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ELEMENTS OF LOGIC

By **CARDINAL MERCIER**



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ELEMENTS OF LOGIC

BY

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HIS EMINENCE CARDINAL MERCIER



THE THIRD EDITION

Translated by

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NEW YORK

THE MANHATTANVILLE PRESS

1912

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Nihil Obstat

REMIGIUS LAFORT, D.D.

Censor

Imprimatur

JOHN CARDINAL FARLEY

Archbishop of New York

LC Control Number



tmp96 026019

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INTRODUCTION

1. Definition of Logic.—Logic is the systematic study of the order to be observed in judging, reasoning, and other processes of thought in order to arrive at the knowledge of truth. This definition shows us:

- (1) the *materials* (material cause) of the logical order;
- (2) their elaboration (formal cause);
- (3) the purpose of this elaboration (final cause).

2. Materials of Logical Order.—In some sense, these materials are acts of the mind, like apprehension, judgment, ratiocination (reasoning); but strictly speaking, only apprehensions are the material object of logical order (3).

(1) By *apprehension* the mind represents to itself one thing or many things, without either affirming or denying anything. Concepts, the product of apprehension, are expressed by *names* or terms.

(2) To establish a relation of identity or non-identity, of agreement or non-agreement, between the objects of two concepts, in affirming or denying one object of another is to judge. A judgment is expressed in a *proposition*.

(3) *To reason* is to combine two or more judgments so as to form a new one. The complete ordinary expression of this simplest exercise of reasoning is the *sylogism*.

3. The Formal Cause of the Logical Order.—The formal object of logic, or the point of view from which logic regards the acts of the mind, is their *adaptability* to certain processes of thought which are called either particular sciences or philosophy. These processes imply stages. The mind must grasp the numerous aspects of reality one after another before co-ordinating the fragmentary explications. Judgment is the first step in combining ideas; judgments in their turn become the materials of reasoning; an isolated piece of reasoning does not suffice to produce adequate knowledge of things, but several reasonings become materials of a scientific system. This rational arrangement of ideas constitutes the logical order properly so called: "the order which reason constitutes for its own acts".

4. Difference between Psychology and Logic.—Many different sciences may be concerned with one and the same subject, if they study different properties in it, and, consequently, consider it from different points of view. They are then said to have a common (that is, undetermined) object, but each has its own formal (or determined) object. Psychology, too, has in part for its (material) object the act of human reason, but it does not study them under the same aspect (formal object) as logic does. Psychology sees in them vital acts, of which it seeks the nature and origin. Logic considers them in so far as they are cognitions of objects, *objective representations*, abstract and universal, furnishing the matter of the relations which reason formulates in judgments and reasonings, and arranges in a scientific system.

In psychology, as in all the sciences of the real, order is the necessary condition of science; but logic has this order for its object. Its *proper object is the form itself of this scientific construction*.

5. Final Cause of Logical Order.—The systematization of the process of reasoning has an ulterior aim: to make our knowledge true.

Before explaining *how* logic directs its operations towards *the true*, it must be recalled that truth and error are qualities of the judgment, and not of the concept. As long as we merely speak of some one object by itself—e. g., the sun or a chimera—no one can say that we speak truly or falsely. Truth or error belongs to the statement that the sun exists, that the chimera exists.¹

Now, how can a science, logic, lead us to the knowledge of *the truth*? Evidently, logic could not in this sense supply the place of all the particular sciences.

Each science enlightens the mind about the particular object with which it concerns itself; and consequently, anyone who had studied all of them would be marvellously equipped for always forming true judgments.

But, besides this initiation into the whole of truth by the successive and collective study of the particular sciences, there is an initiation of another kind, viz., the preparation afforded by a more general science. Thought naturally proceeds from the simple to

¹ See *General Criteriology*, n^o. 6.

the complex. Now simplicity and universality always go together in our knowledge. The most general sciences, then, are those the object of which is the most simple and, for that reason, *best enables us to comprehend the more complex objects* to which it is applicable.

Logic is a general science in the sense that it *regulates* the content of all other sciences and subjects them to its laws in their construction. Its object, of extreme simplicity and boundless in extent, is the *being of reason*.

6. Difference between Logic and Metaphysics.—Another science, having *all being* for its object, also deserves to be called a general science, because it rules all knowledge: this is metaphysics. Metaphysics and logic are both concerned with all being (common material object), but under different aspects (proper formal object). The object of metaphysics is *real being considered formally in its real quiddity, invested with real attributes*.

Logic has for its object the same *being, formally considered in its mental objectivity, invested with attributes of reason which it acquires in thought and in virtue of thought*.

Everything real (existing or possible) is intelligible. Now the real, when it becomes the object of a mental conception, inevitably participates in the attributes which are *inherent in the exercise of thought*: as a mental object, it becomes abstract and universal. Between abstract, universal objects relations are established which under the concrete and particular conditions of existent things are impossible: such a mental object becomes the *attribute* of another object of thought which plays the part of *subject* in regard to the former; the content and extension of ideas give rise to relations of identity or of exclusion; judgments are produced, chains of reasoning are forged, and all the while the material of these various intellectual operations is being, not *real being*, independent of thought, but the *being of reason*, i. e., being under the aspect and with the characteristics which mental conception communicates to it.

Metaphysics is the universal science of the real.

Logic is the science of the science of the real.¹

¹ The relations considered by this philosophical discipline are not the ontological relations upon which the attention of the mind falls im-

7. Is Logic to be Considered a Science or an Art?—Is logic a *speculative* or a *practical* science? *Speculative* science stops at the knowledge of its object; *practical* science makes that knowledge subservient to an ulterior action or work. "The end of the speculative is truth; the end of the operative, or practical, is action." The logician does not study acts of thought merely for the disinterested pleasure of knowing their co-ordination; he puts his science to the ulterior use of directing mental operations. In this sense some hold, and with reason, that logic is a *practical* science. —Others, taking a higher point of view, say that logic is a *speculative* science, because the direction of mental operations is itself subordinate to the knowledge of truth. St. Thomas takes this view when he says: "In speculative matters the rational dialectic science is one thing . . . the demonstrative, another."¹

Logic is also an art, if by this we understand a *body of practical rules*, for the guidance of action.²

mediately, the *prima intentiones*, objects of a first abstraction, but the logical relations springing from the combination of abstract objects to which the reason reflecting returns, *secunda intentiones*, objects of second abstraction.

¹ *Summa Theol.*, 2^a 2^e, q. 51, art. 2, ad 3.

² "Other animals", he says, "are prompted to their acts by a certain natural instinct, but man is directed in what he does by the judgment of his reason. For this reason various arts serve for the easy and orderly execution of human acts. For an art appears to be nothing else but a fixed disposition of reason by which human acts arrive at their due end by way of calculated means. Now reason not only can direct the acts of the subordinate parts, but is also adapted to direct its own function. For it is the property of the intellective part to reflect upon itself: the intellect understands itself, and in like manner the reasoning faculty can reason about its own act. As, therefore, the art of building or of carpentry comes from the fact that the reasoning faculty reasons about the act of the hand, and man is thereby enabled to perform acts of this kind with ease and with well ordered effort, so, also, there must be some art by which the act of the reason itself may be directed, by which man may proceed easily and correctly in the very act of reasoning. And this is the art of logic, i. e., the rational science. Nor is it rational only because it is according to reason, which is a common characteristic of all arts, but also because it deals with the very act of the reason as its proper matter. And therefore it seems to be the art of arts, because it directs us in the act of the reason, from which act all acts proceed." *Post. Analyt.*, lect. I.

8. Divisions of Logic.—(1) It is usual to divide logic into two branches: *formal* and *real logic*. This division, which is of relatively recent date, is very questionable:

(a) It is obviously inspired by certain arbitrary theories of Kant's philosophy.¹

(b) The questions ordinarily discussed in *real logic* constitute for us the object of a treatise which comes next after psychology, and which we call *criteriology* (science of the criterion of truth and certitude), or *analysis of certain knowledge*.

(2) *Formal logic* is generally divided into three parts, treating respectively of apprehension, of judgment, and of reasoning. This division, which is unimpeachable, is borrowed from the material object of logic. Without rejecting it, we prefer:

(3) Another division, which squares better with the general distribution of every philosophic study² and is inspired by the study of logical order by its four causes, *efficient*, *material*, *formal* and *final*.³

The study of the *efficient* cause of logic belongs, properly speaking, to psychology. Here it forms the object of a *Preliminary Chapter (Chap. I)*.

The *First Part* of the treatise on logic will have for its object concepts and terms, the *materials* of logical order: *The Material Cause* of logical order (*Chap. II*).

The *Second Part* will have for its object the *arrangement* of these materials, their deliberate disposition in judgments, reasoning, system, to secure the knowledge of truth: *Formal Cause* of logical order (*Chap. III*).

A concluding chapter will have for its object the employment of rational order in the service of science and philosophy: *Final Cause* of logical order (*Chap. IV*).⁴

¹ See *Criteriology*, n^o. 42.

² Cf. the beginning of an *opusculum* in logic reckoned among the works of St. Thomas: *De totius Logicæ Aristotelis Summa*. Op. XLIV, Proœmium. Ed. Parm.

³ Cf. *General Metaphysics*, fourth part.

⁴ These four causes of logical order are mentioned in the definition of logic [1] and in the text of St. Thomas: Logic is the "art by which the act of the reason itself [material cause] may be directed [formal cause], by which man [efficient cause] may proceed easily and correctly in the very act of reasoning [final cause]."

CHAPTER I

THE EFFICIENT CAUSE OF LOGICAL ORDER

9. Principles and Nature of the Operations of Reason.—The *remote* principle of the operations of reason is the *human substance* composed of body and soul; the *proximate*, or immediate, principle is the *intellectual* faculty.¹

Psychology teaches us that every act has its origin in the senses. While the material thing, which is the object of our sensations, is always *determinate*, made of *particular* matter, endowed with *particular* properties, the object of the concept is abstract and universal, that is to say, is considered apart from the particular attributes which really belong to it in nature (*abstrahere*, to consider separately), and it thereby becomes *universal*, or applicable to an indefinite number of individual subjects. This bell, which I see and touch, is made of bronze, it is round in shape, it gives a pleasant sound, it is there on my desk at this moment as I look at it. All this is determinate. Now I am able to think of a bell which abstracts from all these peculiarities, and which will serve to represent to me, at least imperfectly, *all* bells of whatsoever material they may be made, whatsoever may be their peculiarities of shape or of tone, whatsoever the position in space or the moment of time in which they may exist.

10. Multiplicity of the Operations of Reason. Their Fundamental Identity.—All the operations of reason—apprehension, judgment, and reasoning—are at bottom identical; *they consist in the intuition that something is (quod quid est)*, but they nevertheless present different accidental characters which it is of interest to determine.

I. Apprehension assumes many formalities.

(1) When the mind considers an object independently of its surroundings, the action is called *attention*.

(2) The attention is directed sometimes to a single note in the object, independently of those with which it is united, sometimes

¹ See *Psychology*, no. 153.

to the whole collection of notes which constitute the essence of the object, but apart from the notes which individualize it in reality: such acts of the mind are called *abstraction*.

(3) Abstraction is the basis of *generalization*.

(4) Abstraction effects in the mind *analysis*, i. e., de-composition of the notes of the object known.

(5) When the mind reunites notes previously separated, it makes a *synthesis*.

(6) When we represent to ourselves two objects in succession and perceive a relation between them, the apprehension—or rather, the double apprehension—is called *comparison*.

(7) The perception of an existing reality is an *intuition*. We call it *perception* as opposed to the *conception* of things said to be ideal, i. e., things considered apart from their existence.

(8) When the intelligence has for its object the acts of one's own soul, chiefly its spiritual acts, the apprehension takes the name of *consciousness*.

(9) *Distinction* is an act by which the mind represents one object to itself as not being the same as a second object. By *object* we are to understand anything that can be the term of an act of thought (*id quod ob-jicitur cognoscenti*).¹

II. Judgment consists in attributing one object to another, in seeing that two objects, previously apprehended, have, or have not, anything in common. It is an act of apprehension of which the formal object is the identity between the terms of two antecedent apprehensions (*apprehensio complexa*, or *complexorum*—complex apprehension, or apprehension of complex things—as opposed to simple apprehension, *apprehensio incomplexa*, or *incomplexorum*).

III. Reasoning is a linking-together of judgments. The reasoning faculty compares with a middle term two extreme terms, the identity of which it does not immediately grasp, with the result of seeing, by the aid of this comparison, whether they are identical or not. This process is also termed *ratiocination*.

The acts of apprehension under their manifold forms, judgment and reasoning, fundamentally constitute one and the same act

¹ On the various types of distinction (real, of pure reason, virtual) see *General Metaphysics*, no. 49.

—the apprehension or seeing that something is. They depend upon a single faculty indifferently called *intelligence*, *understanding*, or *reason*.

11. The Abstract Character of Concepts Renders Judgment and Reasoning Possible.—Every being which exists in nature is itself and no other, it is an incommunicable individuality, and it is inconceivable that one real being should be affirmed of another or attributed to another. Socrates is himself, he is no one else; this tree is this tree and no other.¹

How is it, then, that things are affirmed of one another in our judgments? It is because the mind has the power of looking at things without their individualizing notes: it *abstracts*.

In consequence of this abstractive mode of apprehension, the object of the concept is universal; that is to say, it is found, or can be found, in many other individuals, and can be attributed to them in our judgments (*universale in predicando*).

Therefore, by means of intellectual abstraction, things can be affirmed, or, if we may so express it, are *predicable*, of one another. Thanks to this power of abstraction, our notions of beings as they are, are attributable to a whole species, a whole genus; in other words they reproduce characteristics of classes—i. e., of genera and species. Abstraction makes reasoning possible; for reasoning, as we shall see later, supposes a universal middle term, and universality follows abstraction—*abstrahi ad quod sequitur intentio universalitatis*.

¹ See *General Metaphysics*. "Particulars are not predicated of other [objects], but other [objects are predicated] of them." Aristotle, *Prior Analytics*, I, 27.

CHAPTER II

THE MATTER OR MATERIAL CAUSE OF LOGICAL ORDER

12. Object and Division of Chapter II.—By the *matter* or *material* cause of logical order we mean *what this order consists of* (*id ex quo aliquid fit*) the materials to be used in constituting it.

The elementary materials are concepts (*Article I*) and terms (*Article II*).

Article I will treat of: the concept, its object, its properties (§ 1); the division of concepts (§ 2). *Article II* will have a parallel division.

ARTICLE I.

CONCEPTS.

§ 1. *The Concept, its Object, its Properties*

13. The Concept from the Logical Point of View.—From the *logical point of view* (4) the concept is an element of judgment: it is adapted to the rôle of *subject* or of *predicate* in a proposition, *notio subjicibilis vel predicabilis in enuntiatione*. In fact, judgment is the central act of the understanding: the apprehension prepares the elements of the judgment, as reasoning forms a new judgment by means of judgments already known.

By logical concepts, then, we mean the object conceived which is enunciated of another and that of which it is enunciated. The connection of these two concepts, the *copula*, is made with the verb *to be*.

The two concepts, the *subject* (*id quod est subjectum attributioni vel prædicationi*) and the *predicate* or *attribute* (*id quod prædicatur vel attribuitur*) are called the *terms* (*termini*) of the proposition; they are in fact its extreme points or limits.

14. What Has Logic to do with the Act of Mere Apprehension?—Logic is concerned with the acts of the reasoning faculty in

so far as it can direct them towards what is true. Now we have seen that truth and error appertain to judgment, and not to mere apprehension (5). What, then, has logic to do with the study of concepts?—They concern it in so far as they furnish the *matter of true judgments* and *occasion erroneous judgments*.

15. Logical Problems Arising Out of the Act of Mere Apprehension.—The concept can have nothing to do with logic except either as *subject* or as *predicate*.

I. In the last analysis, but only in the last analysis, the subject of the proposition is always *individual*. To be sure the proposition can have as its subject—indeed often has—an abstract type, but in such a case this is the predicate of an antecedent subject. The reason of this is twofold:

(a) *Psychological*: The first object of thought is taken from sensible experience, which is incapable of seizing anything but an individual and concrete reality.

(b) *Ontological*: Only the individual is, rigorously, a subject. Aristotle calls it *πρώτη οὐσία*, first substance. For, on the one hand, it is not attributable to any antecedent subject. Individuality is in fact incommunicable to something else: Socrates is Socrates, he is identified only with himself.¹ On the other hand this first substance is the subject of abstract and universal concepts which can be attributed to it on various grounds.²

Take the proposition: *Snow melts in the sun*. *Snow* is an abstract subject.—But what is snow? Something white which I see falling in light flakes, and which I feel to be cold to the touch. *This* thing that is white to the sight, cold to the hands, and falls in light flakes, is *some* snow. *This* something which our senses perceive as white, cold, light, is a first subject; of *this first subject*, *some* snow is predicated. *Snow* then becomes the subject of a further predicate, the property of melting in the sun.

An examination of the terms of a proposition brings us face

¹ Cf. *General Metaphysics*, no. 46.

² “Of all things that are, some are such that they cannot be truly predicated of any other, as Cleon and Callias, both a singular thing and something that is subjected only to the senses, but other things can be predicated of them; for either of these [sc. Cleon and Callias] is a man and an animate being.” Aristotle, *Prior Anal.*, I, 27.

to face with a first term which is by its origin an individual subject ($\tau\acute{o}\delta\epsilon\ \tau\iota$) and to which our thought refers all its predicates.

The individual subject being disposed of, there remains the predicate.

II. The *predicate* is the object of two principal considerations.

(1) *What* does it represent, *what does it say* about the subject?—The study of the logical *categories*, or *predicaments*.

(2) *How* is it connected with the subject? in *what manner* must it be attributed to the subject?—The study of *categoremes* or *predicables*.

16. Logical Categories or Predicaments.—Obviously, it is out of the question to go *in detail* through all the predicates of the judgments which the human mind enunciates under an indefinite variety of forms. But Aristotle has essayed to reduce them to certain *types of attribution*, so as to understand what *determinations* they bring to the subject which experience supplies, each type of attribution (*typus predicationis*) constituting a category of homogeneous concepts. He recognized the existence of ten great kinds of predicates or attributes, the sum of which is virtually equivalent to all the range of human thought, and in one or other of which it is possible to find a place for any concept whatsoever.

What are the ten predicaments or categories? (1) *Substance*, that is, *second* or *abstract*, *substance*.

This thing which we perceive as white, cold, light, is *some* snow. *Some* snow represents, under an abstract form the substance to which our senses find attached those accidental determinations which are expressed by the adjectives *white*, *cold*, *light*. When the mind attributes an abstract substance to the concrete substance, $\tau\acute{o}\delta\epsilon\ \tau\iota$, perceived by the senses, it applies to that concrete substance *the first category*, $\eta\ \omicron\upsilon\sigma\iota\alpha,\ \tau\iota\ \epsilon\sigma\tau\iota$.

In contradistinction to the individual *subject*, $\pi\rho\acute{\omega}\tau\eta\ \omicron\upsilon\sigma\iota\alpha$, *prima substantia*, upon which all predicates rest (15), the category of substance is called $\delta\epsilon\upsilon\tau\acute{\epsilon}\rho\alpha\ \omicron\upsilon\sigma\iota\alpha$, *secunda substantia*. The latter, indeed, *can* be the subject of attributes, but it presupposes a concrete subject to which it is referred.

(2) The other nine types of attribution represent accidental determinations.¹

¹ On the difference between the substantial quiddity which we take hold of by our logical predicates, see *General Metaphysics*, nos. 83 sq.

Of these some are *inherent* in the subject to which the mind attributes them; two of them are *absolutely* inherent in the subject considered, the categories of *quantity* (e. g., two feet long) and of *quality* (e. g., white, learned); a third belongs to the subject in respect to a being or beings other than itself—the predicament of relation (e. g., double).

Certain predicates represent something *extrinsic to the subject*; the predicates of *place* (e. g., in the public street), of *time* (e. g., yesterday) are borrowed from measure, the one of quantity, the other of the duration of the subject.

Action and *passion* are attributable to the subject because it is the principle (origin) of the former and the term, or aim, of the latter (e. g., he cuts the stone; the stone is cut).

The last two categories, the meaning of which has much exercised Aristotle's commentators, seem to have been felicitously interpreted by the philologist, Max Müller, who sees in the word *κείσθαι*, *intransitive action*, the *active intransitive verb* (e. g., I walk, I am afraid), in *ἔχειν*, the *passive intransitive state* (e. g., I am feeling well).¹

17. The Predicables.—Human thought is *abstractive* and *unitive*. It represents the reality of nature by means of an assemblage of abstract notes susceptible of being universalized. How do these notes (predicates) contribute to the formation of a complete intelligible object (subject)? What *relation* exists between the subject and the predicate? In other words, *by what right* is the latter "predicated" of the former?

There are various *predicables* or *modes of predicability*:

(1) *Necessary, because essential predicables.*—Certain characteristics *constitute the essence* of the thing, which makes the thing what it is (*quod quid est. τὸ τὶ ἦν εἶναι*), and without which it could not exist or be conceived: such are animality and reason in man.

(2) *Necessary, though non-essential predicables.*—Other attributes do not *constitute* the substance, but necessarily result from it. In an invariable manner they interpret—develop—the constitutive perfection of the subject: these are called its *properties* (*proprium, ἰδιον*).

¹ St. Thomas, *In Met.*, V, lect. 9.

(3) *Contingent or accidental predicables*.—Others, again, have a contingent connection with the essence: these are called *contingent accidents* (*contingit ut sint*, *συμβεβηκός*), or, more briefly, *accidents*.¹

Essential predicables are subdivided: The object of the intelligence is not the *individual* essence, but the *specific* essence represented by different abstract and universal concepts. The term *species* (*εἶδος*) designates the sum of the abstract and universal notes which constitutes an essence as the human mind knows it.²

Certain of these constitutive notes of a species are at the same time applicable to other species; these are called generic, they constitute the *kind*, or *genus* (*γένος*); some are proper to it and differentiate it from other species of the same genus, and these form the *specific difference* (*διαφορά*).

Hence three distinct essential predicables; the *species* and its two parts, the *genus* and the *specific difference*.

Add to these three predicables *property* and *accident*, and we have altogether *five predicables*, or catagoremes.

The *properties* (*ἰδιον*) are the determinations which, without being of the essence of the thing, necessarily follow from the essence and, consequently, cannot be separated from it.

A note is said to be *proper* to a given species when it belongs *exclusively* to that species, *universally* to all individuals of that species, and *constantly* to each one of them. "Proprium dicitur quod convenit *soli* alicui speciei, omni et semper."

Thus the radical aptitude for learning letters is *proper* to man; incorruptibility is *proper* to immaterial substances; limitation is *proper* to creatures. In this, the only rigorous acceptation, property, has the same extension as essence.

When a characteristic does not combine the three conditions

¹ Evidently, we must take care not to confound the (ontological) accident which is contradistinguished from the substance—whether it have contingent or necessary attachments to the substance—with the (logical) accident which is immediately contradistinguished from the essence on the one hand, and, on the other hand, from the accidents called *properties*. What is predicated as *accidental* of one subject may be predicated as essential of another.

² *Species* in the logical acceptation here defined must not be confounded with the same term in the sense attached to it by naturalists—that of a collection of individuals capable of indefinite reproduction among themselves.

here stated, it is no longer, rigorously speaking, a *property*; it is no longer co-extensive with essence.

Nevertheless, though in a lesser sense, it justifies the appellation when it presents one or two of the three distinctive notes of property: A characteristic which belongs *exclusively* to a specific type, even though it do not belong either universally or constantly to the representatives of the species, is, in this sense, a property: thus, it is proper to man to be a physician, to be a geometrician.

Similarly, a characteristic found in *all* the individuals of a species, and *always*, but not belonging to them exclusively, may be called a property: in this sense, says Porphyry, it is proper to man to be a two-legged animal.

Such, too, is a characteristic which is common to all the representatives of the species and to them only, but temporarily: Thus, according to Porphyry, it would be proper to man—to every man and to men only—to grow grey in old age.

The *common accidental quality*, *accident* (συμβεβηκός as opposed to ἰδιον, *accidens commune* as opposed to *proprium*), may be defined in a negative way: the quality which is not a property in the strict sense of the word. In a positive way Porphyry defines it: An accident is a quality to the presence or absence of which the essence of the subject is indifferent (*Accidens est quod adest et abest præter subjecti corruptionem*).

The *common accidental quality*, Porphyry adds, is sometimes constant, sometimes belongs to the subject only intermittently. We may say of the animal that it sleeps; black plumage may be attributed to the crow constantly.

From this we see that care must be taken not to confound the quality, *even the constant quality*, with the *property*.

The mere *observation* of facts does not suffice to effect the discernment of a *property*. This discernment, we shall see later, forms the object of scientific induction and calls for the employment of experimental methods.

18. Comprehension and Extension of Concepts.—There are relations of subordination between various predicables. To understand these it is necessary to establish two logical properties of abstract concepts: their comprehension and their extension.

The *comprehension* of an idea is its *content*, the sum of the characteristics or notes which analysis can find in it. Take the

abstract idea of *man*. When we consider *what* this idea represents, we find in it different characteristics taken by abstraction from the individuals. The *extension* of an idea is its range of applicability, the sum of *the subjects to which* the abstract idea is applied or can be applied, *extends* or *can extend*.

We thus consider the abstract and universal concept as a *whole*, whether *metaphysical* or *logical*. *Man* is a *metaphysical* whole, which comprises corporeality, life, sensibility, reason, as so many *metaphysical parts*.¹

The idea of man is attributable to all men, past, present, future, or merely possible; it forms a *logical whole* of which *men*, taken distributively, are the *logical parts*.

The Latin words *totus* and *omnis* correspond to the two members of this distinction.

An idea is more or less comprehensive accordingly as it embraces more or fewer notes. It has greater or less extension accordingly as it applies to a greater or smaller number of subjects.

These two properties of the idea are in inverse ratio to each other: *the greater the comprehension of an idea, the less its extension, and vice versa*.

When we compare two or more ideas in the twofold respect of their extension and their comprehension, certain relations are seen to arise between them.

19. Relations of Subordination among Ideas in Respect of Their Extension.—There are degrees in the universality of concepts; those referable to the same category thus form a logical scale.

On the lowest step we find the *individual substance*, which is not attributable to any subject, and to which all predicates are attributed.

Next above comes the *species*, which is asserted of the individuals. Then the *genus*, which is asserted of the subordinate species and the individuals.

The genera (kinds) may in their turn be manifold: *nearest*, or *immediate*, genus; or *subordinate* genera; *highest*, or *most general* genus.

Porphyry has drawn up a Table showing the essential predicates of substance and their mutual subordination.

¹ See *General Metaph.*, no. 48.

Most general genus . . . Substance

Difference . Corporeal . . .

Incorporeal

Subordinate genus Body

Difference . Animate . . .

Inanimate

Subordinate genus Living

Difference . With feeling . .

Without feeling

Subordinate genus Animal

Difference . Rational . . .

Irrational

Subordinate genus Man

<i>Individuals</i>	<i>Hypostases</i>	<i>Singulars</i>
Some man	Socrates	That man
Some horse	Bucephalus	That horse

20. Comparison of Ideas in Respect of Their Comprehension. Relations of Identity and Opposition.—Two ideas are *identical* or *different* accordingly as they have the same or a different content (the ideas of man and rational animal; of man and animal).

Of non-identical ideas some are compatible (liquid and sweet); others, incompatible (liquid and solid).

Opposition, or incompatibility, between two ideas is produced in four ways: it is *contradictory*, *privative*, *contrary*, *relative*.

(1) The opposition is contradictory when the two terms have *nothing* in common; for one of the terms is being, and the other is the negative of being. Two ideas, in short, are contradictory when one is neither more nor less than the negation of the other (*white* and *not white*, *just* and *not just*, etc.).

(2) *Privation* is the negation of a perfection in a subject *which is naturally fitted to possess it* (negatio alienius formæ in subjecto apto nato habere illam); thus blindness is the privation of sight, death is the privation of life. Privation is not merely synonymous with negation or absence; a mineral has no sight, but is not deprived of it.

(3) Contraries form the two extreme points of a series of elements which are joined in the same genus. Suppose, e. g., that the degrees of light are mentally arranged in a series, the two extreme terms of the series, white and black, are two contraries. There is the opposition of *contrariety* between things which cannot coexist in the same subject. Health and sickness, justice and injustice, courage and timidity, are contraries.

(4) Relative opposition, or *relation*, is that between two terms either of which needs the other to explain it. Ex.: the ideas of father and son, of double and half, of knowledge and the object known.

§ 2. Classification of Concepts

21. Principal Heads of the Classification of Concepts.—Concepts, or ideas, are divided: (1) in respect of the *object* which the intelligence abstracts from the things to be known; (2) in respect of their *manner of representing* the thing known; (3) in respect of their *origin* or their *formation*.

Certain members of these divisions might be placed indifferently under any of several heads.

22. In Respect of the Object Abstracted by the Intelligence, ideas are divided (1) into *transcendental*, *generic*, *specific*, *singular* ideas.

This classification is based on the *degrees* of abstraction of the intellectual cognition.

The idea which represents all the determinations of the object, including those which make it an individuality, is *singular*. Ex.: the ideas of Cæsar, of Napoleon, etc.

The idea which represents the thing *in a more indeterminate manner*, offering to the mind only those notes which belong in common to individuals of the same species, or to several species of the same genus, is either *specific* or *generic*, as the case may be, but in either case is *universal*.

When the idea is *still more indeterminate*, and the intelligence represents things by means of certain characteristics common to *all* being in nature, the idea is called *transcendental*, "because it transcends every genus, every category": the extension of this idea goes beyond all the categories. We distinguish six transcendental notions: *being (ens)*, *thing, one, something, true, good*.¹

Remark: When several individual things are considered as forming one whole, the idea which represents them is called collective; such, e. g., is the idea of a people, an army. The collective idea must never be confounded with the universal.

(2) Into *adequate* and *inadequate* ideas. The former make known to us all the characteristics which belong to the object—all those, at least, which are within the natural range of the intelligence. The latter does not attain this degree of completeness.

The *inadequate* idea is *confused, indeterminate, indistinct*: or it is *clear, determinate, distinct*. The confused idea shows us the object by means of notes which are insufficient to let us distinguish it from every other object, as when I conceive of a fish as a creature that swims. The clear and distinct idea may include certain notes which are common to several objects, but it contains some which belong exclusively to the object to be known, and which therefore distinguish it from every other

¹ See *General Metaph.*, n^o. 39.

object: e. g., when I define the fish as the living creature which breathes only through gills.

(3) Into *complex* and *simple*. The idea is *complex* when it embraces several parts each of which by itself can be a predicate, as the idea *just man*. The ideas *just* and *man* are *simple*.

23. In Respect of the Manner of Representing Their Object, ideas are principally divided into *concrete* and *abstract*, *positive* and *negative*, *proper* and *analogical* ideas.

(1) No *concrete* idea exists, but by this name we improperly designate an idea the object of which is conceived in union with a concrete subject, as the ideas *white*, *animal*.

In opposition to this, an idea is said to be abstract when it represents a note apart from any concrete subject; e. g., the ideas of whiteness, of animality.

In reality the "concrete" idea grows out of an abstractive act; the "abstract" idea comes of a second abstraction, and is reflexively abstract.

(2) The positive idea represents a thing by means of notes which really belong to it; as the ideas of light, of life.

The negative idea makes an object known to us by eliminating from the thought notes which the object excludes; as the ideas of darkness, of death.

(3) The positive idea is *proper* when it grasps a property, i. e., a quality which is *distinctive* of a being, such as it is positively.

The *analogical* idea is that which we form of a being in itself inaccessible to the intelligence: to know it, we compare it with another being of which we know the properties positively. E. g., the Divine life is known to us *by analogy* with created life; the presence of spirits *by analogy* with the presence of bodies in space.

24. In Respect of Their Origin or Their Formation, cognitions are *immediate* or *mediate*.

They are *immediate* or *intuitive* when the object to be known is itself united with the intelligence or, at least, itself begets in the intelligence the representation of what it is.

When the cognition of the object is dependent upon that of another object, the cognition is called *mediate*. This is proper or analogical accordingly as the object which serves as intermediary is or is not of the same nature as the object to be known.

Mediate cognition is sometimes called "abstractive," as opposed to "intuitive" cognition.

ARTICLE II.

TERMS.

§ 1. *The Term, its Objects and Properties*

25. The Object of the Term.—Terms are vocal signs which express *objects* as they are conceived by the intelligence; they are not the expression of subjective concepts as such, or of things as they are in nature, but of things *as the* intelligence conceives them; in a word, they designate *known objects*. "It is through the medium of intellectual conception", says St. Thomas, "that words are related to the representation of things." (*Voces referuntur ad res significandas mediante conceptione intellectus*).¹

The word *sun*, *e. g.*, does not signify the idea of the sun, but the sun itself. And yet that word does not directly designate the sun as it is in nature. For it was long supposed that the sun was a disc moving around our planet; now this is not the true sun, but only the sun as humanity imagined it before the discoveries of Galileo and Copernicus.

It belongs to psychology to study the nature and functions of language.

26. The Ten Parts of Speech.—As the objects of our thoughts can be divided into ten categories, it seems natural to find an analogous division in the terms which correspond to our concepts. Grammarians do, as a matter of fact, distinguish ten parts in speech, just as Aristotle had distinguished ten categories of thoughts in connection with ten kinds of things known.

There is, however, no adequate correspondence between the categories and the parts of speech.

The first subject of all logical attributions is what the senses perceive in its concrete reality, and which at the outset presents itself to the thought in complete indeterminateness,—*this something, hoc aliquid, this, that*.

¹ *Summa Theol.*, I, q. 13, a. 1.

Formal determinations which the mind conceives in an abstract manner, and which the terms of language express, gradually fill up this first indeterminateness. The chief are expressed by the substantive, the adjective, and the attributive verb, which constitute the essential elements of language.

(1) The first determination is the essence, or the very *substance*, of the subject, designated by the *noun*, or substantive. The substantive designates any object which is a substance or any quality considered as if it were a substance (man, horse, height, whiteness).

In its first acceptation the *noun* is abstract and, therefore, *common*.

Further determinations have individualized its signification and made *proper nouns* out of it.

(2) Two categories represent determinations inherent in the subject: some are qualitative; others, quantitative; these are *adjectives*.

(3) The attributive verb represents action or passion in operation.

As for the verb *to be*, it either designates the act of existing (I am) or plays a merely copulative part, uniting subject and predicate, in which latter character it is implied in every attributive verb—e. g., I work = I am working.

It is interesting to note that the results of linguistics agree with the study of logical concepts: just as the predicates of judgments are abstract, so the *roots*, or primitive forms, of language express abstract ideas.

§ 2. Classification of Terms

27. Classification of Terms.—The classification of concepts is applied to terms. Let us note a few properties of the latter.

(1) Terms are *common* or *singular*. Common terms are *transcendental* or merely *general universal*, and these are *generic* or *specific*.

Generic and *specific* terms are *univocal*; *transcendental* terms are *analogical*.

This distinction is based on another classification of terms.

(2) Terms are *univocal* when with a common name they

designate things to which an essentially identical definition corresponds. E. g., the noun *animal* is applied to a man and an ox in an identical sense, either of the two being an animate substance endowed with feeling.

Equivocal terms designate with a common name diverse things the concepts of which are different. E. g. the noun *dog* is applied to an animal and a constellation.

Analogical terms designate with the same name things the corresponding concepts of which are partly the same and partly different. Thus, when we say of bodies and of spirits that they *occupy* a portion of space, the words *occupy space* have not an identical sense in the two cases, but an *analogical sense*. Analogy is expressed by metaphor.

(3) Terms, like concepts, are *simple* or *complex*.

(4) They are *concrete* or *abstract*. The word *white* is a concrete term; the word *whiteness*, an abstract term.

(5) Terms are *positive* or *negative*: e. g., death, immortality. —A positive term may convey a negative idea; a negative term, a positive idea.

(6) Terms are *direct* or *reflex*: e. g., *substance*, *man*, are direct terms; *genus*, *species* are reflex.

(7) *Categorematic* terms have a complete sense in themselves, and can by themselves play the part of subject or attribute (e. g., *man*); *syncategorematic* terms have a complete sense only through their union with another term (e.g., *none*, *all*).

CHAPTER III

FORMAL CAUSE OF LOGICAL ORDER.

28. Preliminary Note.—The orderly arrangement of science is accomplished in a progressive way.

First, the predicate is formally connected with the subject: an act of judgment.

Then, being brought together and combined, the judgments produce more complex judgments: reasoning.

Lastly, several reasonings relating to the same object contribute to the formation of a logical system: organization of science.

Chapter III will consist of three articles corresponding to the three stages of logical order.

Article I, devoted to the study of the judgment and the proposition, will be divided into three sections:

- § 1. Meaning of the judgment and the proposition.
- § 2. Judgments and propositions.
- § 3. Relations between judgments and propositions.

ARTICLE I.

JUDGMENT AND PROPOSITION.

§ 1. *Meaning of Judgment and of Proposition*

29. The Judgment and the Proposition.—The proposition is the expression of the judgment and consists in enunciating (asserting) one thing of another. "Propositio est oratio enunciativa", *ἀπόφανσις*, says Aristotle.

All speech *signifies* something—"omnis oratio est significativa," *φάσις, φωνή σημαντική*—but *not* all speech *enunciates* something. The noun signifies something; it does not enunciate. For instance, "prayer" is a noun, it is not an assertion.¹

"A first enunciative phrase has the form of an *affirmation*,

¹ Aristotle, *Perihermeneias*, c. IV.

another has the form of a *negation*; those which do not present this simple character are, nevertheless, all composed of these elementary enunciations."¹ The enunciation (or assertion) consists of two terms—the subject and attribute—joined by the verb *to be*.

In view of a property which proceeds from the notion of the proposition, we may also define it: a true or false speech.

30. The Place of the Judgment and of the Proposition in Intellectual Life.—Not only is the judgment the central act towards which all the operations of thought converge, but there is in reality no intellectual act which does not end in judgment.

Each of the abstractive acts of the intelligence grasps one of the attributes of the known object separately—e. g., one quality of this tree which my senses perceive, the shape of the trunk or of the branches, the roughness of the bark, the color of the foliage, and so on.

But each one of these acts is accompanied by the apprehension of something subsisting, of a subject from which I borrow, and to which I give back, the abstract attribute.

To abstract these attributes—the shape, the roughness, the color of this tree—is only to attribute them mentally to this indeterminate subject which I am seeking to specify, to say within myself that they belong to it, to *judge* that a tree is what they express.

The science of language confirms and illustrates the teachings of consciousness.

To *create a name* (or *noun*) is, in fact, to apply a concept, moulded in the form of language, to some subject designated indeterminately by a demonstrative pronoun, *this* or *that*. To *name* this animal *that which tears to pieces* (Vr Ka, *lupus*, wolf) is to apply to the creature an abstract concept, that of the act of tearing to pieces.

§ 2. Judgments and Propositions

31. General Classification of Propositions.—*Simple* propositions include only their subject, their attribute, and the copulative

¹ *Ibid.*, c. V.

verb; *composite*, or *complex*, propositions include many *simple* propositions joined together.

Simple propositions are in their turn divided according to their *matter*, their *form*, their *quantity*, their *quality*.

I. CLASSIFICATION OF SIMPLE PROPOSITIONS

32. First Classification of Propositions: According to Their Matter.—By *matter* is meant the terms in their mutual relation, but *previous to the effective enunciation* which the judgment formulates.

Some propositions are *in necessary matter*; others, *in contingent matter*.

A proposition is said to be *in necessary matter* when the connection between the two terms *absolutely* cannot be other than it is, and is revealed to the intelligence by mere analysis of the terms and independently of all experience; as $2+2=4$.

A proposition is said to be *in contingent matter* when the connection between the two terms is such as it is, only upon certain conditions realized in contingent existences and cannot, therefore, be enunciated without experience; e. g., that water freezes at 0° centigrade.

The judgment in contingent matter with which logic is concerned presents, then, a *necessity*,¹ but a contingent necessity, whilst the necessity of the judgment in necessary matter is absolute. Hence *judgment in necessary matter* must not be confounded with *necessary judgment*.

The *necessary* proposition is *knowable by itself*, "propositio per se nota"; the *contingent* proposition, on the contrary, is *knowable dependently upon something other than* the mere terms of the proposition, "propositio per aliud nota."

33. Two Kinds of Judgments in Necessary Matter.—I. *First kind*: The connection is necessary because the subject, considered in its essential elements, is either *the same term* as the predicate (identical judgment), as: a square is an equilateral rectangle;

¹The particular judgment in contingent matter does not directly belong to the domain of science. *Scientia non est de singularibus*.

$2=1-1$; or *includes* the predicate, the latter being in this case part of the essence of the subject, as: a square is a rectangle; man is intelligent. In both cases the comparison of the two terms of the judgment reveals to the mind the *necessity* of their connection.

II. *Second kind*: The connection between the two terms of the judgment is necessary when the predicate *necessarily presupposes* the subject and, consequently, is not definable without bringing the essence of the subject into evidence. This case is where the predicate is a *property* (in the rigorous acceptation) of the subject.

The definition of the predicate (simple or disjunctive), put side by side with the essential notion of the subject, brings out the necessary connection of the two terms.

(a) Example of a simple predicate:

A prime number is one out of which it is impossible to form several groups each containing the same number of objects.¹

This definition does not mention as a component part the number 5. But if we place the definition on one side, and on the other side the result of breaking up the number 5 into two groups of two units each and one of one unit, it will then appear that the definition of a prime number necessarily applies to the number 5. That is, a *prime number* is not the definition of the number 5, but to be prime is one of its properties.

(b) Example of a disjunctive predicate: Every number is either even or odd.

The attribute *even* is not essential to number; it is not even a necessary property. Neither is the attribute *odd* of the essence of number or a property of it. The alternative *even* or *odd* forms no part of the definition of number, but it is a necessary consequence of that definition. Given that unity is not a number, but the principle of numbers, every number is or is not divisible by 2, is even or odd.

The Scholastics, following Aristotle, called the two kinds of necessary propositions which we have just been studying, *duo modi dicendi per se, propositiones per se* (two ways of saying by

¹A prime number is usually defined as one which is divisible only by itself and unity.

themselves, propositions by themselves),¹ καθ' αὐτό, and opposed to them *modi dicendi per accidens, propositiones per accidens, κατὰ συμβεβηκός*.

It must be added that the necessity of the connection becomes apparent sometimes immediately, sometimes in a mediate way after more or less laborious analysis. This is an entirely subjective affair which nowise affects the nature of the connection.

34. Synonymous Designations of the Foregoing.—Propositions in necessary matter are also called *metaphysical* and *absolute*, because their object is metaphysically necessary, independent of the conditions inherent in contingent existences. Under these designations they are opposed to *conditional* or *physical* propositions.

The former are called *pure rational* to indicate that reason is of itself capable of apperceiving their truth; whilst the knowledge of the latter, the *experimental, empiric* propositions, is subject to a verification of fact.

Lastly, since Kant, the former are called *a priori*; the latter, *a posteriori*; the former, *analytic*; the latter, *synthetic*. It is important to note carefully that these expressions are given in the Kantian philosophy a special signification which precludes their identification with the expressions used by the Scholastics.

Between the judgments in necessary and in contingent matter of the Scholastics and the analytic and synthetic judgments of Kant there are fundamental differences which it belongs to criteriology to establish.

35. Second Classification of Propositions: According to Their Form.—*Form* here means the union of subject and predicate as it is effected in the enunciation of the judgment.

¹ "Per se", says St. Thomas, "is used in a twofold sense. In one way a proposition is said to be *per se* when its predicate falls within the definition of the subject, as: Man is an animal; for *animal* is contained in the definition of *man*. And because that which is in the definition of a thing is in a way its cause, in these *per se* propositions the predicate is said to be the cause of the subject. A proposition is also said to be *per se* in another way, when the subject is in the definition of the predicate, as: The nose is a hook; the number is even. For a *hook* [in this sense] is only a nose with a certain curve, and *even* is nothing but a number which has a half, and in these the subject is the cause of the predicate." *De anima*, bk. II, lect. 14.

(1) The proposition is *affirmative* or *negative*¹ accordingly as the mind asserts that the predicate belongs to the subject, and consequently must be joined to it (*compositio*), or not (*divisio*).²

(2) With the form of judgments must be connected their *modality*, or the particular determination which marks the union of predicate and subject. Under this aspect the proposition is *apodictic*, *empiric*, *problematic*. "Every proposition consists in asserting that [something] is contained in, or is necessarily contained in [something] else, or that it may happen to be contained."³

The *apodictic* proposition (which we must take care not to confound with the proposition in necessary matter) asserts that the predicate *necessarily* agrees with the subject or is *necessarily* repugnant to it. As: There must be a First Cause in the world. It is impossible for the world to exist of itself.

The *empiric* proposition asserts that the predicate *as a matter of fact* agrees with the subject. As: So and so died yesterday morning.

The *problematic* proposition, based upon a mere possibility,⁴ asserts in a conjectural way the happening or non-happening of an event which has no natural connection with a determinate cause. As: It is possible that so and so may draw the prize.

¹ A *negative* proposition sometimes has the appearance of an *affirmative*, as: This man lacks generosity—is not generous. Inversely, an apparently negative proposition may be at bottom affirmative, as: Man is not infallible; The world is not infinite.

² Every proposition which asserts something (P) about a subject (S) *mentally* effects a certain union (*composito*) of a predicate with a subject. Here the belonging or non-belonging in question of the predicate and subject is *objective*. St. Thomas, *Periherm.*, lect. 3.

³ *Prior Analyt.*, 1, 2.

⁴ For Aristotle *possible* here does not mean non-contradictory, but *contingent*. St. Thomas writes in the same sense: "That is called *necessary* which in its own nature is determined only to being; impossible that which is determined only to non-being; possible, that which is altogether determined to neither, whether it be more inclined to the one than to the other, or whether it be equally inclined to both, or, as it is expressed indifferently contingent [*contingens ad utrumlibet*]." In *Periherm.*, lect. 14, n. 8.

36. Logical Value of the Predicate of a Simple Proposition.

—The comprehension and extension of the predicate are a function of the *form* of the proposition. In an affirmative proposition they are in inverse ratio to what they are in a negative.

(1) In an *affirmative* proposition the predicate is taken in all of its comprehension, although this may be less than that of the subject; but only in a part of its extension. All the notes of the predicate, taken together or separately, apply to the subject; but the subject need not represent, and consequently does not, *so far as the enunciation goes*, represent more than a portion of the objects within the extension of the predicate. E. g., when I say, "the dog is a vertebrate", I mean to assert that the dog has all the properties included in the idea *vertebrate*, collectively or distributively; but not that there are no other vertebrates but the dog.

There is, however, this reservation to be made: that in essential definitions, the thing defined and its definition have the same extension and the same comprehension.

(2) In a negative proposition, on the contrary, the predicate is taken in its whole extension, but only in an indeterminate part of its comprehension. E. g., when I say, "The mollusc is not a vertebrate", I mean to say that the mollusc is not any one of the vertebrates, because it does not include all the attributes of the vertebrates; but that does not prevent its having some of the properties which belong to the vertebrates. I exclude all the subjects to which the idea of *vertebrate* applies, but I need not therefore exclude all the notes which that idea comprehends.

37. Third Classification of Propositions: According to Their Quantity.—A proposition is *universal*, *singular* (or *particular*), *indefinite*.

(1) The *universal* proposition asserts that an attribute belongs to *all* the subjects of an idea or to *none* of them. As: All men are mortal; No man fatally misses his destiny.

(2) The *singular* proposition enunciates an attribute of *one* individual. When the subject represents a determinate group of individuals, it is *collective*: in the logical point of view it is of the same nature as the singular subject. We also call all those propositions *particular* the subject of which is not universal, whether it include many individuals of the same species or only one. As: Some men are learned; the Belgian people is active.

(3) The *indefinite* proposition expresses the agreement or non-agreement of a predicate and a subject without expressly saying whether the subject is taken in all its extension or only in part of it. As: They have been unjust in this matter.

The universal proposition is more important than the particular. The former, indeed, contains the latter in its extension; to know the former is virtually to know the latter; but the converse is not true.

38. Fourth Division of Propositions: According to Their Quality.—Propositions are *true* or *false* accordingly as the connection which they assert is, or is not in agreement with that which is.¹

II. CLASSIFICATION OF COMPOSITE PROPOSITIONS

39. Classification of Complex Propositions.—Rigorously speaking, a *composite*, or better, a *complex*, *proposition* is an enunciation which includes several simple propositions.

The authors of Port-Royal enumerate six types of proposition in which the complexity is manifest, and four in which it is more or less latent. We will define them and establish the conditions of *truth* in each.

I. The first six are the *copulative*, *disjunctive*, *conditional*, *causal*, *relative* and *discretive*.

(1) The *copulative* proposition is that which includes many subjects and many attributes joined by an affirmative or negative conjunction, *and* or *nor*. This proposition is true only if its parts are true.

(2) *Disjunctive* propositions state an incompatibility at the same time as an alternative, as: Every free action is morally good or bad.

The condition of truth in these propositions is that the two parts of the disjunction should be mutually opposed and should admit of no middle term.

(3) *Conditional* propositions consist of two parts connected by *if*; the first, which contains the condition, is called the *antecedent*;

¹ Many authors call that *quality* which we have called the *form* of a proposition. In respect to the *quality*, they say, propositions are affirmative or negative.—A question of mere words, of very slight importance.

the second, the *consequent*. E. g.: If the soul is spiritual (antecedent), it is immortal (consequent).

For the *truth* of these propositions we have to consider only the truth of the *consequence*: the falsity of both parts does not hinder the proposition, as a conditional proposition, from being true. E. g.: If the soul of animals were spiritual, it would be immortal.

(4) The *causal* proposition contains two propositions joined by some word indicating a cause—*because*, etc.

Reduplicative propositions also belong to this class. E. g.: Evil, as such, is not the object of the will.

For the truth of these propositions it is not enough that the two parts should be true; one part must also be the real cause of the other.

(5) Relative propositions express a connection. E. g.: As the life so is the death.

Their *truth* depends on the correctness of the connection.

(6) *Adversative*, or *discretive*, propositions include several different judgments separated by some such particle as *but*, *yet*, *nevertheless*, etc. E. g.: Not on riches, but on virtue, depends happiness.

The *truth* of these propositions depends on the truth of their parts and of the opposition between them.

II. Four types of *apparently* simple, but really complex, propositions.

(1) *Exclusive* propositions, which assert that an attribute belongs to but one subject, as: God alone is to be loved for Himself.

(2) *Exceptive* propositions affirm an attribute of a subject, but with the exception of some subdivisions of that subject. E. g.: Excess is possible in all the virtues except in the love of God.

(3) *Comparative* propositions say not only that a thing is so, but that it is more so or less so than some other thing. E. g.: Wisdom is more valuable than fortune.

(3) *Inceptive*, or *desitive*, propositions assert that a thing has commenced or ceased to be so. E. g.: The independence of Belgium dates from 1830.

Each of these four propositions really includes two judgments; it is not *true* unless the two parts are true.

§ 3. Relations Between Propositions

40. Relations Between Propositions.—Various kinds of relations between propositions are to be distinguished: their *equivalence*, *convertibility*, *subordination*, *opposition*.

41. Equivalence of Several Propositions.—Propositions are called *equivalent* when they differ only in expression, and in reality are identical as to sense and logical value. E. g.: Every man is just; there is no man who is not just.

42. Convertibility of Propositions.—Conversion consists in transposing the two terms of a proposition so that the new propositions so obtained shall also be true if the original is true.

(1) The *universal negative* is convertible, for both the terms are universal. E. g.: No mineral is capable of vital functions; no being capable of vital functions is a mineral.

(2) The *particular affirmative* proposition is convertible, for here, also, the two terms are of the same extension. E. g.: Some sentient beings are endowed with reason; some beings endowed with reason are sentient.

In these two cases the convertibility is evident: the two terms are purely and simply interchangeable.

These are in fact the only cases of interchangeability.

(3) It must be noted, first of all, that *singular* propositions are never susceptible of any but an apparent conversion, since a determinate individual term, representing in the last analysis a first substance, cannot serve to express a formal predicable idea. E. g., whether I say, "Peter is a learned man," or, "A learned man is Peter," the same Peter, in spite of the inversion, will still be the subject.

(4) The *universal affirmative* is susceptible of conversion, in the sense that the predicate can take the place of the subject and vice versa, but *on condition* that the subject turned into a predicate is modified by some mark of particularity with a restrictive sense. The conversion effected on these conditions is said to be imperfect. E. g.: All men are sentient; certain beings endowed with feeling are men.

There must still be an exception in the essential definition, where the idea defined is equal to the definition.

This "imperfect" conversion is no true conversion, for this consists in the simple mutual substitution of the two terms. The addition of a sign of particularity which renders the conversion imperfect alters its nature.

43. Relations of Opposition and Subordination.—These relations between propositions may be produced in four different ways: propositions are *contradictory*, *contrary*, *sub-contrary*, or *subaltern*. The first two are relations of opposition properly so called.

(1) Judgments so opposed to each other as to exclude any intermediate judgment are said to be *contradictory*. They differ both in form and in quantity. E. g.: Every man is white; some man is not white.¹

(2) Judgments which differ only in form, and have the same universal quantity, are so opposed to each other as not to exclude any intermediate judgment, and are called *contraries*. E. g., every man is just; no man is just—two extremes between which a third judgment may be slipped in: Some man is not just.

(3) Propositions which differ only in form, and have the same particular quantity, are *sub-contrary*. E. g.: Some man is just; some man is not just.

(4) Propositions which have the same form, and differ only in quantity, are *subaltern*. E. g.: Every man is just; some man is just.—No man is just; some man is not just.

Logicians have adopted the convention of designating by the letters A, E, I, O, the four kinds of propositions as distinguished by quantity and form.

A designates a universal affirmative proposition.

E designates a universal negative proposition.

I designates a particular affirmative proposition.

O designates a particular negative proposition.

The following scheme exhibits the contradictory and contrary modes of opposition.²

¹ *Periherm.*, c. VI.

² "A universal affirmative (proposition) and a universal negative are contrary, as *Every man is just*, *No man is just*: for a universal negation indeed not only does away with a universal affirmation, but also indicates the extreme distance, inasmuch as it denies all that the affirmative asserts: this is of the essence of contrariety, and therefore the particular

A	CONTRADICTORIES	O
Every man is just		One man is not just
	CONTRARIES	
I	CONTRADICTORIES	E
One man is just		No man is just

44. Rules on the Truth or Falsity of Opposed Propositions.

—(1) *Contradictories are never either both true or both false*, seeing that one is the negation pure and simple of the other. The truth of the one, then, carries with it the falsity of the other; and *vice versa*, the falsity of the one implies the truth of the other: If it is true that every man is just, it cannot be true that one man is not just.

(2) *Contraries cannot both be true, but they can both be false.*

Contraries cannot both be true; otherwise contradictories would be true at the same time. Suppose the proposition, "Every man is just," to be true; the contradictory, "One man is not just," is false. If it is false to say that one man—even a single individual—is not just, much more is it false to say that every man is not just, or—which comes to the same thing—that no man is just. The proposition, "No man is just," is the contrary of the proposition, "Every man is just."

But the falsity of a proposition does not imply the truth of the contrary. It may be false that all men are just without its being true that no man is just; there may be some just men, even though not all are just.

(3) By a rule opposed to that of contraries, *sub-contraries may both be true*. E. g.: Some man is just; some man is not just. Justice may be an attribute of one portion of mankind and not of the other.

But sub-contradictories cannot both be false, or both of two contradictories would be false. Let the proposition, "Some man is just," be false; the contradictory, "No man is just," is there-

affirmative and the particular negative are in the nature of a mean between the contraries. . . . In contradictories the negation does no more than remove the affirmative." St. Thomas, *In Periherm.*, Lect. XI.

fore true. Much more, then, is it true that some man is not just, which is the sub-contrary.

45. Rules Concerning the Truth or Falsity of Subaltern Propositions.—The particular propositions I, O, are subordinate to universals A, E, respectively.

The truth of universal propositions implies that of their subalterns; but the truth of subalterns does not carry with it that of their universals.

The falsity of particulars implies the falsity of universals; but the falsity of universals does not carry with it the falsity of particulars.¹

46. Immediate Inferences.—We shall presently see that, in a reasoning properly so called, the conclusion springs from the comparison of three different terms, and that this comparison is made in two propositions, the two premises of the reasoning. It is sometimes permissible to draw at once a sort of conclusion from the enunciation of a single proposition: this is called an *immediate inference*.

The *conversion*, *opposition*, and *subordination* of propositions give occasion to inferences of this kind.

The rules given above sufficiently show how these inferences are justified.

ARTICLE II.

REASONING

47. Preliminary Remarks. Object of Article II.—Chapter III of this treatise has for its object the formation of the logical order.

¹With regard to modal propositions, the contradiction between affirmation and negation does not fall upon the attribute of the proposition, but upon *the verb*. The most ordinary cases of opposition between modal propositions are set forth in the following scheme:

This must be so.	CONTRADICTIONES	This need not be so— It is possible that this is not so.
It is not impossible that this is so—This may be so.	CONTRARIETES	This cannot be so.

In a former article we saw how concepts perform their functions in a judgment, and terms in a proposition. We next classified judgments, then set them side by side and compared them.

Judgments in their turn form the elements of a more complex order. Known judgments lead to a new judgment, through a discursive process called *reasoning*. This process, when expressed in words or writing, is called *syllogism*.

Hence these two paragraphs:

Reasoning and syllogism (§ 1).

The various forms of these two (§ 2).

§ 1. *Reasoning and syllogism*

48. Reasoning.—The aim of all intellectual processes is the knowledge of truth.

Certain truths are known *immediately*; others, *mediately*, by means of those known immediately. The former, as generating the latter, are called *principles*; the latter are *consequences*, or *conclusions*. To proceed from principles to conclusions is to *reason*.

A conclusion is a proposition, and, as such asserts a predicate of a subject. When the predicate manifestly belongs to the subject, the proposition is *evident*.¹ This evidence is *immediate* when the objective connection between the predicate and the subject of a judgment is immediately apparent to the intelligence; also *immediate* is the corresponding *certitude*. But in most cases the evidence of the judgment is brought to light only by the employment of one or more *intermediaries*, or *middle terms*—common terms of comparison between subject and predicate. In such cases the evidence is *mediate*, or *by reasoning*, as is the corresponding certitude. The kind of evidence is the evidence proper to *conclusions*.

The necessity of this discursive proceeding arises from the disproportion between the complexity of intelligible things and the inadequacy of the intelligence which is called upon to know them.²

¹ See *Criteriaology*.

² "The discourse of reason always begins in the understanding and ends in the thing understood; for we reason by proceeding from certain

The power of reasoning urges a perfection which the metaphysicians call *mixed*, i. e., marked by imperfection.

It is a *perfection to be able* to reason, i. e., to reach the knowledge of truths which otherwise would remain unknown.

It is an *imperfection to be obliged* to reason, i. e., to reach the truth only by winding and difficult paths.

49. The Syllogism. Terminology.—Reasoning, then, consists in comparing the subject and predicate of a not evident judgment, which is to be the conclusion, with a *middle term* to see whether, objectively, the one implies the other or excludes it. Its complete and typical expression is the *syllogism*. “The syllogism”, says Aristotle, “is a discourse in which, certain things being laid down, another thing follows necessarily, simply because those things are laid down.”¹

When the reasoning faculty declares that the predicate agrees objectively with the subject, the conclusion is affirmative; when it sees that one of the two terms agrees with the middle term while the other does not, the conclusion is negative.

The two terms of the conclusion are called *extreme terms*, or *extremes*, in opposition to the *middle term* (*medius terminus*) with which they are both compared.

The predicate is called the *great extreme*; the subject, the *small extreme*.

The two propositions from which the conclusion is drawn are called *premises* (*præmittuntur conclusioni*); together they form the *antecedent*. The premises are those things which, according to Aristotle, once laid down or supposed, draw the conclusion after them.

The *consequent* is the conclusion. The proposition first in order to be enunciated is often called the major; the second, the minor. But more exactly, the proposition in which the *great extreme* is put with the middle term is called the *major* (*Major, propositio*); that in which the *small extreme* is compared with the middle term, the *minor* (*Minor, assumpta*).

understood things; and the discourse of reason is complete when we arrive at the understanding of what was previously unknown. Our reasoning, therefore, proceeds from some precedent understanding.” *Summa Theol.*, 2^a 2^e, q. 8, a. 1, ad 2.

¹ *Prior Anal.*, I, 1.

The premises and the conclusion, the antecedent and the consequent, constitute the *matter* of the syllogism. The *form* lies in the bond between the antecedent and the consequent; it is condensed in the particle *therefore*, which expresses the *consequente* (*consequencia*, *consecutio*) of the syllogism.

To study the nature of reasoning is to investigate what causes that "certain things being laid down, another thing must necessarily follow *simply because those things are laid down.*"

50. Nature and Logical Basis of the Syllogism.—Take for example this syllogism: *The triangle which has two equal sides has two equal angles. This triangle has two equal sides. Therefore it has two equal angles.*

To reason is to place within the extension of an abstract type some determinate subject, with the result of concluding that a note which belongs to the abstract type as such is attributable to this determinate subject.

The major is a *necessary* proposition: it asserts that the predicate of the conclusion (*the property of having two equal angles*) is necessarily associated with an *abstract* middle term (a triangle which has two equal sides).

Being abstract, this middle term is not *actually* universal, but it *can be universalized*; by an ulterior act of reflection it *can* be attributed to one, or to several, or to all the inferiors of a species or of a genus.

The reasoning faculty, on enunciating the minor, sees that the middle term extends to the subject of the minor—it sees that this triangle has two equal sides.

Then, provided that the major and the minor are taken in at one glance, it will be seen that the predicate of the conclusion *has two angles equal*, necessarily belonging to the middle term, *triangle with two sides equal*, belongs to the subject of the conclusion which is within the extension of the middle term; therefore the necessary connection between the subject of the conclusion and its predicate becomes obvious.

The syllogism is essentially a *process of universalization*. The principle on which it is founded may be thus enunciated: *The note which necessarily applies to an abstract subject—the middle term—applies to the subjects of the extension of the middle term.*

Obviously, the connection established by reasoning between

the extremes and the middle term belongs at once to the comprehension and to the extension of the terms.

In the major, one of the extremes—the predicate of the conclusion—is, by reference to its *comprehension*, connected with the middle term: *Whatever things are the same as a third thing are the same as one another.*

In the minor, the same middle term is considered with reference to its *extension* and in this point of view is connected with the other extreme, the subject of the conclusion. *Whatever is affirmed or denied of a subject taken in the abstract must be affirmed or denied of all its inferiors and each one of them, in one word, affirmed or denied universally.*

The syllogism considered above leads to an affirmative conclusion. The same analyses may be applied to syllogisms with negative conclusions.¹

51. What Kind of Necessity Attaches to the Principles of the Syllogism?—The law which serves as a fulcrum for reasoning is sometimes *metaphysical*, or *absolute* (see example given under 50); sometimes *physical*, or *natural*, and therefore dependent on conditions to be determined by experience (as: Water attains its maximum density at 4° centigrade).

In the former case the predicate in the conclusion expresses the *essence*, total or partial, of the middle term, or a *property* which is a *corollary* of that essence, and the necessity of applying this predicate to the subject of the conclusion is *absolute*.

In the latter case the quality is attributed to the middle term in virtue of a law established by experience, and the attribution of predicate to subject in the conclusion is *hypothetically* necessary. These laws of experience are established by induction, as will be seen later.

52. Logical First Principles.—We have seen that the syllogism derives its demonstrative force from a necessary proposition. Whence does this proposition derive its logical value? From a previous reasoning. We cannot go on from one process of reasoning to another indefinitely.²

¹ See *Criteriology*, no. 58: Stuart Mill's objections against the value of the syllogism.

² *Criteriology*, 52-54.

Otherwise we should be obliged to say that no conclusion is certain. There must be propositions on which the reasonings are supported, and which themselves need no demonstration. These are called *logical principles*: they are the enunciation of a relation between primary notions.

There are two kinds of principles: (1) *generative principles* of the sciences; (2) *directive principles*, or axioms.

53. Figures and Modes of the Syllogism.—The various forms of the syllogism, according to the relation of the middle term with the extremes, are called by Aristotle *figures* (*σχήματα*):

1st Figure: The middle term is subject in the major and attribute in the minor.

2nd Figure: The middle term is attribute in both premises.

3d Figure: The middle term is subject in both premises.

The syllogisms possible in these figures, regard being had to the quantity (universal or particular) of the propositions and their form (affirmative or negative) have been called the *modes* of the syllogism.

Counting all the possible modes of the syllogism, independently of their logical value, we find a total of 256 forms. Of these 24 are conclusive; and 5 of these 24 are useless without being vicious. Hence we have 19 *valid and useful* modes of the syllogism.

54. Rules of the Syllogism.—Besides the special rules of each of the figures, logicians have been wont to formulate eight rules applicable to the syllogism in general, expressing the *nature* of the reasoning.

FIRST RULE.—*Terminus esto triplex: medius, majorque minorque.*—The syllogism must have three terms, neither more nor fewer. To reason is in fact to compare *two* terms with *one and the same third*, so as to see what logical relation exists between the two terms so compared.

This rule may be violated by defect, in using only two terms, or by excess, in using more than three.

(1) A syllogism with *two* terms is, e. g., where one of the premises is tautological. E. g.: Every effect has a cause. But the universe is an effect. Therefore the universe has a cause.

This first rule is violated by the form of sophism called *petitio principii*, which resolves *the question by the question* (begging the question).

(2) A syllogism contains *more than three terms* when one term is equivocal and is taken in different acceptations. E. g.,: The operations of thought have the brain as organ. An operation which has the brain as organ is material. Therefore the operations of thought are material.

In this syllogism the middle term, *has the brain as organ*, is equivocal.

SECOND RULE.—*Latius hoc (terminos extremos) quam præmissæ conclusio non vult, or: Æque ac præmissæ extendat conclusio voces.*—The extremes must be the same in the conclusion as in the premises.

The conclusion expresses the results of the comparison made in the premises. It cannot go beyond that; otherwise it would pass from the terms compared in the premises to *other* terms, and thus would violate the first rule, the essential condition of reasoning.

THIRD RULE.—*Aut semel aut iterum medius generaliter esto.*—The middle term must be taken as universal in one premise at least.

The analysis of the process of reasoning (50) has made this third rule intelligible. If the middle term were taken twice in a restricted sense, that part of its extension which it represents might possibly be different in the two cases, and there would be *four* terms in the syllogism (first rule). E. g.: Every metal is heavy. This substance is heavy. Therefore this substance is a metal. The middle term, *heavy*, is not universal in either of the premises.

This very common sophism is characterized by the adage: *Ab uno disce omnes.*

FOURTH RULE.—*Nequaquam medium capiat conclusio fas est.*—The middle term may not enter into the conclusion.

It is for the conclusion to apply to the *two* extremes the result of the comparison made *in the premises* between them and the middle term. To introduce the middle term into the conclusion, then, would be to miss the aim of the reasoning.

FIFTH RULE.—*Ambæ affirmantes nequeunt generare negatem.*—Two affirmative premises cannot beget a negative conclusion.

If two ideas agree with one and the same third idea, the other rules of the syllogism being observed, they cannot but agree with

each other; and the identity affirmed in the premises cannot be denied in the conclusion.

SIXTH RULE.—*Utraque si præmissa neget, nil inde sequetur.*—With two negative premises no conclusion is possible.

Two extremes both excluded from *one* middle term cannot be connected with each other on account of this exclusion.

But on the other hand, it is possible that two terms excluded from *one* given middle term may be comparable with *another* middle term with which both must be coupled, or else one coupled and the other separated. The use of this other middle term would give a conclusion.

The fact, then, that two extremes are excluded from a given middle term warrants no assertion as to the relation of the extremes.

SEVENTH RULE.—*Pejorem sequitur semper conclusio partem.*—The conclusion should follow the premise of lower rank.

This formula has a double application:

(1) *If one of the premises is negative, the conclusion must be negative.* If, of two ideas A and B, A agrees with a third idea, C, while B does not, it is impossible to conclude therefrom that A agrees with B.

(2) *If one of the premises is particular, the conclusion cannot be universal.*

As the premises cannot both be negative (sixth rule), only two cases are to be considered:

(a) Both the premises are affirmative.

(b) One is affirmative; the other, negative.

In case (a) both the predicates are particular; one of the two subjects is by hypothesis particular: there is, then, only one universal term in the premises. As this must be the middle term (third rule), neither of the extremes is universal in the premises and, consequently, cannot be so in the conclusion. So that the conclusion, since it necessarily has a particular subject, is particular.

In case (b) the premises include two universal terms: the predicate of the negative premise and the subject of the proposition which, by hypothesis, is universal.

But the conclusion is negative, so that its predicate is universal. This term, which is the predicate in the conclusion, is not the

middle term (fourth rule). The second universal term of the premises is therefore the middle term. Hence the extreme which becomes the subject of the conclusion is particular in the premises, and, consequently, in the conclusion. Therefore the conclusion is particular.

For example: Every man is corporeal. But A is not corporeal. Therefore A is not a man.

The result would be the same if one proposition were both universal and negative, as: No man is spiritual. But A is a man. Therefore A is not spiritual.—Or: But B is spiritual. Therefore B is not a man.

When one premise is particular, then, the conclusion must be particular.

EIGHTH RULE.—*Nil sequitur geminis ex particularibus unquam.*—No conclusion follows from two particular premises.

As both the premises cannot be negative (sixth rule), the only possible cases are:

(a) Both premises are affirmative.

(b) One is affirmative; the other, negative.

In case (a) all the terms are particular: the two predicates, because the propositions are affirmative; the two subjects, by hypothesis. The middle term, therefore, is not once taken universally. The third rule is violated. No conclusion.

Example: Some men are rich. Some men are ignorant. Therefore some rich men are ignorant.

If this syllogism were valid, it might be proved in the same way that some rich men are poor, which exposes the sophism.

In case (b) the premises contain only one universal term, the predicate of the negative premiss. But the conclusion being negative, its predicate is universal; being so in the conclusion, it must also be universal in the premises. Consequently, the middle term, which cannot be identical with the predicate of the conclusion (fourth rule), is twice particular in the premises. Once more, the third rule is violated. No conclusion.

Example: Some men are learned. But some men are not virtuous. Therefore some learned men are not virtuous.

The inconsequence is manifest.

55. Range of the Rules of the Syllogism. Logic and Truth.

—The rules just given relate only to *logical deduction*. But

logical connection between antecedent and consequent is one thing; *the truth of the consequent* is another. The necessary connection between the things laid down and the thing which springs from them does not affect the truth or falsity of the premises containing the former.

Two general laws govern the truth and the falsity of conclusions:

(1) If the premises are true, so will be the conclusion: *Ex vero non sequitur nisi verum*. The conclusion, indeed, confines itself to affirming relations seen in the premises; if they have been recognized in the premises, there can be no error in expressing them in the conclusion.

Corollary: As true premises cannot lead to a false conclusion, we may fairly refute a doctrine or a theory by arguing from the falsity of its consequences. Atheism, for example, is refuted by its consequences.

(2) If the premises are false, or if one of them is false, the conclusion will generally be false; but it may be true. *Ex falso sequitur quidlibet*.

Examples given by Aristotle: "Every man is a mineral. Every mineral is an animal. Therefore every man is an animal."—"Every mineral is an animal. No horse is an animal. Therefore no horse is a mineral."—"Every horse is an animal. No man is an animal. Therefore no man is a horse."

From a false principle one may arrive at an exact result, either because the principle is a mixture of true and false, and it has been used only in so far as it is true; or because the errors proceeding from the principle have ended by compensating one another.

Corollary: Since a false antecedent may have a true consequent, a doctrine or theory cannot be rigorously established by showing that this or that one of its consequences is true. Newton, for example, had deduced from his theory of emissions many consequences in respect to the nature of light which were afterwards verified by experiment; nevertheless, the theory itself was disproved. For an argument drawn from the consequences of a theory to be conclusive, it must be demonstrable that the theory leads to none but true consequences.

§ 2. *Syllogisms*

56. Preliminary remarks.—Syllogisms may be classified either by their *form* or by their *matter*. The form of a syllogism is its structure, abstracting from the truth or falsity of the premises themselves; the matter consists of the propositions, which may be *true* or *false*.

In the following two articles we shall successively take the two points of view of *form* and of *truth*.

Scientific induction does not essentially differ from the syllogism. Hence the *analogy* and the *example*, which logicians connect with induction, may also be reduced to the syllogistic process. It follows that all forms of reasoning properly so called are but variants of the syllogism. Such will be the general conclusion to be drawn from this article.

I. SYLLOGISMS CONSIDERED WITH REFERENCE TO THEIR FORM

57. Classification of Syllogisms by Form.—Considered with reference to its form, the syllogism is: *categorical*; *hypothetical* (or *conditional*); *conjunctive*; *disjunctive*. The latter two may be reduced to the *hypothetical* syllogism. The *exclusive* syllogism and the *dilemma*, which are complex, more properly belong, the former to the *categorical* type, the latter to the *hypothetical*.

58. Varieties of the Categorical Syllogism.—The *categorical* syllogism has for its premises two categorical propositions. It will be useful to note some of its possible structural modifications.

Such are the forms of reasoning called *epicheireme*, *polysyllogism* and *sorites*, *enthymeme*.

(1) The *epicheireme* (επι and χεῖρῶ, to take in hand) now¹ designates a syllogism one or both premises of which is immediately accompanied by the proof.

The *polysyllogism* is a series of syllogisms in which the conclusion of each serves as premise for the next.

In practice the polysyllogism is condensed, under the form of

¹In Aristotle *epicheireme* means an attempt at demonstration as opposed to a demonstration properly so called.

sorites (*σῶρος*, heap), into a series of propositions where the predicate of the first becomes the subject of the second, and so on, in such a way that the predicate of the last in the series may be coupled with the first subject.

Example: The human soul forms abstract thoughts; a being capable of abstract thoughts is spiritual; a spiritual being is by nature imperishable; a being naturally imperishable cannot be annihilated; a spiritual being that cannot be annihilated will live with an immortal life; therefore the human soul is immortal.¹

59. Nature and Rules of the Conditional Syllogism.—The *conditional* syllogism is that which has a conditional proposition for its major. E. g.: If the soul is simple, it is imperishable; but the human soul is simple; therefore it is imperishable.

In the major there is only the *assertion of a necessary connection* between the condition (simplicity of the soul) and the conditioned (incorruptibility).

As soon as this connection is accepted as necessary, the rest reduces to an ordinary reasoning the antecedent of which forms the minor and the consequent conclusion.

The whole interest of the conditional syllogism, then, is in the major, which is equivalent to an absolute affirmative proposition. The proposition, "If the soul is simple, it is imperishable," is equivalent to, "Every simple thing is imperishable." Now a *universal affirmative is not convertible* (42).

From this observation we deduce the rules of the conditional syllogism:

(1) Affirm the condition, or antecedent, and you must affirm the conditioned proposition, or consequent. E. g.: If you are from Brussels, you are a Belgian. But you are from Brussels. Therefore you are a Belgian.

(2) Deny the conditioned proposition, or consequent, and you must deny the condition, or antecedent. E. g.: If you are from

¹The *enthymeme* is commonly reckoned among the more or less disguised forms of the syllogism, as though it consisted merely in leaving one of the premises to be understood, not expressed. This is too secondary a circumstance to justify giving the *enthymeme* a place of its own among the forms of syllogism. As a matter of fact Aristotle understood by *enthymeme* a syllogism the conclusion of which is only more or less probable.

Brussels, you are a Belgian. But you are not a Belgian. Therefore you are not from Brussels.

But the inverse is not true.

Remarks: (1) Nevertheless, the *matter* of the conditional proposition may possibly be such that the truth of the consequent carries with it the truth of the antecedent. E. g.: If a figure is a circle, it has equal radii.

(2) The conjunction *if* does not always mean, in the thought of one who uses it, a connection of *necessary dependence* between the antecedent and the consequent; it frequently indicates only a *partial* or a *contingent* connection, and in that case expresses a presumption rather than a rigorous inference. E. g.: If this man were sorely tried by misfortune, he would return to a better state of mind.

60. Conjunctive and Disjunctive Syllogisms.—The conjunctive syllogism is that which has a conjunctive proposition for its major. This proposition alleges an incompatibility between two cases, one of which is affirmed in order to eliminate the other.

E. g.: You could not have been in Brussels and in Paris at the same time. You were in Brussels. Therefore you could not have been in Paris.—This syllogism may be reduced to the conditional type, and follows the laws of that type.

The *disjunctive* syllogism has for its major a disjunctive proposition, which not merely alleges an incompatibility, but implies an alternative admitting no middle term.

Hence the disjunctive syllogism is governed by the following two rules:

(1) The disjunction laid down in the major must be complete.

(2) When the minor affirms one of the members of the disjunction, the remaining member or members must be denied in the conclusion, and vice versa.

Example: Every free act is morally good or bad. Now such or such an act (e. g., an oath) is not morally bad; therefore it is morally good. . . . Or, it is bad; therefore it is not good. . . . Or, it is good; therefore it is not bad. . . . Or, it is not good; therefore it is bad.

61. Exclusive Syllogism.—This type has *both* premises exclusive. E. g.: Only a spiritual being is free. Man alone is spiritual. Therefore he alone is free.

This syllogism may be broken up into two others, one affirmative, the other negative: A spiritual being is free. Man is spiritual. Therefore he is free.—A free being is spiritual. Beings other than man are not spiritual. Therefore they are not free.

62. Dilemma.—The dilemma is the combination of a disjunctive proposition, serving as major, with two or more conditional propositions forming a minor. First, partial conclusions exclude the members of the disjunction one after another; then it is concluded in a general manner that the disjunctive proposition taken as a whole is inadmissible.

This method of arguing is lively and cogent. An alternative is presented to one's opponent: he is left the choice between two positions; then it is proved that in either case he is wrong.

The validity of the dilemma requires a punctual observance of the rules of the disjunctive and of the conditional syllogisms.

First rule: The disjunction of the major admits of no intermediary proposition, but must be complete.

Second rule: Each of the two *conditional* syllogisms which together form the minor of the dilemma must be *conclusive*, and must lead to the same conclusion.

Example (from Père Félix): "If we supposed that Jesus Christ, in spite of His own assertions, is not God, we should be led to one of these two insulting conclusions: that He is a madman; or that He is an impostor. Now, supposing Jesus Christ to be insane, how can we reconcile with insanity the lofty wisdom manifested in His life and doctrine? Supposing Him an impostor, how make His humility and abnegation agree with such ambitious designs? Both these hypotheses, therefore, are equally inadmissible: Jesus Christ is the Christ, the Son of the living God."¹

It is easy to show that the syllogisms are fundamentally reducible to the categorical syllogism.

¹ The dilemma must not be confounded with reasoning "by successive parts", which consists in enumerating all the species of a genus, to take them up afterwards one by one and finally enunciate of all the conclusion which is valid for each of the parts.

II. SYLLOGISMS CONSIDERED WITH REFERENCE TO THEIR MATTER.

63. Preliminary Remarks.—Syllogisms are divided, in respect to their matter, according to the relations of their propositions with the truth. Now, judgments are certain, probable, or erroneous; and syllogisms, accordingly, are demonstrative, probable, erroneous.

(1) The judgment is *certain* when the mind firmly adheres to what it knows to be the truth: a syllogism which leads to certitude is a *demonstration*.

(2) So long as the mind remains between two opposite judgments without definitely adhering to either of the two, it is in suspense.—it *doubts*. When it inclines to one side or the other, but without adopting either side absolutely to the exclusion of the other, it has an *opinion*: the syllogism is *probable* when it begets an opinion, and its probability is in the direct ratio of the strength of the motives which induce the partial adherence of the mind.

(3) The contrary of truth, the disagreement of the judgments with the thing known, is *error*: syllogisms which lead to error are called *sophistical*.

We proceed to examine in order *demonstrations*, *probable arguments*, and those *sophisms* which are chiefly worthy of our attention.

DIFFERENT KINDS OF DEMONSTRATION.

64. I. Primary Division.—A demonstration is a reasoning which proceeds logically from *certain premises* to a *certain conclusion*. And in a more perfect sense, it is a syllogism which *furthmore* produces true *knowledge*, i. e., makes us “know the cause of the thing, know that that cause is really the cause of the thing, and that, consequently, the thing could not be otherwise than we know it.”¹

There is a primary distinction between the demonstration which

¹ Aristotle, *Posterior Anal.*, I, 2.

produces a *certain* conclusion and that which produces a *strictly scientific* conclusion.

65. Conditions of a Strictly Scientific Conclusion.—Examining into the nature of the scientific demonstration, Aristotle determines its properties as follows:

The premises of the determinate syllogism must be *true, primary, immediate, better known than the conclusion, anterior* to it, and the *cause* or *reason* of its truth.

(1) *True*: Although false premises may sometimes be followed by a true conclusion (57), falsity *as such* is never the origin of a truth. The aim of the demonstration being to bring a true conclusion out of the premises, a good demonstration must proceed from true premises, the natural source of *truth*.

(2) *Primary—themselves incapable of demonstration*—in the sense that all the demonstrations of a science should form a single chain, the first link of which is formed out of premises that cannot be demonstrated. Hence, in relation to those which follow them, these primary premises are:

(3) *Immediate, i. e., evident without need of demonstration.*

(4) The *cause* or *reason*¹ of the conclusion, not only in the *logical order* of our knowledge, but in the *ontological order*.

(5) *Anterior to the conclusion*, since the premises must contain the cause or reason of the conclusion. This anteriority may be only a priority of *nature*.

(6) *Better known than the conclusion*, the aim of reasoning being to effect a passage from what is better known to what is less, or not at all, known. Observe that this Aristotelean theory refers to the *ontological* order. In our subjective point of view the sensible fact precedes the abstract quiddity which we separate from it; the particular leads to the universal. But in reality nature is prior to its sensible manifestations, the law is the reason why the fact is, and is necessary to its explanation.

66. Proof of Fact and Causal Demonstration.—Corresponding to the fundamental distinction between the syllogism with a certain conclusion and the strictly scientific demonstration is the Aristotelean division of the proof of fact and the causal demonstration.

¹ On this distinction see *General Metaphysics*, no. 165.

The demonstration *ὅτι*, *demonstratio quia*, or *quod* (quia meaning not *because*, but *that*), is the *proof that* something is. According to Cajetan, this proof bears both on the copulative *to be* and upon the existence, especially on the latter.¹

The causal demonstration *διότι*, *demonstratio propter quid*, brings into evidence the *immediate cause* of the thing demonstrated, the *proper reason*, ἀρχὴ οἰκεῖνα, for which it is. This is why it is strictly *scientific*.

A demonstration which gives an *extrinsic* or a *general* reason for the connection of the predicate with the subject is not a demonstration *διότι*, but is ranked among proofs of fact.

67. II. Demonstrations a Priori, a Posteriori.—This distinction, which, with modern logicians, takes the place of the preceding, is less rigorous, but has a foundation in the nature of things.

A demonstration is *a priori* or *a posteriori* accordingly as the middle term is *in reality* anterior or posterior to the predicate of the conclusion; it proceeds from the cause or the reason (*a causa vel ratione quæ in se est prior—a priori*) to the effect or result (*ad effectum vel rationatum*), or vice versa.—E. g.: An immaterial subject is imperishable. The human soul is immaterial. Therefore it is imperishable.—A being which is subject to change requires a cause other than itself to bring about its existence. The universe is subject to change. Therefore there is a cause of the existence of the universe, God.

To this division some authors have added a third member, the demonstration *a simultaneo* or *quasi a priori*. It has its place where two things have to be demonstrated which in reality are not distinct, but one of which is necessarily conceived as coming before the other. Such is the proof by which St. Anselm thought it possible to demonstrate the existence of God from the idea of the most perfect Being.

68. III. Circular or Retrogressive Demonstration.—The reasoning faculty ascends from effect to cause that it may descend again from cause to effect and account for the latter by the former. It describes as it were a circle, returning, in a manner, to the point from which it started. This process is called *circular* demonstration.

¹ *Posterior Anal.*, II, 1.

The *circular* demonstration sets out from a phenomenon the existence of which is established, but its nature only confusedly perceived; it starts again from the nature of the phenomenon, but only after acquiring a more *distinct* idea of it, which better explains observed effects.

The circular demonstration must not be confounded with the vicious circle.

69. IV. Other Accidental Forms of Demonstration.—(1)

Direct and indirect demonstration: This distinction is connected rather with extrinsic circumstances than with the nature of things. The *direct* demonstration (including all the forms thus far enumerated) shows, without any deviation, that the conclusion is virtually contained in the premises. The *indirect* demonstration, taking into account the subjective dispositions of the person to whom it is addressed, demands his positive adhesion to the truth of the conclusion through the rejection of the contradictory proposition. E. g.: The demonstration of free will by proving the absurdity of the consequences of determinism.

The indirect demonstration is also called demonstration *by the impossible*, or *reductio ad absurdum*.

(2) *Absolute and relative, or ad hominem, demonstration.*

(3) Aristotle also opposes to the scientific demonstration a *demonstratio a signo* or *per signum*, an *extrinsic* proof adduced from things exterior to that which is to be demonstrated. See example (74).

These accidental or secondary forms of demonstration may be reduced to the fundamental distinction between the demonstration *ὄτι*, and *διότι*.

PROBABLE ARGUMENTS.

70. Probable Arguments.—They are those arguments which proceed from one or more probable premises to a conclusion which is only probable.

Under one heading may be classed the various arguments which may be called in a general way *arguments from analogy*: the *enthymeme* (in Aristotle's sense), *analogical induction*, the *example* and certain *inferences drawn from the theory of probabilities*; under another heading, the *hypothesis*; under a third, the *argument from authority*.

71. I. Arguments from Analogy: (1) The Enthymeme.—The enthymeme, says Aristotle, is “a syllogism drawn from certain resemblances or certain marks.”—The “marks” here meant, it must be understood, are not the natural properties of the subject.

Such reasonings are very frequent in ordinary life. E. g.: Most men act from self-interest. Therefore, in this case, Peter acted from self-interest.

72. (2) Analogical Induction or Analogy.—Scientific induction, with which we shall deal later on, disengages from among the many various accidents of a substance a *natural property*, and concludes with *certainty* that this property is the foundation of a general law.

Analogy is a reasoning of the same nature as induction, but its conclusion is only *probable*.

We employ analogical induction, or analogy, when, having recognized in two objects or phenomena certain characteristics which are *really* common, we *infer* that one or more other, heretofore unknown, characteristics of these objects or phenomena *must* likewise be the same.¹

73. (3) The Example.—Induction, whether scientific or analogical, moves from the fact to its sufficient natural reason, to its law and, by consequence, to the universality of its applications.

Example moves in a conjectural way from one *particular* case to another *particular* case.

(4) Probable hypotheses and conclusions drawn from the theory of probabilities.²

74. II. Arguments from Authority.—In many circumstances of practical life men allow themselves to be guided by *others*, and they obey arguments *from authority*.

The affirmation of an authority may bear upon a fact or upon a doctrine; in either case its logical value is probability. It is certain that a legitimate tendency inclines us to place reliance in a general way on the exactitude and sincerity of our fellow-men.

Nevertheless, confidence in the statement of another cannot

¹ Analogy is abused in the sciences either by exaggerating resemblances to suit one's purpose, ignoring differences, or by taking a metaphor for a resemblance.

² See 95.

reasonably be absolute. A man who had never before lacked prudence and circumspection in his observation of external facts might, in this one instance, have acted inconsiderately. An habitually sincere man may have lied in this case.

In each particular case the argument from authority has its value; but no human testimony justifies absolute certainty.

In a doctrinal affirmation, St. Thomas does not hesitate to declare, the argument from authority is the weakest of all: "Locus ab auctoritate, quæ fundatur super ratione humana, est infirmissimus."

This declaration is a crushing answer for those superficial minds who would make Scholasticism an abdication of the personal reason in favor of authority.

ERRONEOUS AND SOPHISTICAL ARGUMENTS.

75. False Reasoning.—Error proceeds from the *basis* or from the *form*: from the *basis* when we take for true and certain premises which are erroneous or doubtful; from the *form* when, consciously or unconsciously, we draw from the premises a conclusion which does not logically flow from them.

In the former case the false reasoning is called an erroneous argument; in the latter case it is called a *paralogism* or a *sophism*. The *paralogism* is a false reasoning of which we ourselves are the dupes; the *sophism*, in the current acceptation, implies the intention of deceiving.

76. False Reasonings or Sophisms.—With Mill we may divide sophisms into two classes:

(1) *Sophisms of simple inspection*, or a *priori sophisms*. These are *prejudices*, that is, maxims generally accepted without argument, which, therefore, no one doubts, and which, nevertheless, are *erroneous* or at least equivocal.

Example: *To lay down as a principle that the logical order must correspond with the ontological*—"ideas with things". This preconceived dogma is one of the supports of Pantheism.—*To repudiate a priori one or more means of knowing* and then to pronounce absolutely unknowable whatever eludes the one means of knowing which has been arbitrarily set aside. This prejudice

enables Rationalism to deny all revelation.—To affirm without reserve that man is entitled to unbounded liberty.

(2) *Sophisms in reasoning properly so called, or sophisms of inference.*

Of these some are sophisms of *induction*; others, of *deduction*, comprising sophisms in *terms* and in *form*.

77. False Reasonings Properly So Called.—I. Sophisms of Induction.—Under this head are included all sophisms which arise in inductive reasoning, whether they affect the preliminaries (sophisms of *observation*) or the inductive reasoning itself (sophisms of *interpretation*, or of *inductive inference*).

(1) *Sophisms of observation.*—Patient and honest observation is the starting-point of all inductive research. Too often, however, eagerness to reach a conclusion drives the investigator into assertions which go beyond the bounds of his observation.

(a) *We see what we wish to see*, instead of seeing what is. Example: Haeckel's primary monerons and Huxley's famous Bathybius.

(b) *We do not see what we wish not to see.* Example: The biological theories which would demonstrate the identity of the animal and the vegetable cell.

(2). *Sophisms of interpretation.*—Those which consist in *wrongly interpreting* observed facts. The observation is complete, but the meaning attributed to it is added by a suggestion arising from the eagerness to form a complete system.

Example: To conclude from the fact that *forms of energy may be expressed in terms of mechanical energy* to the thesis that all corporeal energies—including those developed in nervous tissue, and accompanied by sensation, passion, spontaneous movement, or by thought and volition—*are nothing but mechanical energies.*

(3) *Sophisms of inductive inference, or of induction.*—The *example* is illegitimately employed when we pass from one observed case to another without first taking care to connect both of them by means of induction with a *natural* cause. *Ab uno disce omnes.* The *analogy* is abused in the same way.¹

¹ Certain sophisms of induction may be classified indifferently in several of the groups of hasty generalizations.

78. II. Sophisms of Deduction.—(1) *Sophisms of terms.*—These are connected with the signification of words which are changed, distorted out of their true sense, or taken in several different senses. The principal ones are:

(a) *Equivocation, or ambiguity of terms.* This consists in employing a word in a double sense in reasoning, or taking an ill-defined word in two different acceptations. Example: The use of the terms, *liberty, equality, solidarity, evolution, rationalism, liberalism, socialism*, etc.—Equivocation introduces a fourth term into the reasoning.

(b) *Passing from the collective to the separate sense (fallacia compositionis).* This sophism consists in affirming of things collectively what is true only of those same things taken separately. As when Christ says, in the Gospel: “The blind see; the lame walk upright; the deaf hear”; this can only be true taking these things individually, not comprehensively.

(c) *Passing from the separate to the collective sense (fallacia divisionis).* This consists, on the contrary, in taking the collective sense. E. g., if we should argue: Five is one number; but two and three make five; therefore two and three make one number.

(2) *Sophisms of inference or of “deduction.”*—(A) *The petitio principii* is when we begin by supposing the very thing which is in question. This sophism is committed when we take for granted: (a) *the very thing* that has to be established; (b) *the whole*, when a part of it remains to be proved; (c) *a part* of what has to be proved as a whole; (d) *each one of the parts* of the whole that has to be established; (e) *a point of doctrine* necessarily bound up with the principle in question.

(B) *The vicious circle* is an aggravation of the same sophism: it not only takes for granted what is in question, but it proves two propositions one by the other reciprocally. E. g., Descartes proves God’s veracity by the evident character of truths, and the same evident character by God’s veracity.

(C) *The sophism of accident* confounds (a) what is *accidental* with what is *essential*, or (b) what is *relatively* with what is *absolutely* true. As when a thing is condemned *absolutely* because of certain abuses to which it gives occasion.

(D) *The sophism of non-cause* confounds concomitance or

succession with the relation of causality: *with this, therefore*, because of this; or, *after this, therefore because of this*—or again, concomitance with identity: *with this, therefore this itself*.

(b) Connected with this sophism is the confusion of *condition* with *cause*, or of *partial* with *total* cause.

(E) *The sophism of interrogation* consists in joining together several questions which are really distinct, as if they all demanded a single reply. As: Why did you kill your wife?—This interrogation supposes already settled the preliminary question: Did you kill your wife?

(F) *Ignoring the state of the question, ignoratio elenchi*. This sophism takes three forms: the reasoning proves too much, or too little, or it proves something apart from what is required to be proved.¹

ARTICLE III.

Scientific Systematization.

PRELIMINARY.

79. Science is a System.—The organic growth of science is gradual. Concepts take their places in judgments; judgments, in reasoning. Demonstrative reasoning produces a fragment of science. Reasonings are co-ordinated and subordinated, and the orderly whole forms a science.

A science is an assemblage of propositions which form a *σύνστημα*—a whole which stands up by itself.

It is its formal object that gives a science its unity.

The definition of the essence of a thing gives rise to certain simple and general initial propositions—the principles of the science—from which reason deduces certain conclusions. These first conclusions lead to others, dependent on them, and, through

¹ To this list of the commonest sophisms may be added the *paradox*. This is a judgment which contradicts a common opinion. The latter may be true or false. Hence, there are two classes of paradoxes, of which only the first deserves to be so called. To maintain that all intelligences are equal (Helvetius) is a genuine paradox.—To say that it is better to suffer wrong than to do it, at first seems paradoxical, but is not really so. The paradox is sometimes a mere joke or an ill-natured sarcasm, and is thus of no particular importance.

them, subordinate to the principles; so that the whole scientific structure is based upon principles furnished by the analysis of the subject.

The systematization of science is the supreme intrinsic purpose of logic.

80. Scientific Systematization.—There are three factors of this (*tres modi sciendi*—three modes of knowing): definition; demonstration; division.

Definition furnishes the principles; *demonstration* passes from principles to conclusions. While the *definition* says what a thing is, it shows in what that thing differs from things of another species comprised in the same genus. Thus differentiation, or *division*, is the auxiliary of definition.

Having studied the function of definition and division, and the conditions under which they are employed (§ 1) (demonstration has already been sufficiently treated) we shall enquire how these factors adapt themselves to the various sciences and to philosophy: the study of method in general and of the methods respectively appropriate to the various groups of sciences (§ 2).

§ 1. *Scientific Processes.*

81. I. The Function of Definition.—To define is to say what a thing is.—Definition has a twofold function:

(1) The accessory function of clarifying concepts by resolving things that are to be known into their elements, so as to obtain a better light on them.

(2) The essential function of laying the foundations of science.

Just as not everything can be demonstrated, so not everything can be defined. Passing from analysis to analysis, we must sooner or later end with notions not susceptible of analysis. Such are the notions of unity and of number, the basis of arithmetic. These notions furnish the materials of the definitions, or first principles, on which the whole science rests, as a building rests on its foundations.¹

¹“The principles of the sciences are indemonstrable definitions. The definition manifests what a thing is; thus mathematics lays down as principles what unity is, what an uneven number is, and so on.” Aristotle, *Posterior Analyt.*, II, 3.

82. Definitions of Words and Definitions of Things.—(1)

The *verbal definition* explains the signification, *etymological* or *conventional*, of a word. Its purpose is to make our ideas clear and avoid equivocation.

(2) The *real definition* says what a *thing* is. The real definition is essential, natural, or descriptive.

(a) *Essential definition*.—To know in a *perfect* manner what a thing is, is to know its intimate nature, its essence. Now the *individual* essence, by reason of which *this* individual subject is what it is, distinct from other individuals, is unknowable to man.¹ We know only by classes.

(b) *Accidental definition*.—Neither do we immediately attain the *generic* or *specific* essence. On observing the qualities of beings, we do not even know, at first, whether they are natural or accidental; the designation is often only a description, improperly called a *descriptive* definition.

It is *accidental* when it designates a thing by means of accessory notes the whole sum of which belongs to this thing alone.

(c) *Natural definition*.—When, through induction, the mind comes to discern in the thing one or more necessary qualities, it defines the thing by its *properties*: this is *natural* definition.

The definitions used in chemistry, mineralogy, botany, zoology, etc., are descriptive, accidental, or at most natural.

The *essential definition*, then, is an ideal, which is but rarely attained. And yet, it alone is *rigorously scientific* or philosophic.

How do we form it?

83. Processes of Definition. Synthesis. Combined Analysis and Synthesis.—Some sciences are rational, others, exact or experimental sciences, accordingly as their principles are rational or

supplied by induction.

The process of definition in the rational sciences is synthetic; in the experimental sciences it is first analytic and then synthetic.

(1) *Rational sciences*.—By means of ordinary observation we abstract from reality as perceived by the senses certain very simple notions (decomposition) which we then combine into more and more complex objects (synthesis). Each of the notes put into the synthesis is more universal than the object of the syn-

¹ See *Psychology*.

thesis, but their totality is 'more limited than each of them by itself: synthesis progressively limits its object, and makes its definition (*ὄρος ὀρισμὸς*).

Example: *Three* is the first *uneven number*. Each of the attributes belongs to other numbers; but their combination limits their attribution to the number three: they *define* it.

As the comprehension of the concept increases, so its extension diminishes. Synthesis, then, is a direct process of definition. We shall see later on that it is at the same time an indirect process of elimination—of *division*.

The attribute *uneven* is opposed to the attribute *even*; it excludes the number two. The attribute *first* excludes all the numbers except two and three. So then, the combination, *first, uneven* excludes all the numbers except three. The definition, *first, uneven number*, fits the defined object, *three*, and no other object—it is *adequate*.

(2) The *experimental sciences* end their work with a synthesis; but they begin with an *analysis*.

To arrive at a definition of life, we begin by observing the *various beings* which are called *living*, and look for something in them to justify a common attribute.

When we *eliminate* in thought that which distinguishes some of the various vital acts from the rest (nutrition; cognitions; appetitive acts, whether sensual or intellectual), we find in them a common characteristic: they are *immanent*.¹ Immanent activity is the definition of life.

Division—elimination of distinctive notes—has brought us to definition. And definition will bring back again the division from which the analysis began.

Vital immanence is, in fact, found with specific differences in nutrition, in sensations, and in appetitive acts whether sensual or super-sensual. Science descends again from genus to species, from simple to composite.

This alternation of analysis and synthesis, moreover, will be prolonged. Side by side with the forms of immanent activity there are forms of transitive activity; the mind abstracts their common characteristic, activity; this is the generic element, im-

¹ See *Psychology*.

manence is a distinctive note. And the two notes combined form the definition of life, the combination of a notion of *kind* with a notion of *difference*.

Thus, through all these *species*, analysis pursues a *genus* which is wider and wider, then a type more and more simple, until it arrives at elements not to be analyzed, by means of which those first definitions are formed which are the generating principles of the sciences.

This shows how important is the part played by definition in science. In the experimental or exact sciences, as well as in the rational sciences, to define is to break a thing up and take hold of its simplest determinations, so as to again identify it with these elements (synthesis). The least comprehensive—and therefore most extensive—determination is the *generic element* of the definition; that which complements the generic elements—which delimits the concept, and hence is *peculiar* to, and specific of, the thing defined—is called the specific difference.

Science, however, is in the end always the same: it makes effects known by their causes, consequences by their principles.

84. Rules of Definition.—These relate to the twofold function of definition.

I. *First point of view:* The definition must furnish the first principles of the science. Hence the following rules:

(1) The definition must proceed from an object *antecedent* to the thing defined. Consequently:

(a) Correlative terms (as *health* and *sickness*), being simultaneous, cannot be used to define each other.

(b) Different members of a division are not defined by one another.

(c) A thing is not defined by itself or by that to which it is antecedent.

(2) The *genus* used in the definition must be the *nearest genus*.

II. *Second point of view:* The definition should help to clearness of ideas. It must be *clearer* than the thing to be defined. Consequently, it must:

(a) Not repeat the name of the thing to be defined.

(b) Avoid metaphorical, ambiguous, and obscure terms.

(c) Be concise and adequate.

85. II. Division Inseparable from Definition.—The processes of definition and division go hand-in-hand and complete each other.

The *definition* says what a thing is, identifies it with the simplest components of its essence (genus and specific difference). The *division* shows to what special forms the generic element of the thing defined applies. The genus is the *foundation*, or *reason*, of the division.

(1) In the exact sciences the reasoning faculty sets out from *generic* notions, follows the progress of their *specialization*, and at every stage marks a new division or subdivision of the genus into subordinate species. In the example given in **83** (1) the number is first specialized as uneven, then it is individualized by the exclusion of all other uneven numbers which is involved in the attribute *first*.

(2) In the positive sciences the reasoning faculty at first follows the inverse process, the *analytic*: here division brings us to definition. We observe distinct activities in vegetable, animal, and human substances; nevertheless, at the basis of these activities, there is a common activity: immanent activity, or life. The two different forms of activity—the transitive and the immanent—in their turn cover a common idea—a higher genus—*activity*. Step by step the mind passes from species to genera, from the members of the division to the reason of their separability. Nevertheless, when the common principle is disengaged, the mind turns back to the subjects analyzed to comprehend synthetically the formal divisions of the genus into its species.

Definition and division, then, are indissolubly joined together. In the exact sciences the definition precedes, the division follows. In the experimental sciences a first superficial division leads to the essential definition; the latter in its turn becomes the formal reason of the specific differences observed in the first instance.

86. Rules of Division.—Like definition, division plays a two-fold part: one, fundamental, in the scientific order; the other, secondary, in the pædagogic order.

I. *From the first point of view* the rules of division are: It must be *complete*; *rationaly progressive*; if possible, *positive*.

II. In a *second point of view*, the division is made for *the*

orderly arrangement and clarification of concepts. For this purpose it must be *complete, clear, and methodical.*¹

§ 2. METHOD AND METHODS

87. Method.—**Diversity of Scientific Methods.**—*Method* (*μέθοδος*) means *road*; a *scientific method* is the road which leads to a science.

It varies with the nature of the various sciences to which it leads: *synthetic* or *analytic* accordingly. Still, it may be said that the scientific method is on the whole a mixed one, *analytico-synthetic.*²

This section will treat of the respective methods of (I) the abstract sciences, (II) the experimental, (III) philosophy.

88. I. The Synthetic Method.—An *exact*, or *deductive* science—such as arithmetic or geometry—sets out from certain *principles in necessary matter* and combines them to *deduce* new relations and to form the definitions of the object with which the science concerns itself. It passes from the simple to the complex, from the more general to the less general. This is the *synthetic* method. The synthesis which directly forms a *definition* at the same time effects the *division* of the defined object and governs all rational *demonstrations*. Let us suppose, e. g., these theorems established: (1) that the sum of the angles comprising all the space below a straight line is equal to two right angles; (2) that the interior alternate angles are equal; that a straight line can always be drawn parallel to a given straight line.—The *combination* of these three propositions under the guidance of the principle of identity gives rise to a new relation: the identity of the three angles of a triangle with two right angles.

89. II. Method of the Positive Sciences. Its Object.—The positive or experimental sciences begin from concrete facts and end by formulating laws. They go from the complex to the simple, from the particular to the general—the *analytical* method.

¹ The authors of Port Royal point out that it is “equally a defect to make too few and too many divisions; the one does not sufficiently enlighten the mind, the other dissipates it too much.”

² The analytico-synthetic are the constructive methods of science. Nothing will be said here of the methods of teaching, the didactic methods. See *Higher Course*, vol. I.

Though the happenings of nature are variable, the most superficial observation shows that this variability is dominated by certain constant and general laws: to determine the *laws* of these happenings and the *nature* of things known by experience is the object of the sciences of observation. They begin from the observation of complex and variable facts in order to separate from them the simple element and the permanent law: this process of de-composition (*analysis*), considered as a whole, is called *induction*. Hence the expression, *inductive sciences*, as opposed to the deductive, or rational, sciences.

90. Stages of the Inductive Process.—To perform an induction is to ascend from effects to their cause, to determine the properties, and, through them, the nature of the cause, in order to understand the law of its action. Induction comprises four stages:

(1) The *observation* of certain facts which are presented to the senses. E. g., the chemist observes, *a certain number of times*, in dissimilar circumstances, that different absolute quantities of hydrogen (H) and of chlorine (Cl) have combined to form a definite body (HCl).

(2) The *hypothesis*.—The investigator *supposes* that the observed *phenomenon* is inexplicable by constantly recurring fortuitous coincidences, and that it must have a *sufficient reason* in the nature of reacting bodies.

A scientific hypothesis is the provisional explanation of certain observed facts.¹

(3) The *verification* of the hypothesis, which is the heart of the inductive process, is effected sometimes by simple *observation*, sometimes, in a decisive manner, by *experiment*.

(a) By *observation*. The author of an hypothesis imagines the results that should follow if it were verified and found to operate in nature.

(b) By *experiment*. The observer is not merely a witness of the course of events in nature, but himself influences those events. By artificial means he varies, according to the aim which he has in view, the agents which operate in a complex phenomenon.

(4) The *deduction*.—The *property* of the bodies Cl and H, to

¹ See the thorough study of hypothesis in the *Higher Course*.

combine in the definite proportions of 1 and 35.5, once recognized, the reasoning faculty goes further and from its verified observations draws a *general conclusion*: thenceforward, every time H and Cl are mixed in the proportions of 1 and 35.5, and exposed to the action of the sun's rays, hydrochloric acid will be formed, and 22 calories per molecule-gramme will be liberated.

The consideration of these several stages raises various questions: (1) the *observation* of facts and their *verification* by *experiment* belongs to the description of the methods of induction; (2) the *generalization* of the observed fact raises the question of the basis of induction; (3) as to deduction, or the last stage of induction, we shall note the relations between deduction and induction.

91. Inductive Methods.—Following Mill's terminology, these are the methods of *agreement*, of *difference*, of *concomitant variations*, of *remainders*, and the *composite* method. The first three are the principal ones.

(1) *Method of agreement*: When the phenomenon, the nature of which is to be determined, has occurred in several different cases, and these different cases have a single circumstance in common, this common circumstance is probably the sufficient reason of the phenomenon.

(2) *Method of difference*: Two cases are observed: in one the phenomenon occurs, in the other, it does not; all the circumstances of the two cases are identical except one, which is present in the first case and absent in the second. It may be inferred that this one circumstance is the whole or partial sufficient reason of the observed phenomenon.

(3) *Method of remainders*, a composite method, produced by a modification of the methods of agreement and of difference: When the part known to result from certain antecedents, already determined by previous inductions, is eliminated from the phenomenon, then what is left of the phenomenon is caused by the remaining antecedents.

(4) *Method of concomitant variations*: When the degrees of variation of a phenomenon correspond with the degrees of variation of a given antecedent, it is to be presumed that there is between the two a relation of causality, immediate or mediate. This method, Mill observes, is particularly demanded when in

all the cases the preceding methods are inapplicable, as happens when the cause of the phenomenon cannot be completely isolated.

(5) The *composite method* is the cumulative employment of all the preceding.

92. The Object of Induction.—The experiments which determine the law of a chemical combination reach the *formal cause* of the body, since they reveal the *properties* springing from that formal cause. These same experiments also determine the *material cause* of chemical compounds, because they determine the proportional quantities of the components. They may also regard the *final cause* of the combinations, or the tendencies, in pursuance of which the combinations are formed.

Nevertheless, whatever *cause* in particular may be sought by these researches, they have one object: to determine a *property* and, by means of it, the *specific nature* of a being, and, consequently, the *law* of its action.

We may say, then, that the object of inductive researches is sometimes the discovery of causes (proof of fact, ὄρασις), sometimes—and more profoundly—the discovery of natural laws and the definition of the types of nature (demonstration, δειξις).

The nature of the being is revealed by its properties; on them its laws are based.

Note that inductive conclusions pass through different degrees of generalization.

93. Logical Foundation of Induction.—The problem is usually stated as follows: Induction passes from the fact to the law, *from some observed cases to all observable cases*. Why is this process legitimate? Because the concurrence of a large number of variable elements and forces in one harmonious and persistent combination (the fact established by observation and experiment) demands *its sufficient reason*. Now this sufficient reason can only be a *natural inclination* of the bodies in which the harmonious and stable combinations take place. This thesis has been demonstrated in *Criteriaology*, n°. 63.

94. The Induction and the Syllogism.—The scientific¹ induction does not differ from the syllogism. By means of the induc-

¹ We are not concerned here with the *complete* induction, which is not scientific. See *Higher Course*.

tive method, indeed, the cause of the observed phenomenon is made manifest. The inductive methods reduce to those of agreement and of difference, both of which are applications of the conditional syllogism. Furthermore, when, by means of inductive methods, it has been established that the presumed cause of the phenomenon is its true cause (demonstration $\delta\tau\epsilon$), it is shown that this cause is not indifferent, but is *naturally determined* to the manifestation of a certain *property*, to act in conformity with a *law*. And this demonstration, again, is expressible in syllogisms.

95. Statistics. Their Relation to Induction.—Scientific induction concludes with certainty to the existence of a definite law of nature. Now we are often brought face to face with facts evidently governed by laws, the intricacy of which the mind does not fathom. We then have recourse, provisionally, to the registration of these facts and their coincidences. This constitutes the object of statistics.

Statistics are an inventory of numerous facts in which their relative frequency and their coincidences are noted with the view of discovering indications of natural causes.

It is beyond doubt that there must be a sufficient cause, in the very *nature* of things, for this constant recurrence of events, but we do not know, or even guess, with *what natural properties* this law is connected.¹ Just as soon as the observer guesses, out of all this heap of facts, what invariable conditions (method of agreement), which are also exclusive (method of difference) and correlative in point of intensity (method of concomitant variations), are antecedent to the event to be explained, so soon will he enter upon a science. A *scientific hypothesis* will have emerged. The verification of the hypothesis will be the work of *induction*.

¹ There are cases where the facts show neither the regularity nor the constancy which indicate a law. *e. g.*, A homogeneous die, with one of the numbers from 1 to 6 on each of its faces, is thrown. In 12 throws, the numbers 3 and 5 have each turned up three times; the 2 and the 4, twice; the 1 and the 6 only once. The probability of *contingent* events may be submitted to calculation and affords opportunity for interesting applications. For the theory of probabilities and its logical value, Bernoulli's theorem, and Poisson's law of higher numbers, see *Higher Course*, vol. I, pp. 352 sqq.

96. III. The Analytico-Synthetic Method. Conclusion.—Two scientific methods are commonly distinguished: that of the exact sciences, *synthesis*; that of the sciences of observation, *analysis*. Synthesis is indeed the basis of the first of these groups of sciences, and analysis of the second; but neither character belongs exclusively to either group.

The axioms which lie at the basis of the exact sciences inevitably rest upon certain elementary observations.

The results obtained by analysis and induction in the positive sciences prepare the material for synthetic deductions. All science, in fact, aims at the knowledge of things *by their causes*. The demonstration *propter quid* alone is rigorously scientific. Even the particular sciences, which have nature for their object (e. g., mechanics, optics, chemistry), endeavor to link their conclusions with mathematics and metaphysics.

Finally, then, the only scientific method is *inductivo-deductive* and *analytico-synthetic*.¹

97. The Method of Philosophy.—The same analytico-synthetic method rules in philosophical speculation.

As philosophy is the science of being in general—of *all being*—it embraces both the ideal and the empirical order. It passes through both *analytically*, in order thereafter to explain both *synthetically*. In this sense we define it, with Aristotle, as “the knowledge of things by their most profound reasons”, or as “the profound knowledge of the universal order.”

In each of its parts (physics, mathematics, metaphysics) philosophy uses the analytico-synthetic method.

(1) The physics of the ancients is nowadays divided into cosmology and psychology. By the aid of the physical, chemical, and mineralogical sciences, cosmology reaches the general *inductive conclusions* that corporeal substance is composed of matter and form, and exerts certain proper and characteristic activities. By means of these principles philosophy explains *synthetically* both the movement of corporeal nature, and the diversity, as well as the constancy of the laws which govern it.

¹ After these notions of general methodology, it would be in place, in special methodology, to determine the method proper to each science. On this subject we recommend *De la méthode dans les sciences*, by various professors, Paris, Alcan, 1909.

In psychology, facts warrant the *inductive* conclusion that the first subject of human life is a material compound informed by an immaterial soul. This conclusion, the principle of *synthetic* psychology, enables us better to understand the proper object of human reason, the complexity of psychological life and the interdependence of its divers manifestations.

(2) The philosophy of mathematics is, in fact and of right, bound up with mathematical sciences. The mathematicians have never separated their theorems from the axioms whence they are deduced. Certain rudimentary observations suggest the axioms, the principles of the *syntheses* which form the sciences of number and of quantity, and lead on to the most abstract speculations of pure geometry.

(3) The various parts of the philosophical sciences lead to *indefinable* objects: physics, to substance composed of potentiality and act, of matter and form—to movements produced in a passive subject by an efficient cause determined by an intrinsic end, mathematics, to the one, to the discreet, to addition, to number, etc., or to continuous quantity, as the line, the surface, etc.; criteriology, to the true; ethics, to the moral end, to moral good; lastly, logic, to the being of reason, to the orderly arrangement of the objects of the reasoning faculty. The first philosophy, or metaphysics, takes for its object these indefinable entities and their relations, and these are the point of departure of the general *synthesis* which constitutes, in the *formal* and *strict* sense, rational wisdom, or philosophy.

The ideal of philosophy would be the power to explain the universe, its elements and its laws, judging it, as it were, from above, by means of a synthetic knowledge, as perfect as our nature can attain, of the First Cause Who has created the world by an act of His almighty power, and continually governs it by His providential wisdom: the "synthetic return," or study of the world in its First Cause is the summit of philosophy.¹

¹ Thus we see how the *circular* demonstration differs from the vicious circle.

CHAPTER IV

Final Cause of Logical Order.

CONCLUSION

98. **Logic in the Service of the Knowledge of Truth.**—The order, or internal systematization of the judgments and reasonings which constitute a science, is the *intrinsic* aim of logic.

But logical order, as such, does not ensure the attainment of truth, the final aim of the human mind. This is why the ultimate aim—extrinsic, it is true—of the logician is the certain knowledge of truth, which alone deserves the name of science.

99. **Definition of Science.**—Science may be defined: *A grouping of evident and certain, necessary and universal, systematically organized propositions, which are drawn immediately or mediately from the nature of the subject, and give the intrinsic reason of its properties and of the laws of its action.* The propositions of a science must be:

(1) *Objectively evident*, i. e., manifestly true.

(2) *Certain.* An object of *faith* is, by definition, formally in-evident; it is not, as such, an object of science. Scientific certitude is the outcome of systematic thought.

(3) *Necessary and universal.* To gather particular facts is not the work of science; at most it is preparatory to it. The man of science seeks to know *what things are* independently of their contingent and variable circumstances—what is the law of their action. “There is no science but the universal!”, is Aristotle’s favorite theme.

(4) *Systematic, organized.* Science is a unified whole. The *unity* of science, considered *formally*, consists in this: that its first definitions lay down the principles from which, by synthesis, all the following propositions are deduced. These generating principles are based upon the formal object of the particular science. That object is, if not the essence, at least a natural property, of a real subject. Consequently, the intimate reason of the unity of the science is the *essence*, the *nature*, τὸ τί ἐστίν, of its object.

This unity is the *ideal of a perfect science.*

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THE MANHATTANVILLE PRESS
110 WEST ELEVENTH STREET
NEW YORK CITY

THE MEANY PRINTING COMPANY, N. Y.



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