellect of the demonstrator, the subject genus cannot be the subject of a distinct science. Thus since we do not know the proper principles of separated substance we cannot strictly speaking have a distinct science of separated substances. We can argue to their existence, we can know them by way of negation and eminence but we cannot make strict demonstrations about them. We can have strict science of an object only if we know what is prior to it according to nature. Before we can demonstrate anything about a subject genus we must be able to define it. From this definition we may deduce its properties. As Heracles is the unifying principle of the Heraclides, subject genus is the unifying principle of many demonstrations. In the conclusion it is the subject genus which is the subject of which are predicated many

(1) - St. Thomas, In I Posteriorum, lect. 41, nn. 363-364.

properties. This same subject, however, must have previously appeared in the premisses. In fact, it was the definition of the subject genus which was the middle term of the demonstration. From this definition flow with necessity the properties predicated. The definition of the subject genus is the principle of the properties.

The second condition is that the subject have parts and passions which belong to it per se. By parts here we do not mean subjective parts but rather the principles of the subject itself. Thus in the philosophy of nature, the subject has parts, matter and form, and passions which may be attributed to it. The philosophy of nature begins with a study of the parts, principles of the subject and then continues to a study of the attributes which may be predicated of the subject, the passions. Both of these, however, must belong to the subject per se.(1) Thus those passions which are per se the passions of a triangle are not per se principles of isosceles triangle. Their first subject of inherence is not isosceles triangle but triangle. Therefore the subject genus of triangle does not form one science, rather it is part of one science, namely geometry.

(1) - For the various modes of per se predication, see, Posterior Analytics, I, c. 4; Sheila O'Flynn, op. cit., pp. 49-62; Melvin C. Glutz, C.P., The Manner of Demonstrating in Natural Philosophy, River Forest, 1956, pp. 16-17.

(b) - Diversity of Sciences.

The unity of a science is rooted in its subject genus. What is the root of the diversity of sciences ? Aristotle does not found the diversity of science immediately on the diversity of subject genus as we would have expected after the previous consideration. Rather he founds it on a diversity of principle. Two sciences are diverse if their principles are diverse, that is, if the conclusions of both of them do not proceed from principles which are common to them or if the demonstrations of one do not proceed from the principles of the other. If the principles of demonstration belong to different genera, the demonstrations will be diverse.

Aristotle proves that the diversity of sciences depends on the diversity of principles by a sign which is intimately linked with what he had previously taught about demonstration. All demonstrations are reducible to indemonstrable principles which must be proper to the subject of the conclusion. If the principles are extraneous or common, there is not strict demonstration. The principles thus must be in the same genus as the subject of the conclusion. If therefore the principles of two demonstrations belong to different genera, they will be proper principles of different conclusions. Consequently the sciences will be diverse.

St. Thomas manifests the teaching of Aristotle by linking what is taught here with the teaching on material and formal object.(1)

(1) - In I Posteriorum, lect. 41, n. 366.

Habits are distinguished not because of a material difference of objects but because of formal difference. Now the proper object of a science is the scientifically knowable proposition, the scibile. Sciences, therefore, will be diversified not according to a material diversity of scibilia but according to a formal diversity. What is it that makes one scibile formally diverse from another ? It is the principle by which it is manifested. Thus even if two things are of different natures, they can belong to the same science as long as they are studied in the light of the same principle. The proof which St. Thomas gives of this is a sign taken from the phenomenon of light. That which makes a thing formally visible is the light by which the color is seen. So too, that which makes a thing formally an object of science is the principle by which it is known. The principle of demonstration is compared to light.

It is the principles by which they are known which formally diversify the different sciences. Thus the sound of the human voice differs from the sounds made by inanimate objects. Nevertheless in the science of music all of these sounds are studied in the light of the same principles. Thus the sound of the human voice and inanimate sounds belong to the same science. Conversely things which are of the same nature can belong to diverse sciences if the principles by which they are studied are diverse. Thus a mathematical body in so far as it exists in its subject is the same as the natural body. But since it is known by different principles, it belongs to a different science. The mathematical body is known by the principles of

quantity; the natural body is known by the principles of motion.

Thus for diversity of science we must have diversity of principle.[1] However, as St. Thomas points out, it does not suffice to have diversity of secondary principles. The primary principles must also be diverse. For example, the principles which we use in demonstrations about a triangle and those which we use in demonstrations about a square although differing one from the other, nevertheless are both derived from the principles of a figure. Consequently they both belong to the same science.

St. Thomas concludes his commentary on this passage of Aristotle with an observation which leads to our next step in the search for the subject of natural science. The unity of a science depends ultimately on the unity of primary principles within a particular subject genus (in aliquo genere scibili). But now arises the question which goes beyond the considerations of the logician. What is it that distinguishes one subject genus from another ? Subject genus is distinguished from subject genus according to the various ways (modos) in which we know. For example one way of knowing is had when we define something with matter. Another way is had when we define something without matter. These are two diverse subject genera. Consequently we have two diverse sciences. This leads to a stop which is not proper to the logician but proper to the beginning of the individual sciences.[2] These considerations we call natural considerations.

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(1) - In I Posteriorum, lect. 41, n. 367.
(2) - The reason for this appellation shall be seen later in this chapter.

We should note here that St. Thomas in his explanation of the text of Aristotle has recourse to the distinction between formal and material object. Now, up to this point in the logical discussion of science and demonstration there has been no mention of object either formal or material. The explanation has always been in terms of subject and principle. Strictly speaking we may carry on this investigation of the meaning of natural science and its subject independently of the terminology of formal and material object. As a matter of fact this is precisely what Aristotle does. The question of object arises in the later parts of natural science in the discussion of the potencies of the soul. However, since St. Thomas has used this distinction to manifest the thought of Aristotle and since the scholastics frequently use this distinction,at this point we will translate the passage in John of St. Thomas where the distinction between object and subject formal and material is explained.

> "For the resolution of this difficulty it must be presupposed that in any science there is a distinction between subject and object and that in both of these there is the further distinction between that which is formal and that which is material. The object of a science is something complex, namely, that which has been manifested by the science as inferred and proven namely the conclusions as we are taught in Summa Theologica,IIaIIae, 1, 1; for science is not had unless by inference and proof. What, however, is inferred and proven is the conclusion; the conclusion, however, is something complex, in which a predicate is said of a subject; this proposition or conclusion is called the scientifically knowable object (objectum scibile), that is, that which is known and inferred in a certain science. The subject,on the other hand, is that in the conclusion of which the passions are predicated. Now since the inferred conclusion is inferred from previous propositions which also state something about the subject, it follows that the principles and

the conclusions of a science are about the same subject. There is however a difference. In the principles whatever is predicated of the subject is per se nota, as are essential predicates and definitions, which require no middle term for their proof. In the conclusion what is predicated is something which has been inferred from the principles namely the passions.

The distinction, however, between formal and material in the subject and in the object is as follows. The material object is that proposition which is proven by the illation and known as the inferred truth. The formal object is the light under which and by which this conclusion is manifested; this formal object is found in the principles by which we infer insofar as they are the middle term proving the conclusion. As an example of this we have given virtual revelation in theology, that is the principles of faith in so far as they are the middle term proving a conclusion. - The material subject is that of which something is demonstrated in a particular science. The formal subject is the aspect under which that subject is considered in the particular science. The principle subject which is also called the subject of attribution is that subject to which belongs of itself and first of all the particular aspect or ratio of the science. Thus natural science which studies many diverse bodies such as the heavens, the elements, the composites not under all their aspects but in so far as they are mobile beings. Metaphysics studies not only bodies but also immaterial beings all in so far as they are being. In natural science the bodies themselves are the material subject; mobility is the formal subject. In metaphysics all things are the material subject, while the formal subject is beings in so far as they are being. The principle subject of metaphysics is God." (1)

Before proceeding to the considerations proper to the philosopher of nature, it will be well to summarize briefly that which logic teaches about science and outline what we can expect to learn from the philosophy of nature and from metaphysics.

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(1) - John of St. Thomas, Cursus Theologicus, I, art. XI, p. 402.

As distinguished from the sense faculties, it is proper to the human intellect and reason to know the order between things. The senses know things more or less absolutely. It is the intellect which sees the relations between things. Now there are various types of order and the relations between reason and these various types differ among themselves.(1) Here we will describe but two of these.

First of all, there is the order which reason by its own consideration puts into its own acts. Thus reason orders its own concepts one to the other and it orders the signs by which these concepts are represented. The study of this order belongs to the science of logic which considers the order of the parts of a proposition one to the other and the order between principles and conclusions.

This science of logic in its second part is concerned with manifesting as perfectly as possible the instrument which reason uses in arriving at knowledge of the complex unknown. The most important of these instruments is the syllogism. The most perfect form of the syllogism is the demonstrative syllogism which results in science. Logic studies this demonstrative syllogism both according to form (in the Prior Analytics) and according to matter (in the Posterior Analytics). It tells us what kind of premises are necessary for strict demonstration. It distinguishes the various kinds of demonstration, demonstration of the reasoned fact and demonstration of the

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(1) - This description shall be based on St. Thomas, In I Ethicorum, lect. 1 (edit. Marietti), n. 2.

fact. It also distinguishes demonstration from dialectic. We have glanced briefly at all of these points.

Logic further compares science to science, telling in general what is necessary in order to have distinct sciences. According to what logic teaches, the unity and diversity of science depends on the unity and diversity of the subject genus and the genus of principles in the science. However, it is not the function of logic to distinguish the various genera of being which can be the subjects of science. This distinction is proper to the science in which reason considers the order in things, namely philosophy. It does not belong to the science in which reason considers the order in its own concepts.

There is then another order which is related to reason. This order is the order which is in things and which is considered as such by reason. This is the order which reason in no way makes but merely considers. The study of this order belongs to speculative science.

Within this order of speculative science, there will be diverse sciences according as there are diverse principles of demonstration according to what logic has already taught us. But it is speculative science which will discover these various genera. They are not given a priori. At first sight the philosopher is confronted with the data of his senses, with the world of nature. He is confronted too, with the world of the imagination and with mathematics. By a long process, he will distinguish these as belonging to different subject genera, as constituting two diverse sciences. It is only at the end of his

study of nature, that the philosopher will be introduced to the world of metaphysics in which are discussed the supreme genera of causes. The first task, however, is to determine this genus which is called nature, to discover its principles, to distinguish it from the genus of mathematics. This is what Aristotle does in the first two books of the Physics.

Although the philosopher in such a process may distinguish mathematics, logic and the philosophy of nature one from the other, it is only when he has obtained a distinct knowledge of metaphysics that he is able to come back and distinctly and perfectly distinguish all sciences from one another. Metaphysics will as it were look down on the other sciences and defend their principles, explain their mode and clearly distinguish them one from the other. The meaning of this paragraph may be made more manifest by an example. The human intellect may have made a thorough study of logic but this does not suffice for the perfectly distinct knowledge of logic of which we speak. Logic of its nature is instrumental. This instrument will be perfectly known only after it has been actually used.(1) Thus when one has completed the philosophy of nature, one has a much more distinct knowledge of logic than at the end of the logical treatises. Further, it is only at the end of metaphysics that one can distinctly grasp the quid of logic. The same is true of the philosophy of nature. Its

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(1) - "Et sic hic logicae modus a natura quidem incipit : perficitur autem arte, et usu et exercitio recipit perfectionem." St. Albert, De Praedicabilibus, Tract. I, cap. I.

full significance is seen in metaphysics. This is what we mean by the sapiential function of metaphysics. As the supreme science, it orders all the others.(1)

This however does not deny the validity of the knowledge obtained before metaphysics. It shows however the necessity of the teacher. The teacher with a distinct knowledge attempts to lead the student to the knowledge of the unknown from what is already known to the student and not from what is known merely to himself. Thus the teacher begins with a common knowledge which the student is presumed to have. This is the ordinary procedure. However, as sort of an introduction, the teacher may depart from this method and propose something to the student which contains in germ the whole science.(2) This introduction expresses very cryptically all that is to follow in the science. It is really not something which is more known to the student. It is at this point that the teacher must depend on an act of natural faith on the part of the student.

> Et hoc etiam patet in ordine scientiarum, quia scientia quae est de causis altissimis, scilicet metaphysica, ultimo occurrit homini ad cognoscendum, et tamen in scientiis praeambulis oportet quod supponantur quaedam quae in illa plenius innotescunt ; unde quaelibet scientia habet suppositiones quibus oportet addiscentem credere. (3)

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(1) - "Nam sapientis est ordinare." St. Thomas, In I Metaphysicorum, Proemium.
(2) - This point shall be developed more fully in Chapter Two.
(3) - St. Thomas, Expositio in Boethium de Trinitate, q. III, a. 1.

In the next section we shall try to approach the subject of the philosophy of nature in somewhat the same way as the philosopher of nature approaches it. In other words, we shall try to prescind as much as possible from the considerations which metaphysics can make on the philosophy of nature, although we realize that it is ultimately only the metaphysician who can distinguish and defend distinctly the subject of the philosophy of nature.

2. - Natural Considerations.

The natural considerations of the subject of the philosophy of nature are found in the Second Book of the Physics. In the first two books, Aristotle determines the general principles of natural science. In the First Book he determines the principles of the subject, that is the principles of mobile being.(1) In the Second he determines the principles of the sciences. He does this in two steps. First of all he determines the subject of natural science. Secondly he determines the middle terms of its demonstrations. Why does he

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(1) - "Posito proemio, in quo ostensum est quod Scientia Naturalis debet incipere a principiis universalioribus; hic secundum praedictum ordinem incipit prosequi ea quae pertinent ad Scientiam Naturalem. Et dividitur in duas partes. In quarum prima, determinat de principiis universalibus scientiae Naturalis. In secunda, determinat de ente mobili in communi de quo intendit in hoc libro, et hoc in Tertio libro, ibi 'quoniam autem natura est'. Prima in duas partes. In Prima determinat de principiis subjecti hujus scientiae, idest de principiis entis mobilis inquantum hujusmodi. In secunda de principiis doctrinae in Secundo libro." St. Thomas, In I Physicorum, lect. 2 (edit. Angeli-Pirotta), n. 29. All citations from St. Thomas commentary on the Physics will be from the Angeli-Pirotta edition.

determine the principle of the subject before determining the subject itself ? According to Mansion[1] the reason is historical. Aristotle's predecessors had in effect destroyed the object of natural science either by subscribing to the monistic theories of Melissus and Parmenides or by reducing change to accidental modalities. Such theories are contrary to the whole Aristotelian notion of nature. Thus at the very beginning because of historical reasons, Aristotle must establish the principles of substantial change. To this reason proposed by Mansion, we may add another which is perhaps more fundamental. It is only in terms of matter and form that the philosophy of nature is distinguished from mathematics and the scientiae mediae. Thus the determination of the subject must be deferred until the principles, matter and form have been established. Further the notion of nature is explained in terms of matter and form.

Having determined in Book One the principles of the subject of natural science, namely matter, form and privation, Aristotle proceeds in Book Two to determine the principles of the science itself, namely its subject and the middle term by which it demonstrates. The

(1) - For the relation between Book One and Book Two of the Physics see W.D. Ross, Aristotle's Physics, Oxford, Clarendon Press, (1936) p. 499. Ross holds that there is no organic connection between the two books. Mansion refutes him in his Introduction à la Physique Aristotélicienne, Louvain, Editions de l'Institut Supérieur de Philosophie, 2nd ed., (1954) pp. 53-54. Celestin Taylor, O.P. has summarized both positions in "The Relation Between Book I and II of the Physics", Laval Théologique et Philosophique, vol. VII (1951), pp. 150-158.

steps in the determination of the subject are two. First of all he determines what we mean by the word nature and what diverse meanings the word can have. Secondly he determines the subject of the philosophy of nature. He must begin with the study of nature for it is precisely the confrontation with nature that gives rise to natural science in the human intellect. It is then that he considers the subject of natural science. This determination of the subject of natural science comes down to distinguishing natural science from the other sciences known to the human intellect, namely mathematical sciences and the scientiae mediae. What he is actually doing here is distinguishing one genus of subject and principles from another.

(a) - Nature.

The science under consideration is the science of nature. What is nature ? There are some things which we say come from nature, some from other causes.[1] What are these things which come from nature ? We say that animals, plants and the irreducible elements come from nature. The common denominator here which distinguishes all of these from artefacts is that these things have within themselves a principle of motion. This motion may be local, quantitative or qualitative. Artificial things do not have within themselves this principle of

(1) - "Of things that exist, some exist by nature, some from other causes. 'By nature' the animals and their parts exist, and the plants and the simple bodies (earth, fire, air, water) - for we say that these and the like exist 'by nature'." Physics, II, c. 1, 192b 8-10.

motion. However, it is not merely the principle of motion which is interior but a principle of motion or of rest. For some things though they do not have an intrinsic active principle do have an intrinsic passive principle. They have a natural potency to receive a certain form. Thus the principle for motion in light and in heavy bodies is not active but rather passive. Nature then may be defined as a principle of motion or of rest in that in which it is first of all and essentially not merely accidentally.(1) This word 'nature' can be applied both to the matter and to the form. However the form is more nature than is the matter.

(b) - Subject of Natural Science.

As yet, however, we have not sufficiently determined the subject of natural science for although we have determined the principles of the subject of the philosophy of nature, namely matter, form and privation and although we have analyzed the meaning of nature and have clearly distinguished it from the artificial, nevertheless we have not as yet clearly distinguished the subject of natural science from mathematics and the astrology of the ancients.

In Chapter Two of Book Two of the Physics Aristotle proposes some considerations which would seem to indicate that mathematics,

(1) - "Nature is a source or cause of being moved and of being at rest in that to which it belongs primarily in virtue of itself and not in virtue of a concomitant attribute." Ibid., 192b 21-23.

astronomy and natural science form one science. First of all natural science and mathematics seem to consider the same subjects. Both of them treat of points, lines and superficies. It is evident that mathematics treats of points, lines and superficies. Does natural science treat of them ? Natural science treats of natural bodies. Bodies, however, have planes and surfaces, lines and points. It would seem then that the science which treats of bodies, also treat of lines, points and surfaces. Thus it would seem that mathematics and natural science form one science or at least parts of the same science.(1)

Secondly, astronomy seems to be a part both of mathematics and natural science. Thus, as regards this one part, namely, astronomy, natural science and mathematics seem to be one. It is evident that astronomy is part mathematics. In what sense, however, is it a part of natural science ? Natural science treats of the substance of heavenly bodies. But any science which treats of the substance of a thing should also treat of its accidents. Thus natural science should treat of the accidents of celestial bodies. This is astronomy. Finally there seems to be extrinsic evidence that natural science and astronomy form one science. All natural philosophers have treated the two. Thus once again natural science seems united to mathematics. This time

(1) - "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." Physics, II, c. 2, 193b 22-24.

it is by astronomy.[1]

As should be evident from the difficulties just raised, the determination of diverse genera of subjects is a rather laborious process. Continuing in Chapter Two, Aristotle distinguishes the subject genus of natural science from that of mathematics and describes, too, its relation to astronomy and the other sciences which are called the scientiae mediae.

It is true that both mathematics and natural science treat of points, lines and surfaces. They do so, however, from different points of view. Mathematics does not treat of them insofar as they are the terms of a physical body. Mathematics makes a sort of a separation. It separates the notions of point, line, surface from physical bodies, that is from bodies which are the subject of motion.[2]

Aristotle is very cryptic. He merely says that the concepts of mathematics are separated from notion. Abstracta enim sunt intellectu a motu.

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(1) - "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." Physics, II, c. 2, 193b 25-31.

(2) - "Now 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." Ibid., 193b 32-35.

At this point St. Thomas gives an account of abstraction which although not as detailed as is that found in the De Trinitate[1] nevertheless because of its simplicity and because it is attached directly to our discussion here, is worth while considering now.

There are many things which although one in reality may be considered separately. Thus in reality white and music are united in one subject. It is the one white man who is the subject of both whiteness and music. We can, however, consider each one separately. This is called abstraction. Secondly it is evident that things which are posterior are not necessarily contained in the concept of that which is prior. The concept of animal is prior to that of man and does not contain in itself the concept of man. An animal may be either a man or a brute. Thus we may consider animal without reference either to man in general or to any particular man. This abstraction is called abstraction of a universal from a particular.

Thus that which comes first does not necessarily include in its concept that which comes after it. Apply this now to the accidents which are found in substances. The accident of quantity is prior to sensible qualities, action and passion. Consequently quantity does not contain in itself the concept of sensible quality. Thus the intellect can consider a quantified substance antecedent to qualities, that is, quantity which is not yet subject to motion and to sensible qualities. Thus, this quantity is said to be abstracted from

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(1) - St. Thomas, Expositio in Boethium de Trinitate, q. V, art. 3.

motion and sensible matter. It is these quantities which are the subject of mathematics.

Mathematics abstracts from motion and from sensible matter. Physics, too, has its abstraction but the abstraction is less radical than that of mathematics.(1) Mathematics abstracts from sensible matter. Physics abstracts from individual matter.(2)

Thus the subject of natural science differs from the subject of mathematics according to its degree of abstraction. Natural science remains immersed in sensible matter and motion. Aristotle further manifests this difference in two ways : first by analyzing the definitions of both sciences and then by analyzing the scientiae mediae.

The definitions of mathematics prescind from motion and from sensible matter while the definitions of natural science are completely immersed in them. Thus in mathematics we speak of equal and unequal, straight and curved. Natural science however speaks of flesh and bones and man. Thus the definition of snub nose belongs to natural science because it involves both the notion of curve and flesh. In mathematics, however, we speak but of curved.

Finally, Aristotle manifests the difference between mathematics and natural philosophy by showing the relation of both of them to

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(1) - "The holders of Form 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." Physics, II, c. 2, 193b 35-37.

(2) - St. Thomas, In II Physicorum, lect. 2, nn. 332-334.

optics, harmony and astronomy. These latter sciences usually go under the name of middle sciences (scientiae mediae). This is not the first time that we meet the middle sciences in the works of Aristotle. They were discussed several times in the Posterior Analytics. Thus Aristotle spoke of them when showing that demonstration is not from common and extraneous principle but from proper principles.(1) They were discussed, too, in the chapter about the certitude of sciences and in that about the subalternation of science.(2) Here, in the Physics, Aristotle is showing the difference between mathematics and natural philosophy. He does this by showing the difference between mathematics and the middle sciences which stand half-way between mathematics and natural philosophy. It is obvious that the middle sciences are different than mathematics. Geometry, for example, treats of physical lines but not qua physical. It abstracts from sensible matter. Optics, however, which treats of the same physical line, treats of it qua physical. It does not abstract from sensible matter.

> 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. (3)

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(1) - Posterior Analytics, I, cc. 7 and 9; St. Thomas, In I Posteriorum, lect. 15 and 17.

(2) - Posterior Analytics, I, cc. 14 and 17; St. Thomas, In I Posteriorum, lect. 25 and 41.

(3) - Physics, II, c. 2, 194a 7-11.

St. Thomas in his commentary on this passage gives us a definition of the middle sciences and shows why they are more natural than mathematical. The middle sciences are those which receive their principles from pure mathematics and apply them to sensible matter.(1) Thus, perspective applies geometrical principles to the visual line. Harmony applies arithmetical principles to sounds and astronomy applies both mathematical and geometrical principles to the heavens. From what has been said about these middle sciences in the Posterior Analytics, it might have appeared that they were more mathematical than natural. Thus St. Thomas here shows why Aristotle calls them natural. Although their formal principles comes from mathematics, nevertheless their term is sensible. Therefore they are more natural than mathematical.

What then is the subject of natural science ? What genus of being is it that we shall discuss in natural science. It is the genus of beings which we can denominate as natural. These beings have in themselves a principle of motion. We treat of these beings not in so far as they are abstracted from motion but in so far as they are mobile. The subject is ens mobile.

Thus, the human intellect in its consideration of the order which is inherent in things discovers two subject genera: the subject genus of mathematics and the subject genus of the philosophy of nature. These two genera are irreducible. The principles of one cannot be

(1) - St. Thomas, In II Physicorum, lect. 3, nn. 336-337.

the premisses in the demonstrations concerning the subject of the other. The subject and the principles are extraneous one to the other. Thus the rules for distinguishing sciences as laid down in the Posterior Analytics are followed.

3. - The Species of Mobile Being.

The subject of the science of nature is mobile being. Once this has been determined the science may proceed to its demonstrations. The subject of these demonstrations will be mobile being. Immediately, however, a question is raised. Are there diverse species under this subject genus which can be the subject of their own proper demonstrations ? This is true in mathematics. In mathematics we have two distinct species of the science, arithmetic and geometry. Is the same true in nature ?

Will there be different species of science under the genus of the philosophy of nature ? There will be if we can find irreducible principles from which we can deduce conclusions. These irreducible principles would be the definitions of different species existing in the world of nature. But here our intellect is hard put. It is only with great difficulty that it can pierce to the ultimate essences of beings in this natural world. Consequently it is difficult to find principles which set off one species of natural being from the other. The intellect is capable of grouping them all under the common genus of material being whose principles are matter and form. This will be the principle of demonstration. Further it is capable of distinguishing

general species of motion, local, quantitative and qualitative but these are still extremely general. If the philosopher wishes to syllogize about individual species, he will no longer have proper principles but will only be able to argue from common principles. He will no longer be capable of demonstrating but must use dialectic argumentation. As we shall see later on, the number of demonstrations in natural science are limited and are for the most part demonstrations of the fact (demonstratio quia).(1)

Having determined the meaning of science and demonstration and the subject of natural science, we may now proceed to the discussion proper to this work, namely, the discussions of the order of procedure of the philosophy of nature. We shall do this in six chapters, the main task of which will be to manifest the meaning of the Proemium with which Aristotle begins his Physics. In Chapter Two, we shall give some general notions on a Proemium. In Chapter Three, we shall discuss Ross's interpretation of the passage and the introduction which St. Thomas prefaces to it in his commentary. In Chapters Four and Five, we shall comment on the Proemium using St. Thomas as a guide. In Chapter Six, we shall discuss the certainty of the general knowledge with which natural science begins. In Chapter Seven, we shall discuss the importance of this general knowledge.

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(1) - St. Thomas, In I Posteriorum, lect. 4, n. 43bis; Expositio in Boethium De Trinitate, q. VI, art. I, Resp. ad primam quaestionem.

CHAPTER TWO

THE ARISTOTELIAN PROEMIUM.

Before entering on our study of Aristotle's Proemium to the Physics we shall try to explain what in general was the function of a Proemium in his works. Although he prefaces practically all of his works with a Proemium, at no time does he indicate where a Proemium begins and where it ends. It is up to the student of Aristotle to do this for himself. St. Thomas in his commentaries has clearly indicated the extent, content and purpose of the individual Proemia but he has not left us with any lengthy study of the general nature of a Proemium.(1) It is this type of study which we shall attempt here.

The study here shall be inductive. We will glance briefly at a number of the Proemia and see if we can discern characteristics common to them all and classify them among themselves. Before this inductive study, we may describe a Proemium as the beginning of a treatise which serves as an introduction to the treatise and which has certain characteristics which separate it from the rest of the treatise.

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(1) - In the beginning of the commentary on the De Anima, there are a few remarks on the purpose of a Proemium. "Qui enim facit proemium tria intendit. Primo enim ut auditorem reddat benevolum. Secundo ut reddat docilem. Tertio ut reddat attentum." In I De Anima, lect. 1 (edit. Marietti), n. 2. The commentary of the First Book of the De Anima is not the work of St. Thomas but rather of Reginald de Piperno, one of his students. Ibid., Editoris Praefatio, p. VII.

All of the logical treatises except the first, The Categories (1) contain Proemia and all of them are extremely brief. Usually they but indicate the subject matter of the treatise and the general order which it will follow.

Thus in the Peri Hermeneias we read :

> First we must define the terms 'noun' and 'verb', then the terms 'denial' and 'affirmation', then 'proposition' and 'sentence'. (2)

The Proemium for the Prior Analytics serves also as Introduction for the Posterior Analytics. It, too, is brief.

> We must first state the subject of our inquiry and the faculty to which it belongs : its subject is demonstration and the faculty that carries it out demonstrative science. We must next define a premiss, a term, and a syllogism, and the nature of a perfect and an imperfect syllogism; and after that, the inclusion or non-inclusion of one term in another as in a whole, and what we mean by predicating one term of all, or none, of another. (3)

The Proemium to the Topics, too, indicates the subject matter and the order :

> Our treatise proposes to find a line of inquiry whereby we shall be able to reason from opinions that are generally accepted about every problem propounded to us, and also shall ourselves, when standing up to an argument avoid saying anything that will obstruct us.

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(1) - The Categories begins immediately with a discussion of equivocal names. "Things are said to be named 'equivocally' when, though they have a common name, the definition corresponding with the name differs for each." Categories, c. 1, 1a 1-2.
(2) - Peri Hermeneias, c. 1, 16a 1-2.
(3) - Prior Analytics, I,c.1, 24a 10-15.

> First, then, we must say what reasoning is, and what its varieties are, in order to grasp dialectical reasoning; for this is the object of our search in the treatise before us. (1)

The Sophistical Refutations begins with a sentence which tells us the subject of the science and indicates the order to be followed :

> Let us now discuss sophistic refutations, i.e. what appear to be refutations but are really fallacious instead. We will begin in the natural order with the first. (2)

In the four treatises cited thus far, it is comparatively easy to separate at the beginning of the treatise a part which has the character of an introduction. St. Thomas has done it for the Peri Hermeneias and following his example, we may do it with the others. When we come to the Rhetoric, we find it rather difficult to separate a Proemium from the rest of the text. The opening paragraph points out that which is common to rhetoric and dialectic but this in itself does not seem to have the character of an introduction separated from the rest of the text. Perhaps, we could call the first two chapters, the Proemium. In these chapters, Aristotle proceeds disciplinabiliter to give a definition of rhetoric.

The Poetics opens with a brief paragraph which tells us the subject of the treatise and the various topics to be treated. It is very similar to the Proemia to the other logical works.

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(1) - Topics, I, c. 1, 100a 18-24.
(2) - On Sophistical Refutations, c. 1, 164a 20-22.

> Our subject being Poetry, I propose to speak not only of the art in general but also of its species and their respective capacities; of the structure of plot required for a good poem; of the number and nature of the constituent parts of a poem; and likewise of any other matters in the same line of inquiry. Let us follow the natural order and begin with the primary facts. (1)

In general, it may be said that the Proemia of the logical treatises are extremely brief and that in so far as they mention the subject of the science and the order to be followed, they contain in germ the whole treatise. A distinct knowledge of the Proemium and of the words it uses would more or less equate a distinct knowledge of the whole science. For example, one who would understand completely the words 'noun', 'verb', 'denial', 'affirmation', 'proposition', and 'sentence' as used in the Proemium of the Peri Hermeneias would understand the whole of the treatise. Aristotle possesses this distinct knowledge when he writes the Proemium; the student only possesses a common knowledge.

In the works on nature, the Proemia vary in length but in general they are longer and more detailed than are those of logic.

The Proemium to the Physics which we shall study in detail is longer than any of the Proemia to the logical works. It not only gives the subject but indicates the order to be followed and gives reason for this order. It is still, however, extremely succinct.

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(1) - Poetics, c. 1, 1447a 7-12.

In introducing the De Coelo, Aristotle merely determines the subject of the book and why it belongs to the study of nature.

> The science which has to do with nature clearly concerns itself for the most part with bodies and magnitudes and their properties and movements, but also with the principles of this sort of substance, as many as they may be. For of things constituted by nature some are bodies and magnitudes, some possess body and magnitude, and some are principles of things which possess these. (1)

The science of nature must study bodies and magnitudes and their proper passions because the things of nature are so intimately connected with bodies and magnitudes.

The Proemium to the De Generatione et Corruptione is also very brief. Aristotle briefly indicates what he intends to treat in the book, namely generation and corruption, alteration and augmentation and the relation between the two.

> Our next task is to study coming-to-be and passing-away. We are to distinguish the causes, and to state the definitions of these processes considered in general - as to changes predicable uniformly of all the things that come-to-be and pass-away by nature. Further, we are to study growth and 'alteration'. We must inquire what each of them is : and whether 'alteration' is to be identified with coming-to-be, or whether to these different names there correspond two separate processes with distinct natures. (2)

The Meteorologica is preceded by a Proemium which is longer than those of the De Coelo and the De Generatione and which is very

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(1) - De Coelo, I, c. 1, 268a 2-7.
(2) - De Generatione et Corruptione, I, c. 1, 314a 1-7.

important because it is one of the few places where Aristotle directly tells us the order of his own treatises. In this Proemium, Aristotle does three things. He tells us what has preceded this tract, what this tract will be about and finally what has yet to be done.

> We have already discussed the first causes of nature, and all natural motion, also the stars ordered in the motion of the heavens, and the physical elements - enumerating and specifying them and showing how they change into one another - and becoming and perishing in general.
>
> There remains for consideration a part of this inquiry which all our predecessors called meteorology. It is concerned with events that are natural, though their order is less perfect than that of the first elements of bodies. They take place in the region nearest to the motion of the stars. Such are the milky way, and comets and movements of meteors. It studies also all the affections we call common to air and water, and the kind and parts of the earth and the affections of its parts. These throw light on the causes of winds and earthquakes and all the consequences the motions of these kinds and parts involve. Of these things some puzzle us, while others admit of explanation in some degree. Further the inquiry is concerned with the falling of thunderbolts and fire-winds, and further, the recurrent affections produced in these same bodies by concretion.
>
> When the inquiry into these matters is concluded let us consider what account we can give, in accordance with the method we have followed of animals and plants both generally and in detail. When that has been done we may say that the whole of our original undertaking will have been carried out. (1)

This Proemium although longer than those of logic or of the De Coelo and De Generatione is extremely succinct. At times one word

(1) - Meteorologica (translated by E. F. Webster in The Works of Aristotle translated into English, Oxford at the Clarendon Press, 1931). I, c. 1, 338a 20 - 338b 9.

stands for a whole tract. Thus the phrase 'de primis quidem igitur causis naturae' stands for all that is taught in the first two books of the Physics. Were one to understand all that is contained virtually in these few words one would have as Aristotle, a distinct knowledge of the first two books of the Physics.

The Proemia of the other natural treatises have more or less the same characteristics as those which we have cited.(1) The De Anima begins with a paragraph which tells us the dignity, the order and the difficulties of the study of the soul.(2) The De Sensu et Sensato indicates the subject matter of the treatise and the reason for the treatise. It might be noted here, that when a Proemium is a little longer, it is because there is some characteristic in the particular science which demands further eludidation in the beginning. Thus in the beginning of the De Anima we learn something about the dignity of the science and its peculiar difficulties. There is no doubt about it; the De Anima does have peculiar difficulties and a dignity of which we should be conscious from the beginning.(3) So too with the De Sensu et Sensato, one might wonder why such a tract is necessary. It is necessary because of the relation between soul and body.

(1) - De Anima, I, c. 1, 402 a 1 - 9.
(2) - De Sensu et Sensato, c. 1.
(3) - Concerning the order proper to and peculiar to the study of the soul see Charles De Koninck, "Introduction à l'étude de l'âme", in Stanislas Cantin's Précis de psychologie thomiste, (Laval University) (1948), pp. XLVI - LV.

When we come to the De Partibus Animalium we find ourselves faced with the same difficulty as with the Rhetoric. The first paragraph seems to be sort of a Proemium but so too does the whole of the First Book. Consequently we do not class this as a Proemium in the general sense of the word.

The Ethics begins with a Proemium which is also rather long.(1) It takes up two chapters but here fortunately we have the commentary of St. Thomas to clearly point out where it begins and ends and what is its purpose. The length here is due to something peculiar to the science in question. It is most important that from the very beginning we be informed of the mode of ethics and of the peculiar qualities demanded of the student of this science. It is consideration of these two points that occupies most of this Proemium. Just as in the beginning of the De Anima it was necessary to point out the dignity of the science and its difficulties and just as in the Physics it was necessary to point out the order from general to particular, here in the Ethics it is necessary to point out the contingency of moral matters and the role of experience.

In the Proemium to the Metaphysics which includes two chapters, Aristotle does three things. First of all he determines the subject matter of Wisdom. Secondly he tells us the nature of this science. Thirdly, he tells us what its term is. It is the most noble of all sciences and its term is the exact opposite of its starting point.

(1) - Nicomachean Ethics, I, cc. 1 and 2, 1094a 1 - 1094b 11.

It began with admiration and wonder about the causes of things and it terminates in knowledge of these.

Now what general conclusions may we draw about the nature of a Proemium ?

As regards their content this may be said. All of the Proemia treat of two things, some of three. The briefer Proemia consider at least the general subject matter of the treatise and the general division of parts. The longer Proemia add something on that which is peculiar to the particular treatise to be studied. Thus in the Physics there are remarks on the general order of procedure of physics, namely from the confused to the distinct.(1) In the Ethics there are remarks on the contingency of the matter in moral science which is most important. The Metaphysics begins with a long consideration on the manner of arriving at the subject of this science the ultimate causes and the dignity of this science.

As regards their form, the Proemia are very brief. In a few words they sum up all that will be treated in the book. Thus every word of the Proemia is very important in so far as every word is pregnant with much meaning. The Proemia are not discursive but very

(1) - It is true that the order of procedure from confused to distinct knowledge, is not proper to physics. Nevertheless, since the Physics is the first work of philosophy (logic is but its instrument) it is important that Aristotle point out immediately the order of procedure.

cryptic. Now, this implies a certain perfection in the words used, in so far as the more simple a word is, the more perfect it is.

In commenting on the Epistle to the Romans, St. Thomas brings this point out very clearly. The word of the Gospel is consummans et abbrevians. It is consummans in so far as it is the road to perfection. It is abbrevians in so far as the word of the New Law with its unique sacrifice contains all of the power of the Old Law with its many sacrifices. The word of the Old Law was contained in many commandments but the word of the New is contained in but two. Love God and love your neighbour. A word is more perfect in so far as it is more simple and brief. This is the perfection of the word of the New Law.

> Verbum enim consummans et abbrevians in aequitate, quia verbum breviatum faciet Dominus super terram."
>
> Ubi notatur duplex efficacia evangelici verbi; prima est quia consummans, id est perficiens...
>
> Secunda efficacia est abbreviandi, et haec convenienter primae adjungitur, quia quanto aliquod verbum est magis perfectum, tanto est altius, et per consequens magis simplex et breve. Est autem verbum Evangelii abbrevians verba legis, quia omnia sacrificia figuralia legis in uno vero sacrificio comprehendit, quo Christus obtulit, seipsum pro nobis hostiam, ut dicitur Ephes. v. Omnia vero praecepta legis moralis in duobus praeceptis charitatis concludit : 'In his duobus mandatis universa lex pendet et prophetae.' (1)

Something similar may be said of the words of a Proemium. Just as the few words of the New Law contain the whole law, so the few words

(1) - St. Thomas, In Epistolam ad Romanos, Caput IX, v. 28.

of the Proemium contain the whole tract.

The nature of the words of a Proemium may be manifested by another comparison. In God, the plenitude of intellectual knowledge is contained in one thing, the Divine Essence. This plenitude is participated in by intelligent creatures to a greater or lesser degree. Thus, that which God knows in one thing, namely his essense, intelligent creatures will know through a multitude of species. The lower the intelligent being in the hierarchy of beings, the greater the number of species he requires for knowledge. Superior angels require fewer species than inferior angels. The species, then, of superior angels are more universal (1) than are the species of inferior angels. They extend to more things. This is in a way true of human beings. Some men may grasp the truth of a thing in a few concepts. Others need a detailed explanation of each particular. This is because of a certain weakness of their intellect. This is clear in the science of mathematics. Some men can grasp a problem and its solution by seeing but a few steps. Others must see every step.

There is something analogous to this in the words of a Proemium. In a few words the author can see in a distinct fashion all of the truths of a treatise. The student, however, can see the truth only in a confused way. The word itself is perfect but the student as yet cannot apprehend all of the truth which is virtually contained in it. He needs the long and slow development of the tract before he has a

(1) - Summa Theologica, I, q. 55, art. 3.

clear and distinct knowledge of that which is contained in the Proemium.

Looking at this same comparison from another angle, we might say that the words of a Proemium are similar to the species of the angels. They contain the whole tract. The words in the text are similar to the species of inferior angels. Many more of them are required to explain what is expressed briefly in the Proemium.

Despite the fact that they contain in germ the whole tract which still requires a long analysis, it is presupposed by the author that the student will give his assent to these words. The student accepts the division of the science as presented by the author and he accepts the brief words on the dignity of the science, its mode of procedure, its method according as the case may be. Now what is the motive for this assent to something which is known only confusedly and without detailed evidence ? The assent given here is the assent of faith. The nature and necessity of this faith is explained in a passage of the De Trinitate which we shall cite at length here. The key words are in the last paragraph as we have ordered the paragraphs.

In this passage, St. Thomas does three things. First of all he compares and distinguishes faith from science and opinion. It is similar to science in so far as it is certain. It is similar to opinion in so far as it is concerned with that that which is not evident to the intellect. Est de rebus quae non sunt intellectui naturaliter possibilia.

Secondly he shows the nature and necessity of faith when lack of evidence arises from the very nature of the subject matter, such as in human activity.

Thirdly he shows the nature and necessity of faith, when the lack of evidence is due not to the subject matter but to deficiency of our intellect. Such is the case when we treat of divine things. That which is most knowable to us is not the same as that which is most knowable in itself. As a matter of fact, that which is most knowable in itself is the last known by us. However, at the very beginning of science, we must presuppose that which is most knowable in itself. This can only be done by an act of faith on the part of the disciple.

> Ergo fides humano generi est maxime necessaria. Respondeo dicendum, quod fides habet aliquid commune cum opinione, et aliquid cum scientia et intellectu, ratione cujus ponitur medium inter opinionem et intellectum sive scientiam, ab Hugone de S. Victore. Cum intellectu autem et scientia commune habet certum et fixum assensum, in quo ab opinione differt, quae accipit alterum oppositorum cum formidine alterius, et a dubitatione quae fluctuat inter duo contraria; sed cum opinione commune habet quod est de rebus quae non sunt intellectui naturaliter possibilia, in quod differat a scientia et intellectu.
>
> Quod autem aliquid non sit apparens humano intellectui, potest contingere ex duobus, ut dicitur in II Metaph., scilicet ex defectu ipsarum rerum cognoscibilium, et ex defectu nostri intellectus. Ex defectu quidem rerum sicut in singularibus et contingentibus quae a nostris sensibus remota sunt, sicut sunt facta hominum, et dicta et cogitata; quae quidem talia sunt,

CHAPTER THREE

INTRODUCTION TO THE PROEMIUM TO THE PHYSICS.

We present here in parallel columns the Latin translation by William of Moerbeke of the Proemium to the Physics and the English translation of Hardie and Gaye.

Quoniam quidem intelligere et scire contingit circa omnes scientias, quarum sunt principia aut causae aut elementa, ex horum cognitione (tunc enim cognoscere arbitramur unumquodque, cum causas primas et prima principia cognoscimus, et usque ad elementa), manifestum quidem quae quae sunt circa principia scientiae quae de natura est, prius determinare tentandum.

When the objects of an inquiry in any department have principles, conditions, or elements it is through acquaintance with these that knowledge, that is to say scientific knowledge, is attained. For we do not think that we know a thing until we are acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements. Plainly therefore in the science of Nature, as in other branches of study, our first task will be to try to determine what relates to its principles.

Innata autem est ex notioribus nobis via et certioribus, in certiora naturae et notiora. Non enim eadem nobis et simpliciter. Unde quidem necesse secundum modum hunc procedere ex incertioribus naturae, nobis autem certioribus, in certiora naturae et notiora. Sunt autem primum nobis manifesta et certa confusa magis : posterius autem ex his fiunt nota elementa et principia dividentibus haec. Unde ex universalibus ad singularia oportet procedere.

The natural way of doing this is to start from the things which are more knowable and obvious to us and proceed towards those which are clearer and more knowable by nature; for the same things are not 'knowable relatively to us' and 'knowable' without qualification. So in the present inquiry we must follow this method and advance from what is more obscure by nature, but clearer to us, towards what is more clear and knowable by nature. Now what to us is plain and obvious at first is rather confused masses, the elements and principles of which become known by later analysis. Thus we must advance from generalities to particulars.

Sustintent autem idem hoc quoddammodo et nomina ad rationem. Totum enim quodammodo et indistincte significant, ut puta circulus. Definitio autem ipsius dividit in singularia.

For it is a whole which is best known to sense-perception, and a generality, is a kind of whole, comprehending many things within it, like parts. Much the same happens in the relation of the name to the formula. A name, e.g. 'round' means vaguely a sort of whole; its definition thus analyses this into its particular senses.

Et pueri primum appellant omnes viros patres et feminas matres : posterius autem determinat horum unumquodque.

Similarly a child begins by calling all men 'father' and all women 'mother', but later on distinguishes each of them.

This Proemium may be classed among the typical Proemia of Aristotle. Although it is a bit longer than many others, it does have the general characteristics which we have noted. It is comparatively brief. It indicates the subject matter of the treatise and finally it adds some considerations which Aristotle deems necessary at the beginning of this particular science. Here those considerations concern the order of procedure.

A cursory glance reveals that this Proemium has three parts. In the first part Aristotle recalls that science must begin with knowledge of principles and causes. In the second he indicates the order to be followed in the determination of these principles and causes. Science begins with knowledge of universal causes and proceeds towards knowledge of particular causes. In the third and last part, he manifests the meaning of the second part by means of three signs.

As the student begins the study of the Physics, a more or less common and confused knowledge of these paragraphs suffices.

However, it will be the purpose of our study here to go beyond this confused knowledge to a distinct knowledge of the order of procedure of the philosophy of nature. Consequently we shall make a rather detailed study of the Proemium, its ideas and words. We shall do this in three chapters. In this chapter, we shall expose the interpretation given to the Proemium by Ross. We shall do this in order that by contrast the interpretation which we follow, namely, that of St. Thomas may be more clearly manifested. Further, in this chapter, we shall make some remarks on the Introduction which St. Thomas prefaces to the Proemium. In Chapters Four and Five, we shall comment on the Proemium itself using St. Thomas as guide.

A. - The Interpretation of Ross.

Although the first few lines of the Physics are most important for our understanding of the philosophy of nature, there is no unanimity on their meaning. Among the modern interpretations is that of W.D. Ross[1] which we shall present here. The difference between the interpretation of Ross and that of St. Thomas is rather fundamental. It begins with the interpretation of the very structure of the whole of the Physics.[2] As was mentioned above, Ross considers the First Book of the Physics to be a completely independent work with no organic connection with the books which follow.

(1) - W. D. Ross, Aristotle's Physics (A Revised Text with Introduction and Commentary), Clarendon Press, Oxford, (1936).
(2) - See Chapter One, p. 32, note (1).

> In Book I Aristotle began the study of φυσικὴ with the conception of ἀρχαί, and the main result of the book was the establishment of three distinct ἀρχαί; ὕλη, στέρησις, εἶδος. In Book II he makes a fresh start by studying the conception of φύσις itself. There is no organic connection between the two books; they are independent approaches to the whole subject. Their independence is indicated not only by the absence of close connection in the thought, but by the absence of a connecting particle which is evidence so far as it goes that Book II was originally a separate essay. (1)

Granted that there is no organic connection between Books I and II, it follows that the Proemium of the Physics is not necessarily a Proemium to the whole of the work. How, then, does Ross interpret the Proemium ?

In a section which he calls analysis, he paraphrases the text of the Proemium as follows :

> 184a 10. Since scientific knowledge of anything involves knowledge of its first principles, the part relating to the first principles is the first part of the science of nature to be studied.
>
> 16. The path leads from what is better known to us to what is better known by nature. This path we must now follow; we must reach the first principles by analysis of the confused data we start with.
>
> 23. Hence we must proceed from universal to particular; for wholes are better known to sense, and universals are wholes.
>
> 26. Names are in the same relation to definitions; a name denotes a whole indefinitely, and a definition divides it into its particulars.

(1) - Ross, op. cit., p. 499.

184b 12. So too children first call all men fathers, and only later speak with more precision. (1)

In his commentary, Ross first of all describes the interpretation given to the passage by Pacius and then presents his own. We cite directly his exposition of the position of Pacius.

> Pacius describes Aristotle as propounding three methods for the study of the first principles of physics : (1) the methodus resolutiva a toto integrato ad partes integrantes; e.g. from a natural body into the matter and form that constitute it. This is the method described in 184a 21-23 and actually pursued in Book 1. (2) the methodus divisiva ab universalibus et a notioribus secundum sensum ad particularia. This is the method described in 184a 23-26 and followed in natural philosophy generally as it passes from bodies in general (studied in the Physics) to simple bodies (De Coelo) and then to complex bodies (De Generatione et Corruptione, Meteor. and the biological treatises). (3) the methodus definitiva a nomine ad definitionem, described in 184a 26 - b 12 and used passim in the physical works. (2)

Thus for Pacius, Aristotle does not give here one method and explain it by three signs as St. Thomas mentions in his commentary but rather he presents three different methods for approaching the study of nature. The first is to go from an integral whole to the parts and this is the method followed in the First Book, the second is to go from a universal to particular and this is the general process of concretion in all of the philosophy of nature and finally there is the method by which one proceeds from a name to a definition which is a method used here and there throughout the philosophy of nature.

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(1) - Ross, op. cit., p. 337.
(2) - Ibid., p. 456.

Ross criticizes this interpretation of Pacius and at the same time proposes his own. Pacius was correct in his explanation of each of the three methods but was incorrect in saying that they were three distinct methods. According to Ross, they are all describing a single method the exact nature of which was not clear to Aristotle himself.

> In the whole passage Aristotle seems to regard himself as describing a single method, as to whose precise nature however he is not very clear. (1)

This method has two features which are not clearly distinguished one from the other. The first feature is described in the section from 184a 16 to 184a 23. This is the section wherein Aristotle speaks about going from what is more known to us toward what is more known according to nature. This first feature is just the contrary of the process of science as proposed in the Posterior Analytics. "It is the method of reasoning back from what is confusedly given in experience to what that presupposes... The method is... akin to the process of inferring the presence of fire from that of smoke, except that it passes from whole to elements, not from effect to cause." (2) It is a method "of analysis of the confused data of experience into their elements." (3) This feature of the method is found in Book I where the experienced fact of change is analyzed into the elements, matter, form and privation.

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(1) - Ross, op. cit., p. 456.
(2) - Ibid., p. 457.
(3) - Ibid., p. 458.

The second feature is described in 184a 23 to 184b 12. This is the section in which Aristotle speaks of proceeding from universal to particular and in which he gives the illustrations of names and children. Ross describes this feature as that "of coming to recognize the specific nature of that whose generic nature alone is at first recognized."(1) This feature is seen exemplified frequently where Aristotle goes from a "more general to a more particular determination of some conception."

In his discussion of this second feature, Ross points out that Aristotle is using the word 'universal' (Καθόλου) in a different sense than that which is found in the Posterior Analytics.(2) In the Posterior Analytics the universal is that which is more known according to nature (γνώριμον τῇ φύσει). Here the universal is more known to us (γνώριμον ἡμῖν). "It is clear that καθόλου is not used in its usual Aristotelian meaning. The reference must be not to a universal conceived quite clearly in its true nature, but to that stage in knowledge in which an object is known by perception to possess some general characteristic (e.g. to be an animal) before it is known what its specific characteristic is (e.g. whether it is a horse or a cow)."(3) This second feature of the method is illustrated by two examples, the second of which is clear to Ross, while the first is not.

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(1) - Ross, op. cit., p. 458.
(2) - Here Ross refers to Chapter Two of the Posterior Analytics, I. St. Thomas studies this passage in his commentary on the Proemium.
(3) - Ross, op. cit., p. 458.

The pertinence of the second illustration is clear to Ross. Just as a child at first does not distinguish one man from another but calls all men 'father', so too in the philosophy of nature the initial knowledge is general. It is only after experience that we descend to the particular species. This second feature of the method is according to Ross evidenced in the rest of the Physics.

The first illustration, however, causes some difficulty to Ross. In this illustration, just as the name is contrasted to a definition, so too is general knowledge contrasted to specific knowledge. The problem, here, arises in interpreting the phrase

> "A name, e.g. 'round' means vaguely a sort of whole; its definition analyzes this into its particular senses." (1)

What can Aristotle mean here when he says that a definition analyzes into particular senses. Ordinarily a definition analyzes into logical elements, genus and differentia. Here, however, Aristotle uses the phrase τὰ καθ ἕκαστά. Strictly analyzed this would seem to indicate that definition analyzes into the different species. Does Aristotle mean that definition analyzes into parts or into species ? For Ross, it cannot mean into the parts because of the phrase τὰ καθ ἕκαστα. Secondly it does not mean division into species for the very example used here by Aristotle, namely, the circle has no species.

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(1) - Physics, Proemium.

Thus Ross opts for a third interpretation. It is the essential function of the definition to state the logical elements of a complex term. However, in doing this it will distinguish the various meanings of a term.

> τὰ καθ ἕκαστα seems to have here an unusual meaning : i.e. to mean the various senses of an ambiguous term. Though it is essentially the business of definition to state the logical elements of a complex term, incidentally in doing this it will distinguish the various meanings of the term if this happens to be ambiguous. Only on this interpretation, apparently, will the remark about definition serve to illustrate, even remotely, what it is put forward to as illustrating, viz. the transition from the recognition of the generic nature of an object to the recognition of its specific nature. (1)

Concerning the interpretation proposed by Ross, there are several remarks to be made.

(1). Canon Mansion has sufficiently shown the relation between the First Book and those that follow to enable us to look on the Proemium to the First Book as a Proemium to all of the Physics. Since the Physics is the first book of all natural science, it is quite plausible that the Proemium added to it be sort of a Proemium for all of natural science. This point, I think, Ross would grant because he does admit that the 'method' described here, at least as far as its second feature is concerned is found here and there throughout natural science.

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(1) - Ross, op. cit., p. 457.

(2). According to Ross, in this passage Aristotle is describing one method the nature of which is not very clear. It contains two features which are not clearly distinguished. On this point, it might be well to remark from the outset that ordinarily when we are commenting on the work of a philosopher of the stature of Aristotle, we presume that what he is saying is unified and coherent. This is not to deny that if there is obscurity or ambiguity, we should point it out. Now, in commenting on this passage, St. Thomas resolves the seeming obscurity as we shall see in the next chapters. Both for him and for St. Albert, the passage forms a unified whole. Their explanation does make sense. Ross, however, prefers to discuss the interpretation of Pacius which he admits is not correct and then proposes his own interpretation according to which on his own testimony the passage is not clear.

(3). Ross speaks of 'a single method' with two features which are not clearly distinguished one from the other. St. Thomas explains it otherwise as shall be seen in the next chapter. However, for the moment let us grant the distinct features pointed out by Ross. The first feature refers to the type of argumentation for as Ross says it is "akin to the process of inferring the presence of fire from that of smoke." St. Thomas would call this a discussion of the order of demonstration and with reason. It tells the type of argumentation. Now the second feature is explained by Ross as similar to the process by which we go from knowledge of a universal (for example, animal) to knowledge of the specific nature under that universal (horse, dog or

cow). Now there is no argumentation from animal to horse. When I stand at a distance from a moving object unless either the object moves closer to me or I closer to it, no amount of argumentation will tell me that it is horse, cow or man. This second feature is not a mode of demonstration. It should be placed under what St. Thomas calls the order of determination.

Now, granted that there are two features, they are clearly distinct. There is not confusion. The confusion would be dissipated by recognition of the distinction made by St. Thomas between the order of demonstration and that of determination. Now, actually St. Thomas does not apply this distinction to the two parts of the Proemium but rather shows that the Proemium treats of the order of determination while the Second Book describes the order of demonstration. It is true, however, that Averroes holds that here Aristotle speaks first of the manner of demonstrating and secondly of the manner of determination. The point we wish to make here is that on either interpretation the text is clear.

It is necessary to make this point clear. For if we confuse the order of demonstration with the order of determination "these two features are not clearly distinguished from each other", we will be apt to say that Aristotelian science argues not only from smoke to fire but also from animal to cat. It becomes a jeu de concepts.(1)

(1) - The importance of this distinction between the ordo demonstrationis and the ordo determinationis has been pointed out by Charles De Koninck, op. cit., pp. xxviii ff.

(4). In the next chapter we shall see how St. Thomas opposes both Averroes and Ross when they say that there are two features of the method. He shows that Aristotle is speaking of one method.

(5). We shall see too in our discussion of St. Thomas' commentary, that the illustration taken from the name and definition which Ross found obscure, does make sense in the text.

B. - The Introduction of St. Thomas.

1. - The Title.

Most of the ancient manuscripts of the Physics contain the title φυσικης Ακροασεως de Physico Auditu. Before discussing the Proemium it will be well to explain the meaning of this title, for the title itself suggests the nature of this particular work which is to discuss the general principles of nature in contradistinction to later works in the series of natural treatises.

Ross takes the title to mean that the Physics was given in form of a lecture and that the students listened to Natural Doctrine.(1) This reason is rather extrinsic and according to it all of the works of Aristotle could be called De Auditu.

St. Albert gives a reason which is more intrinsic but which does not seem to be completely justified. For him, the title indicates

(1) - Ross, op. cit., p. 18.

that the Physics does not proceed by way of demonstration from causes but rather is concerned with establishing the first principles. The doctrine, therefore of the Physics is not received by demonstration but by hearing.

> Dicitur etiam de auditu physico : quia ibi tanguntur ea quae auditu plus quam demonstratione sciuntur ex physicis, hoc est, principia physica universalia, ex quibus alia habent probari : propter quod aliquando intitulantur de principiis Physicis. (1)

This reason given by St. Albert is more intrinsic but it leaves much unsaid in so far as it does not explain how knowledge from demonstration differs from knowledge ex auditu.

St. Thomas makes a very brief comment on the title but one which in light of doctrine taught elsewhere is very illuminating.

> Hic autem est liber Physicorum, qui etiam dicitur de Physico sive de Naturali Auditu, quia per modum doctrinae ad audientes traditus fuit. (2)

The operative words here are per modum doctrinae. The teaching of the eight books of the Physics is given per modum doctrinae. This is not true of the De Coelo, De Generatione, De Anima or any other of the natural works. Now what does he mean by the phrase per modum doctrinae ?

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(1) - St. Albert, Liber Physicorum, I, Tract. I, Caput IV (edit. Borgnet), p. 10.
(2) - St. Thomas, In I Physicorum, lect. 1, n. 5.

Aristotle begins the Posterior Analytics with the following sentence :

> Omnis doctrina et omnis disciplina intellectiva ex praeexistenti fit cognitione. (1)

In his commentary, St. Thomas explains the relation between doctrina and disciplina :

> Nomen autem doctrinae et disciplinae ad cognitionis acquisitionem pertinet. Nam doctrina est actio ejus, qui aliquid cognoscere facit; disciplina autem est receptio cognitionis ab alio. (2)

Doctrina and disciplina are two aspects of one and the same thing. That which is taught per modum doctrinae is the very same as that which is learned per modum disciplinae.

Now, the classic text in St. Thomas for the explanation of the modum disciplinae is to be found in his commentary on the De Trinitate of Boethius. In the Sixth Question, Article One, the question arises :

> Utrum oporteat versari in naturalibus rationabiliter, in mathematicis disciplinabiliter, in divinis rationabiliter. (3)

It is the second of the two quaestiones which interests us here. The mode of discipline is attributed to mathematics not because mathematics is

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(1) - Posterior Analytics, I, c. 1, 71a 1. We have cited the Latin translation here because the English loses the words in which we are interested. "All instruction given or received by way of argument proceeds from preexistent knowledge."
(2) - St. Thomas, In I Posteriorum, lect. 1, n. 9.
(3) - St. Thomas, Expositio in Boethium de Trinitate, q. VI, a. 1.

the only science to proceed according to that mode but because the mode belongs more especially to mathematics than to other sciences, although it can be found in them too.

St. Thomas then proceeds to discuss what we mean by discipline.

> Cum enim discere nihil sit aliud quam ab alio scientiam accipere, tunc dicimur disciplinabiliter procedere, quando processus noster ad certam cognitionem perducit, quae scientia dicitur. (1)

The key word in this whole discussion is the word 'certain.' The more a science is certain, the more appropriate is it to it to proceed disciplinabiliter. Now mathematics is more certain to us than either natural philosophy or metaphysics. It is more certain than the philosophy of nature because it abstracts from sensible matter which can be a cause of incertitude. It is more certain than metaphysics, at least, as far as we are concerned, for the subject of first philosophy is too remote from the senses from which we draw our first knowledge. Thus standing in the middle as it were between metaphysics and natural philosophy mathematics is the most certain. It is most apt to be taught. The teacher can easily show the certitude in mathematics. Thus in the Ethics we are told that mathematics is the first science to be taught after logic, for it does not require the experience of natural philosophy nor the powers of abstraction of

(1) - St. Thomas, Expositio in Boethium de Trinitate, q. VI, a. 1.

metaphysics. (1)

However, as noted above, while the mode of discipline is attributed in a peculiar way to mathematics, it can also be found in other sciences. Such is the case with the first book of the philosophy of nature, the Physics. Here too what is taught is very certain and can be taught by way of doctrine. The reason for this is that this part of the philosophy of nature does not require the great experience and experiment required in the later parts. There is great certainty but this certainty is about very general principles. There is a certain abstraction here from matter which gives this part of the philosophy of nature a certainty akin to that of mathematics. This part of the philosophy of nature does not depend on a long and detailed experience. Consequently it can come before long experience. All it requires is a general knowledge that can be had by anybody.

2. - The Subject of Natural Science.

The first lesson of St.Thomas commentary on Book I of the Physics explains the Proemium to the Physics. We can divide this lesson into two parts; first there is the introduction of St. Thomas;

(1) - "Erit ergo congrua ordo addiscendi ut primo quidem pueri logicalibus instruantur, quia logica docet modum totius philosophiae. Secundo autem instruendi sunt in mathematicis quae nec experientia indigent, nec imaginationem transcendunt. Tertio autem in naturalibus; quae etsi non excedunt sensum et imaginationem requirunt, tamen experientiam. Quarto in moralibus quae requirunt experientiam et animum a passionibus liberum, ut in primo habitum est. Quinto autem in sapientialibus et divinis quae transcendunt imaginationem et requirunt validum intellectum." St. Thomas, In VI Ethicorum, lect. 7, n. 1211.

secondly there is the explanation of Aristotle.

In this introduction, St. Thomas does three things. First he establishes the subject of natural science. Secondly he establishes the subject of the Physics and finally he gives a general idea of the order of the phylosophy of nature.

Now this brief introduction of St. Thomas is itself sort of a Proemium with the characteristics of a Proemium which we mentioned above. It determines the subject and the order of the philosophy of nature and does this very briefly using words which are very perfect. It supposes a certain amount of faith on the part of the hearer in so far as things are briefly mentioned which will only be shown later on in the tract of natural science and even in the Metaphysics.

We have already seen how Aristotle determines the subject of natural science in the Second Book of the Physics. There it was a question of determining the meaning of the word 'nature' and of distinguishing natural science from mathematics. There was no need to distinguish either of the two from metaphysics. Here, however, St. Thomas gives proemialiter the complete doctrine on the distinction of the sciences. Although this treatment is brief it is more complete than that of Book Two of the Physics for here natural science is distinguished both from mathematics and metaphysics. In the Second Book of the Physics, however, everything is proven while here much is presupposed from the later books of the Physics and from the Metaphysics. The complete analysis of what St. Thomas proposes proemialiter here

is found in the Sixth Book of the Metaphysics.(1)

Starting out from the fact that science is in the intellect and that intelligibility depends on abstraction from matter and from the fact that science in so far as it is the effect of demonstration will be diversified by the mode of definition, he arrives at the conclusion that the subject of natural science is ens mobile.(2)

Having determined the subject of natural science, St. Thomas proceeds to determine the subject of this the first book of natural science, namely, the Physics. Natural science studies all mobile being. The Physics studies ens mobile in communi.(3) Before studying specific types of mobile being we should study its general characteristics. The reason given here by St. Thomas is rather extrinsic. We treat of common things in the beginning so that we will not be forced to repeat them in each tract. The reason is one of economy and differs from the more profound reason which Aristotle points out in the Proemium and which we shall see shortly.

Finally in his Introduction, St. Thomas indicates briefly the order to be followed in natural science.(4) Once we have discussed that which is common to all mobile being, we turn to a discussion of the species of mobile being. The first species is local motion and this is treated in the De Coelo. There follows in the De Generatione et

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(1) - St. Thomas, In VI Metaphysicorum, lect. 1.
(2) - In I Physicorum, lect. 1, n. 4.
(3) - Ibid., n. 5.
(4) - Ibid., n. 7.

Corruptione a discussion of motion to a new form and discussion of the first principles of mobility, the elements and their general type of motion. In the Meteorologica we discuss the specific movements of these elements. The De Minerabilius discuss motion in composites which are not living. There follows the study of motion in living beings in the De Anima and the tracts which follow on it. This division of natural science is based on the division of the three species of motion as determined in the Fifth Book of the Physics.(1) The first part treats of local motion. The second treats of qualitative and the third treats of quantitative.

After this brief introduction, St. Thomas proceeds to comment on the Proemium of Aristotle. The purpose of this Proemium is to manifest the order of procedure in natural science. This is done in two steps. First of all, Aristotle shows that we must begin with a consideration of principles. This is done in the first paragraph. Secondly, he shows that we must begin the study of nature with more universal principles. We shall study each of these steps in detail. In Chapter IV, we shall study the first section. In Chapter V, we shall study the second.

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(1) - "If, then, the categories are severally distinguished as Being, Quality, Place, Time, Relation, Quantity and Activity or Passivity, it necessarily follows that there are three kinds of motion - qualitative, quantitative, and local." Physics, V, c. 1, 225b 5-8.

CHAPTER FOUR

THE FIRST PART OF THE PROEMIUM TO THE PHYSICS.

In the first paragraph of the Proemium, Aristotle shows that we must begin the study of nature with a consideration of the principles.(1)

Quoniam quidem intelligere et scire contingit circa omnes scientias, quarum sunt principia aut causae aut elementa, ex horum cognitione (tunc enim cognoscere arbitramur unumquodque, cum causas primas et prima principia cognoscimus, et usque ad elementa), manifestum quidem quae sunt circa principia scientiae quae de natura est, prius determinare tentandum.

When the object of an inquiry, in any department, has principles, conditions, or elements, it is through acquaintance with these that knowledge that is to say scientific knowledge is attained. For we do not think that we know a thing until we are acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements. Plainly, therefore, in the science of Nature, as in other branches of study, our first task will be to try to determine what relates to its principles.

St. Thomas reduces the argument of this first sentence to a syllogism in which is contained everything given in Aristotle except the proof of the major. This syllogism is very clear and I think the best instrument we can use in our study of the text.

> In omnibus scientiis quarum sunt principia aut causae aut elementa, intellectus et scientia procedit ex cognitione principiorum, causarum et elementorum.
>
> Sed scientia quae est de natura habet principia, elementa et causas.(2)
> Ergo in ea oportet incipere a determinatione principiorum.

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(1) - Physics, I, c. 1, 184a 9-15.
(2) - St. Thomas, In I Physicorum, lect. 1, n. 15.