

The Science of Logic

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FORMAL LOGIC

Introduction

The Definition of Logic

REASONING AND THE SYLLOGISM—What is logic and so what? Is it emotionless criticism worthy of the Vulcan name? If so, it would seem that the logician is almost inhuman; at least, that's the message that Spock seems to give. The logical person, he seems to say, denies all those areas which distinguish man from other animals and it turns him into a cold, analytical computer. Quite to the contrary, as we'll see in this course, Logic perfects man in that precise area which makes him to be specifically human: namely, reason. And the emotions aren't denied or destroyed by Logic, but rather, a logical and prudent man will use what Logic teaches to properly discipline the emotions—in this way, anger, love, desire etc. will not be buried deep in the human personality, but instead they will only appear at the right time and in response to the right objects. Logic will actually make man more human by perfecting his reason and making it act as it should, just like the medical doctor will perfect the human body and make it perform and function as it should.

But what is reason? And how is it perfected? Perhaps its easiest to explain what reason is by first giving some examples. I have a son, Liam. He's three months old. And one of the things that my wife has impressed upon me is that I need to constantly check his diaper. If it feels wet, then I need to change him. So, about every hour I examine his diaper. And I'll say something to myself along these lines:

His diaper is wet.
Therefore, I need to change it.

In saying this, I've actually gone through an informal process of reasoning. By saying 'therefore' I'm indicating that the second statement follows from the first as a consequence. But there's a third element implicitly contained in my hourly process of reasoning: namely, the command of my wife—if Liam's diaper is wet, then I need to change him. If we were actually to state this command as it implicitly appears in the reasoning, we would get the following:

If Liam's diaper is wet, then I need to change him.
But Liam's diaper is indeed wet.
Therefore, I need to change him.

This fully stated process of reasoning is called a syllogism. It's a movement of the intellect from two truths that we know (e.g., my wife's command, and the fact that Liam's diaper is wet) to a third truth that we previously did not know: namely, the conclusion that I need to change Liam now. Before I joined my wife's command with the fact that Liam's diaper is wet, I didn't know for sure whether or not I needed to

change him. But by knowing that a wet diaper means ‘change him’, and by knowing that, in fact, his diaper is wet, the conclusion is caused in my mind by certain logical laws. It’s these logical laws connecting the statements and the conclusion that we’ll be studying in this course.

We go through reasoning processes like this all the time. Whenever we intellectually analyze something, or make decisions about what to do, we use reasoning processes similar to the one above. If we walk outside and see that the ground is wet, we might reason to the conclusion that it rained. We might say:

The ground has become wet.
But a wet ground might be caused by rain.
Therefore, it might have rained.

And to strengthen the likelihood that rain was the cause, we might add other processes of reasoning:

A wet ground is caused by rain if I observe nothing else that could have moistened it. But I don’t observe anything else that could have moistened it (e.g., no sprinklers, no broken water main, etc.).
Therefore the wet ground is caused by rain.

Even when we try to decide where to go out to dinner, we use processes of reasoning. ‘Should we go to the steakhouse for dinner?’ ‘No, I don’t like their food’. That is:

We shouldn’t dine at a place which gives me displeasure.
But the steakhouse is a place which gives me displeasure.
Therefore, we shouldn’t dine at the steakhouse.

And a plethora of examples can be found in political debate:

What leads to a shortage of needed doctors is bad for health care.
But nationalization of health care coverage leads to a shortage of needed doctors.
Therefore nationalization of health care coverage is bad for health care.

Of course, we very rarely state the syllogism in this long, explicit form. We usually just resort to an abbreviated form of the syllogism (e.g., ‘Why shouldn’t we nationalize coverage? Because it leads to a shortage of doctors.’). And though this might make conversation a lot easier (and a lot more colorful!), it also leads to a lot of mistakes. Often times, what we mean in that abbreviated syllogism contains logical errors of which we aren’t aware. Hence, Logic will help us to avoid error by ‘blowing up’ and exposing the syllogisms that we employ to examine them closely. You’ll be surprised just how many arguments used in the political arena are totally fallacious! Then again, maybe you won’t be... The point is that all human discourse employs this syllogistic reasoning. Literature, poetry, and scientific inquiry cannot escape from the fact that the mind, in coming to new knowledge, always works in syllogism. And in this course we will take examples from each to ‘blow up’ the syllogisms and analyze them. This ‘blowing up’ is what we call putting arguments into strictly syllogistic form.

Let’s take a passage from St. Thomas to see the process of reasoning contained within it:

“It is natural for man, more than for any other animal, to be a social and political animal. For all other animals, nature has prepared food, hair as a covering, teeth, horns, claws as means of defense or at least speed in flight, while man alone was made without any natural provisions for these things. Instead of all these, man was endowed with reason, by the use of which he could procure all these things for himself by the work of his hands. Now, one man alone is not able to procure them all for himself, for one man could not sufficiently provide for life, unassisted. It is therefore natural that man should live in the society of many.”¹

The argument contained in this passage might be ‘blown up’ as follows.

A creature which cannot procure all the natural provisions for life without assistance of others, is a creature which is naturally ordered to live in society.

But man is a creature which cannot procure all the natural provisions for life without assistance of others.

Therefore, man is a creature which is naturally ordered to live in society.

Putting the argument in this very clear form we see that the inability to procure all of life’s necessities is being used to compare two things: namely, man and the natural ordering to live in society. In this example, Thomas is arguing syllogistically that providing for all of life’s necessities is the final cause or reason why man is naturally ordered to live in society.

The arguments of St. Thomas are some of the clearest ever written. Pick out a few other passages in Thomas’s writings and see if you can put them in this strictly syllogistic form.

LOGICAL RELATIONS or SECOND INTENTIONS—THE OBJECT OF LOGIC—When a thing exists outside of the mind, it has certain physical properties and characteristics. A baseball, for example, has a certain weight, diameter, hardness, temperature, etc. But when it is conceived, it takes on certain logical characteristics which belong to it precisely in this mental existence. For example, the baseball becomes a ‘noun’, and in the statement, ‘a baseball was pitched’ it becomes a ‘subject’ while ‘pitched’ is the predicate. So everything has a twofold set of properties: one set as it exists outside the mind, and another which are added to it only when it is conceived by the intellect.

Take the following example of reasoning:

If Joe is a pitcher, then he is baseball player.

But Joe is a pitcher.

Therefore, he is a baseball player.

Joe and the game of baseball are real things that exist independently of the mind. You can see Joe, you can go to a baseball game, you can throw out a pitch, etc. But there is something in the syllogistic argument that can’t be touched, or watched, or tasted, or in any way sensibly experienced. There is something in the argument that exists in the mind along and is known only by the intellect. Namely, the relationship between if and then. The if-then statement is nothing real; it doesn’t exist outside the mind and you’ll never encounter it walking down the street. Joe is a physical reality and exerts a

¹ De Regno, L. I, c. 1, n. 5

real cause on the motion of the baseball he is throwing. This force which he exerts as a pitcher can be studied, measured, and varied. The physics of throwing out a baseball has its own properties and determinable laws. But the physicist will never bottle up the 'if-then' relationship and put it under a microscope. Nevertheless, it has its own laws which can be known and studied. The 'if-then' relationship with all its knowable properties and laws is just one example of a logical relationship. While the physicist might be interested in the density of the ball, the speed of the pitch, and the relationship between the two, Logic is interested in things like the relationship between 'if' and 'then'. Imagine if we were to say:

If Joe is a pitcher, then he is baseball player.
But Joe is a baseball player.
Therefore, he is a pitcher.

As we will learn later, this violates a special law of reasoning. Just because Joe is a baseball player it doesn't follow that he is a pitcher. He might be a right fielder, for instance. If the argument were true, then everyone playing baseball would be a pitcher. So we have two kinds of orders that can be examined here. We have the real physical order with which the physicist deals when examining the velocity of the ball, or the ability of Joe to toss out a pitch; and we have the logical order which considers Joe, not as a physical being, but as a part of the if-then relationship. Studying this non-physical way of existence is what concerns the science of Logic.² And as we'll learn there are determinate rules which govern these logical relationship; not only the 'if-then' relationship, but the subject-predicate relationship, the principle-conclusion relationship, and many, many others.

Let's take a few more examples.

Every corporeal (i.e., bodily) being is corruptible (i.e., can be broken apart).
But every man is a corporeal being.
Therefore, man is corruptible.

Man and bodily beings are real things that exist outside the mind. But in this syllogism bodily being is related in a special, logical way to man and corruptibility. As we'll learn later, this special way of being related is called the 'middle term'. Corporeal being, in the syllogism, is related as the middle term which joins man and corruptibility. And because the relationship of corporeal being to the other terms is employed validly here (i.e., it doesn't violate any logical rules), the conclusion follows from the premises. Because the logician knows what a middle term is, and because he knows the rules for uniting two terms by means of a middle term, he can look at this syllogism and pronounce that the reasoning is good. But what happens if we are to switch a few things around? What if we said:

Every corporeal being is corruptible.
But every man is a corruptible.
Therefore, every man is a corporeal being.

² In I Post. Anal, lect. 2.

Well, the conclusion is perfectly true, but this is not a good process of reasoning. One of the rules of logical relationships is being violated here. As we'll learn a little later, 'corruptible' is being used as a middle term uniting man and corporeal being, but it's not supposed to be doing this. Let's use a more obvious example to illustrate the point:

Every plant is corruptible.
But every man is corruptible.
Therefore, every man is a plant.

The process of reasoning used here is exactly the same as the previous example, but we can clearly see that an error has been made. It's not necessary that you know right now exactly what that error is, but you need to understand the importance of examining the logical relationships that exist between our various concepts. An improper change of relationships will lead to a very troublesome reasoning process. These relationships are the object of the Science of Logic.

The rules governing logical relationships are not always easy to see. As with the laws governing physical reality, it often takes much laborious inquiry and a long time at study in order to determine them with precision. Only a person who makes the effort to know and understand these rules will be able to reason well; and he who devotes the time necessary to mastering these rules will not only be able to reason well, but he will be able to defend everything that he says, and he will be able to destroy the erroneous arguments of others.

THE SCIENCE AND ART OF LOGIC—Now, when it comes to judging that rain causes the ground to be wet, as we used in an earlier example, most people have no problem with this reasoning process. It's quite easy to see that no other explanation will adequately account for the outdoors being so hazy and wet. Even people who have never taken a course in Logic can make such simple syllogistic processes. In fact, some of the greatest scientists have never been formally schooled in Logic. Yet, they are generally competent in making rather complex rational arguments. This is because everyone has the natural ability to reason. Since we first formed propositions as children we have been actively reasoning about the world. This innate, native ability to move from previous knowledge to new knowledge by means of syllogizing is as natural a function of the mind as growing and nourishing is to the body. But there is still a big difference between the two.

The growing body is naturally ordered to grow in a certain way; it is determinate in its processes and these natural inclinations cannot be changed. The body will always tend to grow in one way, and any variation will mutilate the body. But the intellect is not so determined. In fact, in judging about things—that is, in saying that such-and-such is true or such-and-such is false—the intellect is not at all determined by nature. It may judge something to be true which really is true, but then again, it might judge something to be true when in fact it's false. Though the intellect naturally judges and naturally reasons, it doesn't always reason correctly about this or that particular material. In a similar fashion, our fingers naturally move, but they don't naturally move in a manner required for, say, playing the piano. If they did, then everyone would naturally be a pianist. But we aren't all pianists. To become a pianists we have

to learn specific rules for moving our fingers in such-or-such a pattern in order to strike the keys in the right way. The movement of the fingers is indeterminate to playing any instrument (be it piano, or trumpet, or violin), and we require—in addition to our natural ability to move them—the art of piano playing by which our fingers are determined to move in a way suited to playing the piano.³ So by examining the motions of the fingers we develop certain rules by which the fingers are best disposed to playing the piano; we might call this ‘piano theory’ or the ‘science of piano playing’. And by consistently moving our fingers according to the rules laid down in the ‘science of piano playing’ we will gradually develop the habit or ‘art of piano playing’. Only then will we be pianists.

The intellect works in the same way. Though we all have the natural ability to reason (just as the natural ability to move our fingers), we don’t always employ this properly to get the desired effect; namely, true and certain knowledge. Occasionally, by the natural ability to reason alone we get lucky and reach true and valid conclusions—just as occasionally the new piano student can play a passage perfectly—but we only possess the art of reasoning when we can do it consistently and without much effort—just as the student only becomes a pianist once he can consistently and easily play the same passage without making any mistakes. So in addition to our natural ability to reason, we will require a habit of consistently reasoning well and without error. This is what we call the art of Logic. And just as the rules for playing the piano have to be laid down first before we can knowingly practice piano playing in agreement with those rules (i.e., the ‘science’ of piano playing must precede the ‘art’), so the ‘science of reasoning well’ must precede the ‘art of reasoning well’. In other words, we only get the art of reasoning well when we know the rules laid down by the science of reasoning well and we make a concerted effort to reason according to those rules until we have developed the habit of good reasoning. The term ‘logic’ then refers to the Science of Logic which studies the logical relationships present in the syllogism and lays down rules for reasoning well; but it also refers to the Art of Logic which is the habit of reasoning well that we acquire but constantly reasoning accordance with the laws laid down by the Science of Logic. Our course is in the Science of Logic. We will examine the various logical relationships that exist in the syllogism and we will lay down the laws for proper reasoning. But we learn the Science of Logic in the hopes that you will practice thinking in accordance with the laws until you develop the habit of thinking clearly, orderly, and error-free: we study the Science in hopes that you will acquire the Art.

From all that we’ve said, it’s easy to see why Logic has come to be nominally defined as ‘Rational Science’ or ‘the science and art that directs the acts of reason’. It’s not only concerned with studying the acts of reason or determining what these acts are—such is really the domain of psychology—but it’s interested in determining how these acts of reason ought to be ordered so that reasoning is right and true. Logic is called rational science not only because it is reasoned knowledge (all science is reasoned knowledge) but because its final cause is to determine how best to exercise and coordinate our mental operations for the sake of acquiring truth while exploring the various areas of the knowable universe. Hence, according to its etymology, Logic is nominally defined as the art or science of reason.

³ I-II, q. 57, a. 3

St. Thomas puts all this very succinctly:

In the beginning of his *Metaphysics*, Aristotle states that the human race lives by art and reasoning. He seems to touch here on something properly human, which distinguished man from the other animals. For while the brute animals are moved to their actions by natural instinct, we direct our actions by rational judgments. To enable us to carry out these actions easily and in an orderly way, we have invented many arts. For an art is nothing other than a certain ordering of reason by which human acts achieve a suitable end through determinate means.

Now reason is able to direct not only the acts of inferior faculties, but also its own acts. For the capacity to reflect upon itself is proper to the intellectual power; the intellect understands itself and, similarly, reason can reason about itself. Now, if by reasoning about the acts of the hand, we discovered the art of building, and this art enables us to build easily and in an orderly way, then, for the same reason, we need an art to direct the acts of reason, so that in these acts also we may proceed in an orderly way, easily, and without error. This art is logic, the science of reason.

Logic concerns reason not only in the sense that it is according to reason (this is common to all the arts), but also in the sense that it is about the acts of reason itself as its proper matter. Therefore, it seems to be the art of arts, inasmuch as it directs the acts of reason, from which all the arts proceed.⁴

So to give the real definition of the Science of Logic we would say that it is the rational investigation of logical properties determining the rules by which the operations of the intellect are directed to attaining truth. And the real definition of the Art of Logic would be the habit by which man may proceed with ease, order, and without error in the very acts of reason themselves.

The Divisions of Logic

The Art of Logic

The Science of Logic

So we've seen that Logic is divided into the Art of Logic and the Science of Logic. How else is it to be divided?

Logic is a kind of mental construction; it builds up in our intellects a complex construct of various relationships; it builds arguments and sciences. Now, in any kind of construction we have to consider two things: namely, the material or matter out of which the construct is built, and the form which is given to that matter. So in building a house, we have to consider what will be used to build the house (e.g., stone or wood or brick, etc.) and we have to consider how that material is going to be arranged (e.g., four walls, a proper foundation, a roof which will protect from the elements, etc.). Knowledge of both the matter and form will be required to properly construct a house. Even if an architect has an exact knowledge of blueprints and knows precisely how to arrange all the parts to create a perfect home, nevertheless the house isn't going to stand if he picks an inferior material. On the other hand, even if he knows the

⁴ In *I Post. Anal.*, prooem.

strongest and best materials to use in building a house, even if he knows the absolute best material for constructing a roof, this won't matter at all if he doesn't have any knowledge of the blueprints. Hence, both matter and form are necessary in the construction of something.

Logical constructions are no different. The matter of the syllogism, and hence the matter of reasoning, is the concepts and propositions that go to making up the argument; while the form of the syllogism is the particular disposition of those concepts and propositions within the syllogism itself. So in the syllogism:

Every animal has senses.
But man is an animal.
Therefore man has senses.

'Animal', 'having senses', and 'man' are the matter, but also the propositions 'every animal has senses' and 'man is an animal' are the matter. The form, however, has to do with the arrangement of this matter within the syllogism. The form in this example might be expressed as follows:

Every A is B
But C is A
Therefore, C is B.

If we want to have a good and proper syllogism we need to know not only how the concepts and propositions should be arranged (i.e., the form of reasoning), but we also need to know what types of concepts and propositions these should be (i.e., the matter of reasoning). Take the following example:

Every bird can fly.
But pigs are birds.
Therefore, pigs can fly.

Notice that this follows the exact same form of the previous argument (Every A is B, but C is A, therefore, C is B); from the point of view of this form we have a perfectly valid reasoning process. No one can deny that if A is B and C is A then C will be B. Yet the conclusion isn't true. Pigs don't fly. For true reasoning it isn't enough that the form be valid but the material which is plugged in for A and B and C must be the right kind of material. Take the following examples:

Every man is an animal.
But all animals require nourishment.
Therefore man requires nourishment.

All soccer balls are donkeys.
But all men are soccer balls.
Therefore, all men are donkeys.

Both examples follow the exact same form of reasoning—all A is B, but all B is C, therefore all A is C—and consequently they are both valid processes of syllogizing. But there is a big difference between the two. In the first example, every statement is true

and as a consequence the conclusion is true. But in the second example, none of the statements is true; the matter is not what it should be. So there is a big difference between the form of reasoning and the matter of reasoning. When the form is as it should be a syllogism is said to be valid. When the matter as well as the form is as it should be the syllogism is said to be true.

Let's take three more examples:

1) Every animal has senses.
But man is an animal.
Therefore man has senses.

2) Every animal is rational.
But a dog is an animal.
Therefore, a dog is rational.

3) Every animal is living.
But every living thing has senses.
Therefore, everything with senses is living.

In the first example, all the statements are true and the reasoning process is valid. It's a good syllogism in regard to both matter and form. In the second example, the reasoning process follows the same form as the one before it, but one of the statements is false; i.e., it fails to be a good syllogism because of its matter. Hence, it is valid but not true. In the third example, we have defects in both matter and form: it's not valid to argue Every A is B, but every B is C, therefore, every C is B. And it's not true that every living thing has senses (some living things are plants).

So the science of Logic studies both the form and matter of reasoning. Formal Logic is that part of Logic which studies what must be the disposition or arrangement of concepts and propositions so that reasoning be correct and valid. Material Logic is that part of Logic which teaches what the content and mode of expression of concepts and propositions must be in order that the conclusion of reasoning be true and certain. This semester we will be studying Formal Logic, next semester we will be studying Material Logic.

Formal Logic

Now, Formal Logic is subdivided according to what we will call the three operations of the intellect. So far we have seen a good number of examples of the syllogism or reasoning. This is the process by which the mind gradually progresses from old knowledge to new knowledge which was potentially contained in the old⁵:

Every man is an animal.
But all animals require nourishment.
Therefore man requires nourishment.

⁵ I, q. 79, a. 8.; De Veritate, q. 15, a. 1

But before it can undertake this rational process of combining judgments together, the mind must first make those judgments; that is, it must judge that 'every man is an animal,' and it must judge that 'every animal requires nourishment.' But that's not all. Before it can judge that 'every man is an animal' and 'every animal requires nourishment', the intellect must know what man, animal, and nourishment are. It must apprehend the concepts of 'man', 'animal', and 'nourishment.' So in order to reason, the intellect must first judge, and in order to judge the intellect must first apprehend. So we have three operations of the intellect, one ordered to the next.⁶ And these are:

Simple Apprehension
Judgment
Reasoning

Simple apprehension is the intellectual act whereby you conceive of something without affirming or denying anything about it. So I think 'animal' without asserting or denying anything about the nature of animal. I don't think 'animals are living' or 'animals are not plants'. I simply apprehend a nature or essence or, what we will call, a 'quiddity'. Quiddity means the essence of a thing. It's derived from the Latin question 'quid est?' or 'what is it?' A quiddity is anything which can be conceived by the intellect and manifests what a thing is. Thus, man, whiteness, learned, animal, nourishment, etc. are all quiddities. In simple apprehension I conceive of a quiddity, even if only vaguely and obscurely, without affirming or denying anything about it.

Judgment is the act of the intellect whereby it composes or divides concepts by affirming or denying them of each other.⁷ Hence, 'animals require nourishment' composes or joins together the simply apprehended concepts of 'animal' and 'nourishment' by affirming (or 'predicating', as we will call it) nourishment of animal. Again, 'no animal is a plant' divides or separates the concepts of 'animal' and 'plant' by denying or negating plant of animal. When I say 'man is an animal' my intellect is assenting or approving or 'seeing' the composition of the predicate 'animal' with the subject 'man' in the same subject; that is, the intellect is apprehending not just the concepts but its understanding that the thing represented by the subject (i.e., man) and the thing represented by the predicate (i.e., animal) are found together in reality outside the mind identified in the thing being observed and considered (i.e., the man being studied). Whereas there is no logical truth in simple apprehension (e.g., the concept 'nourishment' is neither true or false), there is indeed truth and falsity in the judgment (e.g., it is false to deny nourishment of animal, and it is true to deny plant of animal). When we compose what is separated in reality or separate what is composed in reality, we have falsehood.

Simple apprehension and judgment are the elements of reasoning. And everything composed of elements depends on the integrity of those elements for its own integrity;

⁶ In I Post. Anal., lect. 1, n. 4; In I Periherm. (De Interp.), lect. 1, n. 1-2; In III De Anima, lect. XI; I, q. 85, a. 5.

⁷ De Veritate, q. 14, a. 1

as they say a chain is only as strong as its weakest link. So in order to properly build up the syllogism we must deal with each operation in turn. That is, if Logic wishes to perfect the intellect's ability to reason, it must also perfect (insofar as it can) the intellect's ability to apprehend and to judge. For this reason, Formal Logic is divided into the Logic of the First Operation (i.e., simple apprehension), the Logic of the Second Operation (i.e., judgment), and the Logic of the Third Operation (i.e., reasoning).

Formal Logic of the First Operation

Formal Logic of the Second Operation

Formal Logic of the Third Operation

Material Logic

Material Logic is also subdivided. The goal of logical training is to lead the mind to perfect knowledge; knowledge which is not only true, but certain as well. That is, knowledge which cannot possibly be false. When we have a syllogism that leads to knowledge that cannot possibly be in any other way then we have demonstrative knowledge. In demonstrative knowledge, the intellect has no choice but to assent to the conclusions; it sees why the conclusion necessarily follows from the premises and it sees why the opposite cannot possibly be true.

So: a plane figure with three sides necessarily has three interior angles equal to 180 degrees.

But an isosceles triangle is a plane figure with three sides.

Therefore, an isosceles triangle necessarily has three interior angles equal to 180 degrees.

This syllogism is absolutely certain; the premises are certain because this is definition of a triangle and the conclusion is certain because it validly follows from the certain premises. The conclusion is demonstrated.

But sometimes, the intellect is not so compelled by the evidence given to it that it necessarily assents to the conclusion. Sometimes the propositions or judgments that make up the syllogism are not unquestionably certain and true, but they are only probable. To be probable means to be 'open to debate'. A probable premise is one which might be true but nevertheless doesn't exclude the possibility that it is false. So when we say,

All mothers love their children.

But Jane is a mother.

Therefore, Jane loves her children.

The first proposition, namely, that all mothers love their children, is not necessarily true. Though nature gives each mother a natural inclination to care for their children, we know from sad experience that some mothers violate this natural tendency and despise their children. So the conclusion that Jane will love her children just because she is a mother follows only with a certain amount of probability, but it's open to

debate. Syllogisms that don't remove all demonstrate something, that is, syllogisms that lead to a conclusion which may be true but may be false pertain to what we call Dialectic. Dialectic is the part of Logic which establishes a method of arguing from probable principles. Most modern science makes use of dialectic. When the botanist notes that plant A exerts a certain gas, and plant B exerts the same gas, and plant C as well, and then notices the same gas being given off by plants D, E, F, and so on, he might conclude that all plants give off this gas. But his conclusion is only probable. Why? Look at his argument:

What is true of plants A-Z is true of all plants.
But giving off this gas is true of plants A-Z.
Therefore, giving off this gas is true of all plants.

His first proposition is only probably true. Perhaps plant YYY doesn't give off this gas, but the botanists stopped just before examining plant YYY. As it stands, his conclusion is only probable; that is, it might be false. He will require more evidence to demonstrate his conclusion. It must be proven, which is why a probable proposition might also be called provable ('probable' comes from the Latin 'probare' meaning 'to prove').

Now, Demonstrative Logic and Dialectical Logic appeal directly and exclusively to the intellect. In demonstration the intellect is compelled to assent to the conclusion because it sees that something is true and it sees that the opposite must be false; in dialectic the intellect sees that the conclusion is possible but makes no irreversible commitment to the truth or falsity of the conclusion. However, there is a lower level beneath dialectical argumentation which appeals not only to the intellect, but to the will as well. And we call this Rhetoric.

In Rhetorical argument, the intellect is not compelled by the evidence to believe one side or another just as in dialectic, but the arguer intends to persuade the will (not the intellect) to choose one side over another; to accept a conclusion not because the intellect sees evidence to support that conclusion, but because it is proposed to the will as something which is good to believe. In other words, the rhetorician doesn't want to prove anything to you. Rather, he wants you to believe that it is a good thing to accept his position and a bad thing not to accept it. He is not concerned with truth, but with desire. Rhetoric makes up the bulk of modern political debate. Rarely will you here a politician or political commentator appeal to the intellect through cogent, reasoned arguments defending and proving his position. Instead, he will try to persuade you that undesirable things will follow if you don't believe him and accept his position.

Now, even lower than Rhetoric we have the domain of Poetics (sometimes called 'Literary Argument'). Poetics is the lowest form of reasoning. It makes almost no appeal to the intellect; its syllogisms are fraught with abuse and equivocation or, sometimes, missing entirely. Poetics is an attempt to persuade you to accept a position because of a pleasing or displeasing representation. Describing an event with harsh and unpleasant words is a poetic tool; by using words that upset us, it is hoped that you will reject what is taking place at that event. Speaking of a political proposal with words that make us feel good is the same kind of argument. It is hoped that we will accept it because of the way it makes us feel. Poetical argumentation, then, makes

no appeal to the intellect or to logical proof. It is aimed at the emotions; it is an attempt to manipulate the passions in the hope that we will follow them instead of reason. Hollywood documentaries are a prime example of poetics. We accept the charge to combat global warming because we feel sorry for all the images of polar bears stranded on melting ice. Never mind the scientific evidence in favor or against man-made global warming, and never mind the rational examination of our obligations to animals; no, we accept global warming and our duty to end it merely because the images make us feel guilty. Poetical argumentation, for all its beauty and use, becomes an insult to man's rational nature when it forces him to act contrary to the dictates and commands of reason. And spotting poetical argumentation can be very simple: it usually involves the word 'feel' (as in 'don't you feel...' or 'I just feel that...').

Now, sometimes reason fails completely in making an argument because of some defect or substantial error in its reasoning. This is called Sophistry. We won't study this in Material Logic. Instead, we study it at the end of Formal Logic because all sophisms, as we will see, are defects in the form of reasoning, not in the matter of reasoning.

So depending on the matter which is used, reasoning can either be Demonstrative, Dialectical, Rhetorical, or Poetical. Hence, Material Logic is divided into those four branches. In the second semester of our course, however, we will only study Demonstration and Dialectic. The reason is because Rhetoric and Poetics require a knowledge of the passions and the will, and these aren't studied until you reach Psychology. Demonstration and Dialectic, on the other hand, make no appeal to the passions or will, but only to the intellect.

St. Thomas summarizes what we have seen while commenting on Aristotle:

The parts of Logic must therefore correspond to the different acts of reason, of which there are three. The first two belong to reason insofar as it is a kind of intellect [i.e., insofar as it simply understands without moving itself through a syllogistic process]. The first of these is the understanding of indivisible or simple things [i.e., the simple apprehension of a quiddity], the act by which we conceive what a thing is (some call this act 'intellectual representation' or 'intellectual imagination.') Aristotle's teaching in the Categories is ordered to this act of reason. The second act of the intellect is the composition or division of things that are understood, the act in which truth or falsity is found [i.e., judgment]. Aristotle considers what pertains to this act in his On Interpretation. The third act is proper to reason itself; it is the act by which we proceed from one thing to another, so as to arrive at a knowledge of the unknown from the known. The remaining logical treatises [of Aristotle] pertain to the third act of reason.

In certain respects, the acts of reason are similar to natural acts (hence, art imitates nature as much as possible). Now, natural acts differ in three ways. In some of them, nature acts with necessity so that it cannot fail. In others, it usually achieves its proper act, although it sometimes fails. Here there are two possible acts. One takes place for the most part, e.g., when a physically complete animal is generated from the germ cells. The other takes place when nature fails to achieve the appropriate result, e.g., when an abnormal animal is born, because of a defect in the generative process.

This threefold difference is also found in the acts of reason. One process of reasoning leads to a necessary result where truth cannot fail [i.e., Demonstration]. Through this process we acquire the certitude of science [by which Thomas means true and certain knowledge

demonstrated by the syllogism]. Another process attains truth for the most part but not with necessity [i.e., Dialectic, Rhetoric, and Poetics]. A third process fails to attain truth because of a defect in some principle which should have been observed in the reasoning process [Sophistry].

The part of Logic concerned with the first process of reasoning is called the 'judging' part, because judgment achieves the certitude of science. Now, we cannot judge about effects with certitude unless we resolve them into their first principles [i.e., all demonstrative syllogisms must ultimately rest on self-evident judgments which cannot be doubted, as we'll learn later]. Therefore, the judging part of Logic is called 'analytics,' i.e., the analyzing or resolving part [i.e., tracing the processes of reasoning back to the self-evident judgments on which they are based]. The certitude of judgment achieved through analysis is based either on the form of the syllogism alone or, together with the form, on the matter of the syllogism, i.e., on propositions which are per se and necessary [we'll learn about these later]. The analysis based on the form [i.e., Formal Logic] is treated in the Prior Analytics, which considers the syllogism in itself, and the analysis based on matter [i.e., Material Logic] is treated in the Posterior Analytics, which considers the demonstrative syllogism.

The part of Logic which pertains to the second process of reasoning is called the 'inquiring' part. Inquiry does not always arrive at certitude; hence, what is discovered by inquiry must be submitted to judgment before certitude is possible. Just as among the natural processes which occur for the most part, there are various degrees (for the stronger a natural power is, the rarer its failure to achieve its proper effect), so, among the rational processes which lack certitude, there are various degrees, depending on how closely each one approaches to perfect certitude.

One such process, while falling short of science, does achieve belief or opinion because of the probability of the propositions from which it argues. Reason fully embraces one part of a contradiction, though not without some fear that the other part may be true. The part of Logic which is called 'topics' or 'dialectics' is ordered to this rational process, since the dialectical syllogism proceeds from probable premises. Aristotle treats of it in his Topics.

There is another process which does not fully achieve belief or opinion, but only a kind of suspicion. Reason does not fully embrace one part of a contradiction, although it does tend more towards one part than the other. The art of Rhetoric is concerned with what pertains to this rational process.

Sometimes we are moved towards one part of a contradiction by nothing more than a kind of regard or esteem resulting from the way something is represented. This is analogous to the way in which a particular food appears disgusting when it is represented in the image of something disgusting. The art of Poetry is ordered to this. For the poet's vocation is to guide us towards what is virtuous by representing it as attractive.

All of these pertain to the part of philosophy which concerns reason, since it is by reason that we are led from one thing to another.

The part of logic concerned with the third rational process is called 'sophistics' and is treated by Aristotle in his On Sophistical Refutations.

EXERCISES: Before we start learning the rules of reasoning, let's test your Natural Logic and see just how well developed it is. In the following arguments, pick out the conclusions which validly follow from their premises and those which do not follow. For the latter, give the reason why they do not follow from their premises.

1. Since Americanism is opposed to Socialism and Socialism is opposed to Fascism, it follows that Americanism is opposed to Fascism.

2. Every vegetative being is living; but every sentient being is living; therefore, every vegetative and every sentient being are living.
3. Since no triangle has five sides, neither can any square have five sides, for no square is a triangle.
4. No ape is rational, because some animal is rational, and no ape is an animal.
5. What's immaterial is inconsequential; thus thought is inconsequential, since thought is immaterial.
6. Since all Socialists are threats to the integrity of our country, then all juvenile delinquents are Socialists, because all juvenile delinquents are threats to the integrity of our country.
7. The poor have little money; but John's health is poor; therefore, John's health has little money.
8. Since no rectangles are three-sided, it follows that some plane figures are not rectangles because some plane figures are three-sided.
9. No illegal immigrant has the right to vote in the U.S. This man is not an illegal immigrant, and therefore he has a right to vote in the U.S.
10. All men are intelligent beings, and all intelligent beings are possessed of free will; hence, all beings possessed of free will are men.
11. Football players are the campus ideal. But John is a football player. Therefore John is the campus ideal.
12. Since no syllogisms are inductive, and some syllogisms are probable arguments, then some probable arguments are not inductive.
13. Since all men have the right to health care, and since the government must ensure that to which everyone has a right, it follows that the government must provide universal health care coverage.
14. Since it is true that all Texans are American, it follows that:
 - a. It is false that all Americans are Texans
 - b. It is true that all who are not Americans are not Texans.
 - c. It is true that some Texans are Americans
 - d. It is true that no Texans are non-Americans
 - e. It is false that some Texans are not Americans

State whatever conclusions validly follow from the premises given below:

1. Courteous people are not always talking on their cell phones; irritating people are always talking on their cell phones; therefore...

2. Clever politicians rarely admit a controversial position; careless politicians always say too much; therefore...
3. Nothing that is useful should be avoided; internet theft is useful; therefore...
4. Congress should do nothing that doesn't benefit the good of the American people; but this stimulus bill is for the good of the American people; therefore...
5. Eminent domain gives the government the moral right to take private property which is not being used in the best interests of all; but this private property is not being used in the best interests of all; therefore...

The following is a short passage from John of St. Thomas' book, *Ars Logica*. In the text, he argues briefly for the necessity of Logic. See if you can put this argument into a syllogism:

"The necessity of this art is the greatest both for the reason general to all arts which are necessary, so that a man be directed correctly and without error in his works; and especially because Logic directs the works of reason on which all inference and reasoning depend in order to be correct and to proceed with order and without error. Certainly this is exceedingly necessary for a man using his reason."

Demonstrative Logic

Dialectic

Rhetoric

Poetics

The First Operation of the Intellect: Simple Apprehension

Concerning Concepts

The Definition of the Concept

The Divisions of the Concept

Considered Absolutely

From the Point of View of its Object

[By Reason of Extension](#)

By Reason of Comprehension

Simple

Concrete

Abstract

Absolute

Connotative

Complex

[From the Point of View of its Perfection](#)

From the Point of View of its Origin and End

Mediate and Immediate

Intuitive and Abstractive

Direct and Reflex

Ultimate and Non-Ultimate

[Considered Relatively](#)

By Reason of Sameness and Difference

Identical

Strictly

Equipollently

Diverse

By Reason of Inclusion and Exclusion

Impertinent

Pertinent

Pertinent of Sequel

Convertible

Inconvertible

Pertinent of Repugnance

Contradiction

Privation

Contrariety

Mediate

Immediate

Relation

Concerning the Signs of Concepts, i.e., the Term

Signs in General

The Definition of Signs

The Division of Signs

Related to the Thing Signified

Natural

Conventional

Customary

Related to the Knowing Faculty

Instrumental Signs

Formal Signs

Signs used by Living Beings Specifically

Vocalized Signs

Its Nature

Its Division

Inarticulate

Articulate

[Significant](#)

Insignificant

Graphical Signs

Its Definition

Its Division

Ideographic

Phonographic

Gesticulative Signs

The Second Operation of the Intellect

The Third Operation of the Intellect

MATERIAL LOGIC (Second Semester)