Class BL 108

Book .D33

Copyright No.

COPYRIGHT DEPOSIT.

Essentials of Logic

Essentials of Logic

By

William Dinwiddie, LL.D.

Chancellor, and Professor of Philosophy,
Southwestern Presbyterian University

New York
The Neale Publishing Company
1914

BC 108
.I55

Copyright, 1914, by
THE NEALE PUBLISHING COMPANY

MAY -5 1914

$1.00

©Cl.A369956

2nd

CONTENTS

PART I

GENERAL

PART II

DEDUCTIVE INFERENCE

PART III

INDUCTIVE INFERENCE

PREFACE

This is intended to be a working handbook of logic, and not a history of the subject. No novelty is claimed, except the novelty of simplicity, and freedom from needless technicalities, hereditary nomenclature, and other barnacles; as, for example, in the treatment of the syllogism and of fallacies. With teachableness and early practical application in view, traditional accretions and controversies have been omitted; and yet, it is believed, without sacrifice of essentials. There is constant endeavor to make evident the relation between different parts of the subject.

Quotation marks have been used freely where they seemed advantageous, but not according to any hard and fast rule.

The book contains a large collection of examples for practice, selected also for their intrinsic value, and illustrating the forms of thought that occur in actual literature, and not merely in logical exercises. Adequate use of these will double the working length of the book.

W. D.

Clarksville, Tennessee,
October, 1913.

PART I — GENERAL

ESSENTIALS OF LOGIC

CHAPTER I

WHAT LOGIC IS

1. **Logic Defined.**—Correctness of thought is vital to success in everyday affairs, to progress in knowledge, to science, to literature, to philosophy, to theology, to logic itself. Hence it is of great importance to know the laws of correct thinking, and this knowledge is acquired by the study of logic, which may be defined as the science of the forms and laws of correct thought.

2. **Logic not Art but Science.**— Science differs from other knowledge in being systematically arranged. Science is knowledge classified or systematized. Such knowledge often forms the basis for the highest skill, or art; but art is concerned with doing, science with knowing. The closeness of this relation of science and art is the reason why the two are often confused or identified. A man, however, may know the science of architecture in minute detail, and yet not have the art to build; a doctor may know the position and use of every tissue in the body, and yet have no skill as a surgeon.

Logic is a science, not an art. Logic does not give us the power to think correctly, but it acquaints us with the laws of correct thought; it gives us the knowledge of what correct thinking must be. The ability to think correctly may be possessed without the study of formal logic, for it is an ability natural to man, but fuller knowledge of what is correct in thought results naturally and increasingly in the use of what is correct.

3. **Logic a Distinct Science.**— Scientific knowledge is divided into branches, each called a science, and each distinguished from others by the distinct nature of the facts it investigates and systematizes. Systematized facts as to the human body form the sciences of anatomy and physiology; the plants give us botany; the stars, astronomy; the weather, meteorology; the mind, psychology; thought gives logic. The distinctness of logic from other sciences is due to the distinctness of the facts of thought from the facts treated of in other sciences.

We need to distinguish carefully from each other sciences whose facts are closely related, as physiology and anatomy, physics and chemistry, geology and mineralogy, psychology and logic, or grammar and logic. Grammar, psychology, and logic all have to do with thought. Grammar, however, is concerned not with the correctness of the thought, but merely with the expression of the thought; that is,

with the language. Psychology treats of thought solely as an activity of mind, while logic deals with the thought itself; psychology looks at the mind as it thinks, logic at the thought; psychology considers the mind as it produces thoughts, logic considers the product. Psychology asks: What does the mind do when it thinks? Logic asks: What is the thought?

As to the nature of thought it is enough to say here, somewhat loosely, that the affirmation or the denial that one of two things, groups of things, qualities, or ideas is related to the other of the two, is a product of thought, or, in brief, a thought. For such affirmation or denial to be warranted, it is evident that its two terms, the subject and the predicate, must first have been compared in mind with each other or with some third term. Thought affirms or denies that one thing is contained in or comprised under another.

4. **Logic Related to All Science.**—Since science is knowledge classified or systematized, and since it is thought that classifies or systematizes, and logic that treats of thought, it follows that logic is vitally related to every science. The things we think about are many; the correct ways we think about them are few; and as everything we think about must be thought about in some definite way, or form, according to some definite law, if we think correctly; then it follows that the science of any set

of things or facts depends on the forms or laws correct thought must use, in other words, on the facts of logic. Since all science involves thought, every science depends on logic, the science of thought. Logic itself can be a science only by conforming to the laws of thought of which logic treats.

Logic, then, is a science of forms in which a countless variety of thoughts about many things may be cast. Logic treats, not of the things we think about, but of the ways in which we think about things, in trivial everyday affairs or in highest regions of scientific deliberation. Its realm is the universe of thought. One of the forms of thought is the term, or notion. Examples of the notion are: apple, red, sphere, thought, man, each of which, as will appear later, stands for the result of prior comparisons. Other thought-forms are judgments, by means of which we affirm or deny that two notions are related to each other, as: the earth is a sphere, snow is white, justice is not mercy; also, subject and predicate, genera and species, inferences, syllogisms, and many others. The form can be made clear only by filling it with matter, which is a step beyond pure logic, but used freely in pure logic for illustration.

CHAPTER II

NOTIONS

5. **What Notions Are.**— Grammatically, a notion is a noun or an adjective, as for example, "apple," "red"; logically, a notion is either a "mark," or quality of a thing, as red is a quality of apple; or the notion stands for a group of qualities, and is called a concept, as apple stands for round, juicy, edible, etc.; or it stands for a group of things, as apple stands for every member of the group called by that name; psychologically, the notion is the result of abstraction, conception, and generalization. For example, looking at a certain object, we "abstract," or take away in our minds, and consider apart from other qualities, that which we see, and say, the object is red; handling it, we abstract shape and weight from other qualities and say, it is round, it is heavy; smelling it, we say it is fragrant, and so for each quality perceived by the senses. It is evident that abstraction is purely a mental process in no way affecting the object or its qualities. Each of the abstractions above is expressed in the form of a "judgment," which is thus used in forming no-

tions, as well as the notion in forming other judgments. The judgment is discussed in Chapter IV.

The second mental step in forming a notion gathers into one the various marks noted by abstraction, and for convenience gives this bundle of marks a name. This bundle of marks is called "concept," or "gathered together." Thus the red, round, heavy, juicy, edible object of the above illustration of abstraction is called "apple"; and apple is the concept which includes, or "connotes" the marks red, round, etc.

The third mental step in forming a notion is generalization. The marks red, etc., and the concept apple refer only to the one particular object we have been examining; but we receive similar impressions from other objects, and we say they are red, round, juicy, etc.; that is, all these objects have these marks, all are apples. Thus we "generalize" the concept apple, we say it includes every object of a certain group, or class, or "genus." In this way we classify our knowledge, we get the genera of science.

The order in which conception and generalization are mentioned above is arbitrary. We may either bundle the marks of one object into a concept and then generalize, or we may observe a number of objects having similar marks, and generalize each of these marks before forming them into a concept.

Marks and concepts are notions. Each form can be changed into the other. The difference is solely in the way the form is used, and may be disregarded in the development of the science of logic.

It is evident that a concept may be viewed as a group of marks or a group of things. "Apple" is said to "connote" the marks juicy, subacid, etc., and to "denote" all apples. To give the marks which a notion includes is to "define" it; to give the classes of things contained under a notion is to "divide" it. Logical definition and division are discussed in sections 7 **b** and 7 **c** below.

Many concepts include a practically unlimited number of marks: hence in defining the concept by giving its marks, we select only those essential to the nature of the object or the class, those without which the object would not be what it is. The concept man includes the marks, two-legged, having hair on the head, erect, and many others, the absence of which would still allow the objects denoted by the concept to be men; but the marks animal and rational must be present, else the objects denoted will not be men.

According to what is known as "the law of inverse ratio," the fewer marks a concept contains, the greater the number of things it includes, and the reverse. If to the marks of apple we add "red," the objects included under "red apple" are evidently fewer than those under "apple"; if from

the marks of "rocking-chair" we take the mark "rocking," we have "chair," a class containing more objects than "rocking-chair." All the marks contained in a concept are called the "intension" of the concept; the things contained under a concept are called the "extension" of the concept; and the above law of inverse ratio may be stated thus: The greater the intension, the less the extension, and the reverse.

A notion is also called a "term" (Latin, terminus, end), because in its use as subject or predicate it is the end of the sentence. A notion often consists of a group of words, as, for example: North American Indians, rivers which flow into the Atlantic Ocean.

PRACTICE ON SECTION 5

1. What marks do you find in your notion of government, campus, home, railroad, beauty, food, athletics, miser, education, money?
2. What classes or kinds do you think of as included under each of the above notions?
3. Name some marks common to two or more of these notions.
4. Name two or more concepts having one of the following marks in common: free, heavy, four-legged, juicy, upright, smooth, false, yellow.
5. Does every mark you think of as belonging to one of these concepts, belong to every one of the classes under the concept?

6. Can you name a mark that belongs to some of the classes under a concept, and not to others?
7. Add some mark to one of the above concepts, and show that the resulting concept denotes fewer things; then add other marks successively, noting the effect on the number of things.
8. Illustrate any of the above exercises by using five other concepts.
9. Add two classes of things, such as acute and right triangle, say what mark has been lost, then add another class to the result, and so on.
10. Give other illustrations of the above exercise.
11. Illustrate abstraction, conception, and generalization by any of the above notions.
12. State the intension and the extension of any of the above notions.
13. Change any of them from marks to concepts, and the reverse.
14. Name some of the marks connoted and some of the kinds denoted by each of the two meanings of the following terms: school, band, mark, notion, bed, log, yard, party.
15. Would a perfect language have words of two meanings?

6. **Kinds of Notions.**—The following are the most important of the many ways in which notions may be grouped in classes:

6 a. Notions are "concrete" or "abstract." A concrete notion is the name of a thing or of a quality thought as being in a thing: for example,

"green" is a concrete notion, because it can in this form be thought only as belonging to grass or other green things. It is of course the adjective and not the noun "green," of which this is true. An abstract notion is a quality of a thing thought as being itself a separate thing; for example, greenness, truth, morality, hardness. These are not things, though named as if they were; they are qualities only; respectively, say, of grass, assertions, conduct, iron. All adjectives are concrete. Many nouns originally abstract have by change in usage become concrete; as, "relation" for "relative," "action" for "act."

6 b. Notions are "particular" or "general." A particular, or "singular," or "individual" notion denotes one object; as John, Mr. Brown, this hat, my house. The objects we see, hear, or know through any sense, are particular objects. Abstraction and conception, the first two steps in the formation of notions, described in Section 5, have to do with particular notions; the third step, generalization, with the general notion, or the notion which denotes a "genus," or "kind," or "class"; as martyr, bean, horse, and all common nouns. The general does not exist except in thought; real things are individual, singular, particular, and not general. The general notion, however, is often made to denote a particular object by the use of some limiting word or group of words, as "this," "that," "his,"

"the," a relative clause, etc. Sometimes there is ambiguity, and care must be taken, as always, to get at the actual meaning of the words. For example, in the sentence: a man is a complex creature, "a man" is general, and the meaning is the same as: man is a complex creature; but in the sentence: a man is running down the street, "a man" is particular, denoting only one man. Again, in: the ox is patient, and, the ox is dead, we have the double use of "the"; the first either general or particular, the second particular. The limiting words, phrases, or clauses, which thus reduce the general notion to the particular, are called "particular marks."

It is therefore obvious that all strictly proper names are particular. The difference between the proper name and the common name in its particular use, as above, is that the latter implies marks, the former not. For example, "George" has no meaning whatever, is a mere sign arbitrarily associated with an individual person; but to designate the same person George as "that boy," attributes to him all the marks of the concept "boy." So-called proper names, however, often show sex, or other marks, and are to that extent not strictly proper: John is of the male sex; the latter part of "Clarksville" means city; so "port," "burg," "ton," and other parts of names.

A proper noun may be used as a general name, some prominent mark possessed by the owner of

a well-known proper name being thus attributed to others; as, a Daniel come to judgment; or, he is a Nero, a Herod.

6 c. Notions are "obscure" or "clear." Obscure notions are those not well enough known to be separated in thought from others nearly alike; as, perhaps, caribou, moose; adhesion, cohesion, attraction; college, university; thought, feeling, consciousness, desire; memory, imagination. On the other hand, we have a clear knowledge of dog, house, ocean, school, etc.

Clear notions may be "indistinct" or "distinct." We have a clear notion of "grass" for example, but our knowledge is not distinct unless we know the marks and the kinds of grass. "Table," "carpet," "bread," "book" are examples of notions distinctly known, for we know their marks and their kinds, the two phases or parts of distinct knowledge.

It appears that clearness is attained by denials, which say what a thing is not; distinctness by affirmations, which say what a thing is: as, he is no fool, he is a man of great ability; a mandolin is not a violin, it is not played with a bow, it has a larger air-chamber, it is played with a plectrum.

Distinct notions may be "inadequate" or "adequate." Inadequate notions are those that do not imply enough marks for them to represent accurately and fully the things in question; while adequate

notions are those which imply enough marks for the particular purpose in view.

Distinct notions are also "intuitive" or "symbolic." Intuitive notions are those used in thought by means of a mental image of one of the things included under the notion; as, for example, bed, house, dog, if accompanied by a visual image of a bed, a house, a dog; or intuitive notions may be accompanied by the actual perception of one object of the class, as when we are looking at a bed, etc., or at a picture of the object. If not so accompanied, the words, bed, house, dog, etc., are mere symbols, and we do not look the thing in the face, as "intuition" means. Many notions, therefore, may be used either intuitively or symbolically; many others are too complex to be imaged by the mind, and can be used only symbolically; as, education, prosperity, peace, the velocity of light, the government of the United States.

Perfect knowledge is clear, distinct, adequate, intuitive. Most of our knowledge is imperfect; but the possibility of progress toward perfection is ever-present, and the effort to make the progress is a duty.

Language is the vehicle and the storehouse of thought, and the notion is the fundamental word. The child can make its wants known surprisingly well without other words than the noun. A verb can be resolved always into the verb "be" and a

notion. The explanation of the notion is the explanation of language. Without language, the progress of thought would be very narrowly restricted. By imperfect language, the accuracy and the communication of thought are jeopardized. The abstract should be frequently tested by the concrete, the general by the particular, the symbolic by the intuitive.

6 **d.** The following classifications of marks are important:

1st. Marks are "positive," or "negative": "wet" is a positive, "dry" a negative mark, meaning merely the absence of moisture. Marks are positive or negative in themselves, without regard to any particular concept to which they may belong.

2nd. Marks are "essential" or "accidental"; as, "for heating" is an essential, "self-feeding" an accidental mark of stove. Marks are not essential or accidental in themselves, but with regard to the concepts to which they belong.

3rd. Marks are "common" or "peculiar," according as they belong to a concept in common with other concepts, or belong to that concept only: "living" is common to man and horse, "laughing" is peculiar to man, "neighing" is peculiar to horse.

PRACTICE ON SECTION 6

1. Name ten concrete, and ten abstract notions.
2. Name five concrete, and the five corresponding abstract terms.
3. Change the following notions from general to particular, or the reverse: bread, a storm, the horse, truth, pleasure, fire, charity, king, that tree.
4. Which, if any, of the following are proper names: Cæsar, Czar, Kaiser, Pharaoh, President, Mr. President, Bible, Episcopal Prayer-Book, High School, University of Berlin, Mathematics? What marks are connoted by any which are not proper names?
5. Write a list of ten general terms. Of ten particular terms.
6. Mention several notions not clear to you, naming those not separated clearly from them in your thought.
7. What are some notions you know clearly, but not distinctly?
8. Can you think of a notion you know clearly and distinctly, but not adequately?
9. Give examples of the intuitive and the symbolic representation of several concepts.
10. Mention something your knowledge of which you deem perfect.
11. Are the following marks positive or negative; that is, do they indicate the presence of a quality, or mere absence: original, negative, essential,

complex, sober, protestant, pure, reckless, restful, clean, insane, impartial, silent, dark, weak, hard, soft, paralyzed, oblique?

12. Give the opposite negative or positive mark corresponding to each of the above.
13. Which of the marks in list *a* are essential to any of the concepts in list *b*? *a*. round, juicy, living, dead, harmful, peaceable, long-winded, intelligent. *b*. horse, poison, pencil, orange, bore, corpse, earth, circle.
14. Can you name essential marks of house, kitchen, stove, study, book, star, plow, spoon, chair, ball, bird, dog, logic, college?
15. Name, if you can, notions of which one of the following is an essential mark: square, blue, loud, sour, smooth, fragrant, animal, logical, mental, conscious, extended, rational, military, strong, scientific, stingy.
16. Use 14 and 15 above, substituting accidental for essential.
17. What marks can you think of that are peculiar to any of the notions in 14? What that are common to any two or more of these notions?

7. **Relations of Notions.**— It was seen in Section 5 that a notion may be viewed either as a group of marks or as a class of things, the marks being the "intension," the things the "extension" of the notion. Intensively, notions may agree, and therefore unite in thought; as, good and great, tall and manly, hardness and weight; or they may disagree

in the sense that they do not actually co-exist in one object, which is however a question of matter, not of form, and therefore not in the realm of pure logic; for example, a blue toothache, a happy tree; or again, the two notions may contradict each other, and therefore can not be combined either in thought or in fact, which is the only true logical disagreement; as, theistic and atheistic, wet and dry, learned and ignorant.

Extensively, two notions may represent classes of things in any of five relations:

1st. The two classes may exclude each other and not be immediately contained under some wider class: as desk and walk, spoon and wheelbarrow. This relation may be called "exclusion," and is shown by the fact that no member of either class is a member of the other.

2nd. The two notions may exclude each other, and yet be immediately contained under some wider class; as, Catholic and Protestant under Christian, Greek and Roman under Catholic, right angle and oblique angle under angle. This is the relation of "co-ordination," each notion being of the same rank (Latin, ordo) with respect to the wider class immediately containing it.

3rd. The relation of the notion contained under another to this other is "subordination."

4th. Again, each of two notions may have a part in common with the other, and a part not in

common; as, Europeans and Turks, wholesome food and flesh, men and students. This relation is "intersection."

5th. Lastly, two notions may be equivalent; as negro and darkey, sun and fixed star, leaves and foliage. Such notions are said to be in the relation of "co-extension." The test is that every member of either class is also a member of the other.

Each notion may be represented by a circle, two circles outside of each other illustrating co-ordination, if they are contained in a third circle, or exclusion if there be no third circle; one circle within another illustrates subordination; and two intersecting circles, intersection.

7. a. **Classification.**—It is evident that a notion which is subordinate to another may have other notions subordinate to it; and that the notion to which others are subordinate may itself be subordinate to some wider notion, so that a system of notions, or classes may be formed. This is classification.

If, as in co-ordination, two classes exclude each other, one of the classes must have at least one mark that the other does not have; or, to state the matter differently, one class has a positive mark not belonging to the other, while the other has the corresponding negative mark; without this difference in marks, the two classes would of course coincide, and the relation would be co-extension instead of co-

ordination. For example, Protestant includes the mark, denying authority of the Pope, while Catholic does not; right angle has the mark, having a definite magnitude, while oblique angle has not. In fact, each of two co-ordinate classes contains every mark of the wider class to which they are subordinate, and each contains in addition one other mark; as, Catholic and Protestant contain all the marks of Christian, and in addition, respectively, the marks, accepting the authority of the Pope, and, not accepting the authority of the Pope; or, the classes red raspberries and raspberries of other colors have each all the marks of the class raspberry, and in addition, respectively, the marks red and not-red.

It is evident that we are here considering the three processes in the formation of concepts, described in Section 5, from a somewhat different point of view; for it is by abstraction that we learn the marks, by conception that we form the notion, and when we generalize, we form a class. It is further evident that the law of inverse ratio, of Section 5, applies here, so that each of two co-ordinate classes, as man and brute, having each one mark, as rational and non-rational, respectively, more than the wider class, animal, to which they belong, contains fewer things. To add marks is to diminish the number of things included under the concept, to divide the things under the former concept into two classes, one having the mark in question, the other

not; it is to classify, to make classes, or species. On the other hand, to take away marks is to add things, to generalize, to make genera (plural of genus). So genus and species are relative terms; any genus may be divided into species, and these species may in turn be genera of lower species; so any genus except the highest may be in turn a species under a higher genus.

What are the limits to the process? How far can we continue to add marks, to cut off things? Theoretically, until all common marks are included, that is, until we reach a class such that not even any two of its members have a common mark which is not also a mark of all the other members of the class. In such a case there can be no further division into classes, for unless at least two things have such a common mark, division will result not in classes or species, but in separate individuals; and if all the other members of the class have the only marks that are common to any members, any attempt at division would include the whole class, and be no division. For example, a group of men contains one lawyer, one doctor, one merchant, one statesman, and one railroad president, and can be divided on the basis of profession only into individuals. This illustrates the lowest logical species, the species that can not be a genus and be divided into lower species, but only into individuals.

On the other hand, how far can we continue to

generalize, to subtract marks, to add things? Theoretically, until all things are included. Disregarding the metaphysical distinction of matter and form, the widest class, the "summum genus," therefore, is "thing," which has only the one mark, "existing," and denotes everything. For practical scientific ends, classifications do not have to begin with this highest class, but with the class most suitable in the different sciences. Astronomy, for example, starts with heavenly body; botany, with plant; and so on. When we do not know the proper class for an object, or do not care to be scientific, we refer it to the "summum genus," and call it a "thing."

The two relations of notions, co-ordination and intersection, are of such importance that they are treated more in detail in Sections 7 b and 7 c immediately below.

PRACTICE ON SECTIONS 7 and 7 a

1. Pick from the following such pairs of notions as (1) may unite in thought, or (2) do not actually unite in an object, or (3) can not unite in thought or in fact: wide, clear, poor, savage, blue, sweet, arm, pain, wealthy, mean, man, music, sorrow, gentle, short.
2. Illustrate the five extensive relations by various pairs of notions.
3. Draw a pair of circles representing each of these relations.
4. Show that the following notions are subordi-

nate to other notions, and also have other notions subordinate to them: lock, brick, grass, dog, concept, college, lake, bird, stone, monarchy.

5. What mark has one member of each of the following pairs of co-ordinate notions, that the other has not? man and brute, straight chair and rocker, right triangle and oblique, plant and animal, steamer and sailboat (or other kind)?
6. What wider class, in each case, includes the pairs above, and what mark, positive or negative, has each member of the pair, that the wider class has not?
7. Select five other pairs of co-ordinate species, and their proximate genera, stating in each case the distinctive mark of each species.
8. See how far you can continue the division into species, begun above.
9. How far can you carry the process in the other direction, toward the widest genus?
10. Can you supply the other species for each upward step in 9?
11. Can you reach a class in 8 or 9 above, beyond which the process can not possibly be carried? If so, can you say why?

7. b. **Co-ordination and Logical Division.**— Physical division separates from each other in space, actual things or parts of things, as when an apple is plucked from the tree, or is cut in two. Logical division separates in thought one logical class from another. Physical division is "quanti-

tative," one amount, part, or quantity being thereby separated from another; logical division is "qualitative," for thereby one class having a certain quality is thought as separated by the possession of that quality from another not having the quality. Physically, "a tree" may be divided into any number of actual parts, trunk, branches, twigs, leaves, bark, roots, etc.; logically, "tree" may be divided into the classes fruit-tree, and other kinds, separated in thought from each other by the presence and the absence of the mark, fruit-bearing; and in an indefinite number of ways by selecting other marks. Physically, we divide with a knife; logically, with a mark.

With physical division logic has nothing to do, except as a test to distinguish the individual from the class; for the individual is pictured in imagination as physically divided into parts, and never logically into classes, while the general notion or class-name is logically divided into classes, and not into parts. We may think a notion, however, either "mathematically," that is, as a quantity or an individual, separable into parts; or we may think it "logically," as a class, separable into kinds. With reference to this mathematical or logical division, notions are called "wholes." "A tree" is a mathematical whole, for it can not be thought as divided into classes; while "tree" is a logical whole, for it can not be divided into parts, but into kinds, as oak-tree,

pine-tree, etc. The test for the kind of "whole," therefore, is that wholes separable into kinds like the whole, are logical; those separable only into parts of the whole, unlike it, are mathematical.

The division illustrated in Section 7 a, resulting in only two co-ordinate classes, differing only in that one class has a certain mark, and the other has it not, is called "dichotomy" (cut in two). This is the only strict logical division, giving contradictories, as "stone" and "non-stone," "man" and "non-man," or under the class, animal, "man and brute." "Trichotomy" (cut in three), and "polytomy" (cut in many) are used for divisions other than strictly logical; as if "tree" be divided into oaks, pines, birches, etc. Dichotomy would divide tree into oaks and non-oaks, etc. A trichotomy, or a polytomy may be a convenient summary of successive dichotomies; as living things are plants, men, and brutes. Apparent continuity in the thing divided, or lack of sharp definition of terms often makes it difficult to dichotomize, and not leave a middle, neutral term; as in hot and cold, with warm between; poor and rich, light and dark.

Successive logical division, resulting in a logical system of classes, must conform to certain rules:

1st. The same ground of division must be used throughout. If not, the resulting classes will overlap, and cause confusion; as if books be divided into octavo, duodecimo, works of reference, text-

books, Greek, and Latin books. This is called "cross division," and the relation between the overlapping classes is not that of co-ordination, but of intersection. In the above example, the ground of division is first size, then purpose, then language.

2nd. The one ground of division should be an essential (Section 6 d) mark, or a mark important for the purpose of the division. The ground of division may thus vary according to the end in view, but it must not be changed in any one system. We might, for instance, divide books according to size to fit our shelves, or according to use for convenience of reference, or according to language for a similar reason. The scientist for varying reasons divides man into classes according to race, color, language, religion, government, etc.

3rd. The genus must be divided into species immediately subordinate to it. Intermediate classes must not be omitted. When geometry is called the science of space, science is thought as divided into the science of space and other sciences, and an intervening class, mathematics, is omitted. Science should be divided into mathematics and other sciences, and mathematics into geometry and other branches. Such strictness is necessary for scientific accuracy, but not for much of the ordinary interchange of thought. We speak of a dog as an affectionate animal, rather than an affectionate brute, thus passing over some of the intervening classes;

and of clover as a valuable plant, omitting several intervening botanical classes.

4th. The two classes, or species, resulting from division, must constitute the whole of the genus divided. There must be no part not included, for this part would form a third class, and the division would not be a dichotomy. If fence be divided into rail fence and wire fence, this rule is violated, for plank fence, stone fence, etc., are not included.

PRACTICE ON SECTION 7 b

1. Indicate the physical, the logical, and the mathematical division of the following: sword, house, dog, grain, school, landscape.
2. As given, are the above logical or mathematical wholes? Transfer each to the other kind of whole.
3. Illustrate the above exercises by five other examples.
4. Divide the following, each in several ways by (1) dichotomy; (2) trichotomy; (3) polytomy: school, hair, shoe, farm, prison.
5. Give other examples of these three kinds of division.
6. State what mark is the basis of the division in each example in 4 and 5.
7. Divide and subdivide any class notion four or five times in accordance with Rule 1.
8. Illustrate cross division.
9. In how many ways can you divide building, for

example, and for what important purpose in each case?

10. Test the following for violation of the principles of logical division:
    (1) Science: of form and of matter; or, systematized and unsystematized.
    (2) Government: monarchy, aristocracy, and democracy.
    (3) Flower: annual and perennial; or, shrubs and vines.
    (4) Church: Catholic and Protestant; or, true and false.
    (5) Men: moral and immoral; civilized and pagan; black and white; laborer and capitalist; rich and poor; handsome and ugly; native and foreign.
    (6) Thing: animate, inanimate, plant, animal, brute, man.
    (7) Student: studious and idle; athletic and weak.
    (8) Figure: plane and solid; rectilinear and curvilinear.
    (9) Metal: heavy and light; precious and plentiful; white and yellow.
    (10) Year: spring, autumn, summer, winter; B. C. and A. D.
    (11) The ten virgins: five wise and five foolish.
    (12) Heavenly bodies: planets, meteors, comets, stars, and suns.
    (13) Brute: animal and other; living and dead; biped and quadruped.

(14) Literature: prose, poetry, fiction, drama, history.

(15) Racehorses and carriage horses; automobiles and street-cars.

(16) His conduct is either foolish or crazy.

11. Divide and subdivide man so as to include white, black, yellow, red; and citizens, to include natives, Europeans, Germans, Tennesseeans.

12. Criticise the table of contents of this text on logic.

13. Give examples of violations of Rule 3.

7. c. **Intersection and Logical Definition.**— Taking the genus man, and selecting the mark, believing in a God, we divide man into two species, theist, having the chosen mark, and atheist, not having it, thus determining by strict dichotomy two classes, theist and atheist, co-ordinate with each other and subordinate to the genus, man. We are here dealing with the things denoted by the notion man, that is, with its extension (Section 5, end), and we are looking down the logical scale from greater extension to less.

Again, taking the species, theist, and looking up the logical scale, we say, a theist is a man believing in a God, or similarly, an atheist is a man not believing in a God. This, the reverse of logical division, is logical definition, involving a species, its proximate genus, and the distinctive mark separating the species from its co-ordinate species. This

mark is called the "specific difference," that is, the mark in which the two species differ.

The logical relation of intersection (Section 7, 4th) is here shown; theist, for example, being the part common to the two intersecting classes, man, and believer in God, each of these two classes having also a part not common to the other. In a definition, therefore, the genus and the specific difference may be viewed as intersecting notions, the notion defined being the common part.

Here, as always, extensive and intensive forms are interchangeable. We may define a theist as a human believer in God, thus exchanging genus and specific difference; or we may use marks only and say, a theist is human and believing in God. This purely intensive form is the primary form of the definition, which renders a notion distinct by analyzing it into its component marks, while division renders it clear by separating it into classes.

Logical definition, therefore, requires two essential marks (Section 6 a); or a genus higher than the notion defined and a specific difference; or two intersecting classes with a part common and a part not common; all these, as we have seen, being essentially the same. A notion, therefore, having only one mark, as, thing, can not be defined. Other examples are space, time, infinity, choice.

An individual can be identified, but not defined, for we can not sum up in one all the marks of an

individual save one distinctive mark. There are no two intersecting classes whose sole common part is an individual. Only general notions may be defined; individuals may be pointed out, described, located in space and time, but not in a logical system.

A logical definition must be:

1st. Not too wide. The genus and species, as in division, must be proximate, no intervening class being omitted. If geometry be defined as the science of space, instead of the mathematics of space, this fault is committed.

2nd. Not too narrow. The specific difference, as in division, must be a mark belonging to every member of the species, and not only to some, as when a dog is defined as an animal that barks, which is not true of Eskimo dogs.

3rd. Not tautological. Neither the name of the thing defined nor a synonym or a word of the same derivation may be used in the definition, as when logic is defined as the science of logical forms, or life as the sum of the vital functions. Some of the definitions in dictionaries are logical definitions, many are mere verbal explanations, by means of synonymous terms, and often tautological. This, however, may accomplish the purpose of the dictionary.

4th. Not superfluous. If a hexagon be defined as a polygon with six sides and six angles, this

principle is violated; or if an oak be defined as a kind of tree, for the name of a logical form, as "kind," can not be part of a real definition of a thing.

5th. Not figurative. Figures indicate not what a thing really is, which is the aim of definition, but what it is like; as, gratitude is the memory of the heart.

6th. Essential. (Section 6 d, 2nd.) The specific difference must be an essential mark of the notion defined, as: plants and animals are living things; and not an accidental mark, as: plants and animals are useful things.

7th. Clear. If not, the purpose of the definition will be defeated, as when a net is defined as a reticulated texture with large interstices.

8th. Short. That is, no longer than necessary. Too great brevity is also a defect, for it may destroy clearness. If all that is superfluous be omitted, and equally clear brief expressions be substituted for lengthy phrases, this end will be attained. A phrase or a clause may often be condensed.

9th. Positive, if the notion defined be positive; negative, if that be negative. A negative definition of a positive notion, or the reverse, shows only what the notion is not, and not what it is, and is therefore not a real definition. If a point be defined as position without magnitude, the specific difference is negative. But the negative notion, silence, is

properly defined as the absence (a negative term) of sound.

PRACTICE ON SECTION 7 c

1. Illustrate definition by any of the examples of correct division under the last head, pointing out in each case the genus and the specific difference.
2. Show how each is a case of intersection, and that the part common to the two intersecting notions is the thing defined.
3. Show that either of the two intersecting notions may be used as the genus in definition, and the other as the specific difference.
4. Show that, therefore, there is a double subordination in every case of correct definition.
5. State each of the above definitions intensively.
6. Select ten dictionary definitions for criticism.
7. Test the following by the principles for correct definition.
   (1) True knowledge is knowing how little we really do know.
   (2) A wise man is a fool who has found himself out.
   (3) An equilateral triangle is one whose sides and whose angles are equal.
   (4) An acute-angled triangle is one which has an acute angle.
   (5) Lead is a metal heavier than iron.
   (6) Cheese is a caseous preparation from milk.
   (7) A fallacy is an incorrect mode of reasoning.

(8) Conversion is changing the terms of a proposition.
(9) A pump is a machine for raising water.
(10) Man is a featherless biped.
(11) An elephant is an animal that drinks through its nostrils.
(12) Silence is the entire absence of sound.
(13) Truth is that part of human thought which has proven correct.
(14) Logic is the art of thinking.
(15) A triangle is half a parallelogram.
(16) Logic is the science of thought.
(17) Mind is unextended substance.
(18) A cur is a kind of dog.
(19) Geometry is the science of extension.
(20) Psychology is the science of mental life.
(21) Psychology is the science of mind.
(22) Psychology is the science of the phenomena of mind.
(23) Psychology is the science of consciousness.
(24) Thinking may be defined in one of its aspects at least as the process of interpreting the special by the general, or the new experience by the old. (Hibben.)
(25) A moral being is one who has a conscience.
(26) Evolution is a continuous change from indefinite incoherent homogeneity to definite coherent heterogeneity of structure and function, through successive dif-

ferentiations and integrations. (Spencer.)

(27) Capital is income-producing investment.
(28) Wages is the price of labor.
(29) Green is a color composed of blue and yellow.
(30) A synopsis is an outline of a topic.
(31) Motion is change of place.
(32) Space is indefinite extension.
(33) Dirt is matter in the wrong place.
(34) Health is freedom from disease.
(35) Wealth is accumulated property.
(36) A sphere is a geometrical solid bounded by a surface every point of which is equally distant from a point within, called the center.
(37) An angle is the space between two lines.
(38) Conscience is that faculty of the soul which discerns right and wrong in conduct.
(39) A rocker is a chair with rockers.
(40) A straight chair is a chair without rockers.
(41) A plow is an instrument for cultivating the soil.
(42) A house is a building to live in.
(43) An animal is a brute or a human being.
(44) An ostrich is a large swift bird that hides its head in the sand.
(45) A story is an interesting account of an incident.

(46) A peacock is a bird with brilliant plumage.

8. Correct any of the above that are defective.

CHAPTER III

THE PRIMARY LAWS OF THOUGHT

8. **Introductory.**—If we think, we must use the notion and the judgment (Sections 3 and 5); that is, we must affirm or deny that two notions are in some one of the logical relations of Section 7. The necessity implied in the word, "must," is the essence of law, and the expression of what is necessary for correct thought constitutes the laws of thought.

The two species, as "plant" and "animal," resulting from the dichotomy of a genus, as "living thing," are logical "contradictories," and can not co-exist in a thought about the same object. This opposition persists, of course, between any respective subordinate members of the original co-ordinate species, as "plant" and "dog," "potato" and "animal," "potato" and "dog"; but all these are examples of opposition only within the limits of the class divided, and in the case of the last three pairs above, the opposition is still further limited. These last three and similar cases are not called contradictories, but contraries.

Absolute contradictories are those that result from

logical division of the universe of things, as man and non-man, brute and non-brute, and the test is that every notion whatever belongs only to one class or to the other. Limited contradictories are those that result from the division of some genus lower than the highest, as man and brute; these are contradictory only within the sphere of the divided genus, that is, every member of that genus belongs only to one or the other; every animal is either man or brute. Contraries are pairs resulting from trichotomy or polytomy or from combinations like those in the above paragraph; no notion within the sphere of the class divided can belong to both of the contrary classes, but there are notions that belong to neither.

It must be kept in mind that in logic we are dealing with the form of the thought, and not with the matter or with the language; and examples used to illustrate forms of thought must, therefore, be so worded as to show the form fully and clearly, and the logician has the right to make any change in the wording that will accomplish this end.

9. **The Law of Affirmation.**—Any notion not contradictory to another notion may be affirmed of it. This law covers (1) the relation of co-extension, or entire identity, as, all gems are jewels, or all jewels are gems; (2) the relation of subordination, both from the point of view of the species, as, all base-balls are globes; or from the point of view

of the genus, as, some globes are base-balls; and this applies not only to species proximate to the genus, but to those further down the logical series, as in the above examples; (3) the relation of intersection, which is merely a double subordination, as, man is an animal, and man is a rational being; also, some animals are men, some rational beings are men. But the law does not forbid the affirmation of one of two notions, which are not contradictory (nor contrary), of the other, though the affirmation may not be true; as, the earth is a cube, every man is a liar, no plant is good for food. The law, therefore, does not establish truth, but merely forbids a specific error.

10. **The Law of Denial.**— Any notion contradictory to another notion, must be denied of it. This law deals with the relation of co-ordination, including the limited contradictories and contraries, each within its proper sphere (Section 8); examples are: no man is a brute; no man is a horse; no white man is a brute, or a horse; no circle is square; no luminous body is non-luminous, etc.

Apparent contradiction is often used to give point to real truth; as, make haste slowly; when I am weak, then am I strong.

11. **The Law of Exclusion.**— Of two contradictory notions, one must be affirmed of any third notion. Or, any notion must be either affirmed or denied of any other notion. A is either B or non-B;

volcanoes are either in eruption or not in eruption; houses are either brick or not brick. If the contradiction be not absolute (Section 8), then the "third notion" of the above law is limited to this lower genus, and the law is true only within the scope of that genus; as, every animal is either man or brute. "Exclusion" means, therefore, that a third possibility is excluded.

The laws of denial and exclusion may be combined and variously stated; as, of two contradictory notions, one must be affirmed, the other denied of any third notion; or, any notion must be affirmed of one of two contradictory notions, and denied of the other.

12. **The Scope of the Laws.**—Such are the primary laws of thought. From them are derived the many secondary laws and rules of logic. These laws do not establish truth. Their observance merely eliminates error in the form of the thought. We may reason correctly about false statements or non-existent things. What these laws and those derived from them forbid must be rejected; what they do not forbid may or may not be true; it is beyond the province of pure logic to decide. Logic, therefore, gives only negative and partial tests of error, and no positive criterion of truth. Truth depends on the matter of the thought.

PRACTICE ON SECTIONS 8 to 12

1. Select from the following list pairs of (1) contradictories; (2) contraries: sharp, white, clear, alive, cowardly, obscure, dull, hard, dead, black, brave, soft.
2. Name five other pairs of (1) absolute contradictories; (2) limited contradictories; (3) contraries resulting from trichotomy or polytomy.
3. Which of the following notions does the law of affirmation allow to be affirmed of the notion "cube": round, square, pink, fragrant, spherical, soft, conical, alive, costly, true?
4. Which of the above list does the law of contradiction require to be denied of the notion cube?
5. Give five examples of apparent contradiction with real meaning.
6. Complete the following according to the law of exclusion: food is wholesome or . . . ; governments are monarchical or . . . ; everything is useful or . . . ; religions are true or . . . ; animals are rational or . . .
7. Which of the three kinds of pairs in 2 above illustrate exclusion?
8. What point under this general head is illustrated by the following examples:
   (1) He was the lion of the party.
   (2) After he changed the figure, it was a circle with the corners square.
   (3) True knowledge is knowing how little we really do know.

(4) His conduct is either foolish or crazy.
(5) A wise man is a fool who has found himself out.
(6) He is beside himself.
(7) His alter ego was responsible for that deed.
(8) That was the wettest rain I ever was in.
(9) He was so thin he could not tell whether he had the backache or the other kind.
(10) I saw right through him.
(11) He had reached a great height of humility.
(12) He was either at home or in his bedroom.
(13) A liar told the truth.
(14) There is one thief who never steals.
(15) Here lies a man named "Miles," from Cincinnati, aged 59.
(16) Iron is a very soft metal. Iron is hard. What is hard is soft.
(17) It is decreed that you the enemy will slay.
(18) He is a wise fool.
(19) The friendship of the world is enmity with God. Friendship is enmity.
(20) He that findeth his life shall lose it; and he that loseth his life for my sake shall find it.
(21) But many that are first shall be last; and the last shall be first.

CHAPTER IV

PROPOSITIONS

13. **What Propositions are.**— A judgment is an affirmation or a denial that one notion is contained in another, that the two are identical in whole or in part. Either marks are thought as contained in a concept or not; as plants are non-sentient, living, existing; or things are thought as contained in a class or not; as, plants are non-sentient living things. It is evident that the judgment deals with notions and their relations, and affirms or denies according to the primary laws of thought, the law of exclusion forbidding any third possibility. Also, when we remember that by abstraction we find that plants are non-sentient and living and existing, thus forming the concept, plant, we see that a judgment is primarily an explicit statement of what the concept already contains. We are, therefore, merely looking at things already familiar, but from a slightly different point of view. Concepts are judgments in a nutshell; judgments are the kernels of concepts.

A proposition is a judgment expressed in language, and must therefore consist of the names of the two

notions compared, and the verb affirming or denying their relation. The notion of which another is affirmed or denied, is as in grammar called the subject; the other, the predicate. In strict logical form, affirmation is always made by the verb " is " or the plural, " are "; for the relation of the two notions is not dependent on time, but on their real nature, and general truth is expressed by the present tense. Denials are made only by " is not," and " are not." The " is " or " are " is called the copula, and " not " is said to qualify it; every other word in the sentence belongs either to the subject or the predicate. Strict logical treatment requires every proposition to be put in the form, " subject is predicate," and any change in order or in expression which is necessary for arrangement in this form, must be allowed, the thought itself of course not being affected. As has been said, the subject and the predicate are also called the " terms " (Latin, terminus, end) of the proposition; and notions also are therefore called terms.

Examples of propositions in strict form are: God is (i. e., is existing); water is necessary to life; the sum of the angles of a triangle is two right angles; the doctrine that the earth is the center of the universe is not now held by astronomers. The subject or the predicate may be a word, a phrase, a clause, or even a whole sentence; the subject, however, is substantive, the predicate substantive or

adjective, according as the thought is extensive or intensive (Section 5, end).

14. **Kinds of Propositions.**— Conditional propositions are those which (1) affirm the dependence of one of two propositions on the other, as, if land be rich and well-watered, it is fertile; or (2) affirm that one of two contradictories is true of some third notion, as, Cook either reached the North Pole or not; or (3) combine these two, as, if her husband dies, she will either marry again, or remain a widow. These forms are discussed in Section 23.

Categorical propositions are those which affirm or deny without condition or alternative, as, rich and well-watered land is fertile; Cook reached the North Pole; Cook did not reach the North Pole.

Simple categorical propositions are those which have only one independent subject and predicate expressed or implied, as the examples in the last paragraph of Section 13; while compound propositions have more than one independent judgment expressed or implied; as, gold is heavy and yellow, cotton and corn are raised in the South, he is their only friend, none but the brave deserve the fair, all but two were killed. For strict logical treatment, compound are resolved into simple propositions. The above examples would yield the simple propositions: gold is heavy, gold is yellow, cotton is raised in the South, corn is raised in the South, he is their friend, no other than he is their friend, the brave deserve the

fair, no coward deserves the fair, nearly all were killed, two were not killed.

A proposition simple in form, may be attended in mind by its opposite, and should in that case be treated as compound, and both components expressed. If I say, some people are not selfish, with the emphasis on "some," I mean also, some are selfish, and the full expression of the thought requires both propositions. In speech, the mere tone or emphasis may be the only difference between compound and simple forms.

The grammatically complex proposition, having subordinate clauses, is logically simple; as, men who are eager to be rich are likely to be unscrupulous; this may be reduced to the simple form: men eager to be rich are likely to be unscrupulous.

15. **Quality, Quantity, and Symbols of Propositions.**— Propositions affirm or deny, and are said to have affirmative or negative "quality." Care must be exercised to ascertain whether the negative belongs to the proposition, that is, to the copula, and not merely to the subject or the predicate; especially as the transfer of the negative from copula to predicate or the reverse, is often easy. In "the universal cry was, no quarter," the negative belongs to the predicate, and the proposition is affirmative; in "all is not gold that glitters," the negative belongs with the "all," and the meaning is: "not all is gold that glitters," which, however, in

strict form becomes: "some things that glitter are not gold," and the proposition is negative; in "no news is good news," the negative belongs to the subject, which is equivalent to "the lack of news," and the proposition is affirmative; in "he is no gentleman," the negative belongs grammatically to the predicate, "gentleman," though the proposition is obviously a logical denial. The positive and the negative aspects of a thought lie close together in the mind, yet the expression of the two is usually quite distinct, and we cannot say that the mere expression of the one aspect implies the other, though we may have both in mind when we express only one.

According to their "quantity," judgments are divided into "total" and "partial." Total judgments are those which affirm or deny the predicate of the whole subject; partial judgments, of only part of the subject; whether very little or nearly all, or however much, makes no difference in logic. The only distinction is that between the total, involving all, and the partial, involving only some of the subject; with the relative magnitude of part and whole, logic has nothing to do. In strict form, every proposition begins either with "all," or an equivalent, (negative, "no," "none"); or with "some" (negative, "some . . . not").

Every thought must and does deal with either some or all of the subject, and if fully expressed, the

quantity would appear; but because of the customary omissions of speech, or through carelessness, it is not always possible to decide even from the context whether the subject be total or partial. It is not a question of what we would mean, but what the quantity was in the mind of the thinker. Of such cases we must judge according to our opinion of the probabilities, in fairness admitting the possibility of doubt. If in irritation some one says: men are fools, I judge him to mean some men, possibly only one; if some one says: boys will be boys, I judge the meaning to be all boys.

Some of the words indicating quantity are as follows:

Total: a, an, all, always, any, both, each, every, individual name, name of substance, my, your, etc., the, this, that, etc., whoever, etc.; with the negatives: neither, never, no, none, not any, nowhere.

Partial: a, an, a few, a little, almost all, certain, many, most, nearly all, one, two, etc., some, sometimes, somewhere, the, the majority, there are; with the negatives: all . . . not, few, hardly any, little, not all, not always, not every, rare, rarely, scarcely any, seldom, slight, small.

It will be noticed that "a," "the," "all," "few," "little," appear in both lists. Examples of the double use are as follows: Total: a or the mule is a hybrid, all fixed stars are suns; partial affirmative: a few were saved, a little learning is a

dangerous thing, a or the mule is a tricky animal; partial negative: all trees are not pines, few were saved, little learning is thorough.

Propositions whose subjects are individual or mathematical wholes (Section 7 b), are called individual propositions, and are total; other total propositions whose subjects are classes, are called universal propositions.

The division of propositions into affirmative and negative, and again into total and partial, gives four kinds, the total affirmative, the total negative, the partial affirmative, and the partial negative. Taking the first two vowels of "affirmo" (Latin, I affirm), the total affirmative is symbolized by A, the partial affirmative by I; while the vowels of nego (I deny) give E for the total negative, O for the partial negative. Examples are:

A, All men are rational beings; E, No men are brutes; I, Some men are blacksmiths; O, Some men are not blacksmiths.

Propositions whose predicates as well as their subjects are mathematical wholes, or quantities, are mathematical or quantitative propositions. As their subjects are always total, never partial, they are always symbolized by A or E, never I or O; as, the sun is the center of the solar system; x is equal to y; the sum of any two angles of a triangle is greater than the third angle. There is a class of propositions which may be viewed either

as mathematical or as compound: as, all present are all the members of this class, evidently mathematical as just defined, and yet resolvable into: all present are members, and, all members are present.

PRACTICE ON SECTIONS 13 to 15

The following list is purposely long, that different examples may be selected at different times, or for different classes. 1st. Put each proposition in strict logical form; 2nd, if compound, put each component in logical form; 3rd, affix to each the proper symbol, showing whether it be affirmative or negative, total or partial; 4th, point out any that are individual, and any that are mathematical.

1. Every mistake is not a proof of ignorance.
2. All but one have disappeared.
3. There's not a joy the world can give like that it takes away.
4. Metals are all good conductors of heat.
5. Nothing is beautiful except truth.
6. Not many of the metals are brittle.
7. There is no place like home.
8. Not many, if any, metals are without luster.
9. All gold mines cannot be wrought with profit.
10. Heaven is all mercy.
11. Romulus and Remus were twins.
12. One kind of metal at least is liquid.
13. Charity affords relief as far as possible.
14. Few are acquainted with themselves.
15. Some of our muscles act without volition.

16. God's word, exclusively, is to be received without question.
17. Only citizens can hold property.
18. Nearly all the troops have left the town.
19. Only ignorant persons hold such opinions.
20. Few persons are proof against temptation.
21. Over the mountains poured the barbarian horde.
22. Logic is only common sense formulated.
23. Some students do not fail in anything, while all do not succeed.
24. No illogical author is truly scientific.
25. Not every man could stand such hardships.
26. Work that cannot be paid for is alone worth doing.
27. Necessity knows no law.
28. All men are at times actuated by unselfish motives.
29. No one who is not a taxpayer can vote in this election.
30. What can't be cured must be endured.
31. Four years of study is required for a degree.
32. Unasked advice is seldom acceptable.
33. I shall not all die.
34. There is none righteous, no, not one.
35. They also serve who only stand and wait.
36. He was too impulsive not to have committed many errors.
37. Mankind are all men and women.
38. A lie faces God, and shrinks from man. *Bacon.*
39. There is no man doth a wrong for the wrong's sake. *Bacon.*

40. Prosperity is not without many fears and distastes. *Bacon.*
41. A man that is busy and inquisitive is commonly envious. *Bacon.*
42. It is a miserable state of mind to have few things to desire and many things to fear. *Bacon.*
43. To spend too much time in studies is sloth, to use them too much for ornament is affectation, to make judgment wholly by their rules is the humor of a scholar. *Bacon.*
44. Measure not dispatch by the times of sitting, but by the advancement of the business. *Bacon.*
45. To choose time is to save time. *Bacon.*
46. It never troubles the wolf how many the sheep be. *Bacon.*
47. No people overcharged with tribute is fit for empire. *Bacon.*
48. There is nothing makes a man suspect much more than to know little. *Bacon.*
49. Certainly, the best mean(s), to clear the way in this same wood of suspicions, is frankly to communicate them with the party that he suspects. *Bacon.*
50. The principal thing that hath been the destruction of most plantations, has been the base and hasty drawing of profit in the first years. *Bacon.*
51. As the baggage to an army, so is riches to virtue. *Bacon.*
52. Of great riches there is no real use, except it

be in the distribution; the rest is but conceit. *Bacon.*

53. Men mark when they hit, and never mark when they miss. *Bacon.*
54. Nature is often hidden, sometimes overcome, seldom extinguished. *Bacon.*
55. There be monks in Russia for penance, that will sit a whole night in a vessel of water, till they be engaged with hard ice. *Bacon.*
56. Commonwealths and good governments do nourish virtue grown, but do not much mend the seeds. *Bacon.*
57. No man prospers so suddenly as by others' errors. *Bacon.*
58. There are a number of little and scarce discerned virtues, or rather faculties and customs, that make men fortunate. *Bacon.*
59. Those who ascribe openly too much to their own wisdom and policy, end unfortunate. *Bacon.*
60. Certainly there be, whose fortunes are like Homer's verses, that have a slide and easiness more than the verses of other poets. *Bacon.*
61. They say that it is a pity the devil should have God's part, which is the tithe. *Bacon.*
62. Some books are to be read only in parts; others to be read but not curiously (i. e., attentively); and some few to be read wholly, and with diligence and attention. *Bacon.*
63. Histories make men wise; poets, witty; the mathematics, subtle; natural philosophy,

deep; moral, grave; logic and rhetoric, able to contend. *Bacon.*

64. Some men's behavior is like a verse, wherein every syllable is measured. *Bacon.*
65. To praise a man's self cannot be decent, except it be in rare cases. *Bacon.*
66. Bismarck was a great statesman.
67. Bismarck was the greatest statesman of his time.
68. The fear of the Lord is to hate evil. *Bible.*
69. There is that speaketh like the piercings of a sword. *Bible.*
70. The eyes of the Lord are in every place, beholding the evil and the good. *Bible.*
71. He that loveth pleasure shall be a poor man. *Bible.*
72. He that hath no rule over his own spirit is like a city that is broken down and without walls. *Bible.*
73. A whip for the horse, a bridle for the ass, and a rod for the fool's back. *Bible.*
74. As a mad man who casteth firebrands, arrows, and death, so is the man that deceiveth his neighbor, and saith, Am I not in sport? *Bible.*
75. Where no wood is, there the fire goeth out: so where there is no talebearer, the strife ceaseth. *Bible.*
76. He that by usury and unjust gain increaseth his substance, he shall gather it for him that will pity the poor. *Bible.*
77. Though he heap up silver as the dust, and pre-

pare raiment as the clay; he may prepare it, but the just shall put it on, and the innocent shall divide the silver. (Said of the "wicked man.") *Bible.*

78. The wealth of the sinner is laid up for the just. *Bible.*

79. For God giveth to a man that is good in his sight wisdom, and knowledge, and joy: but to the sinner he giveth travail, to gather and to heap up, that he may give to him that is good before God. *Bible.*

80. The words of wise men are heard in quiet more than the cry of him that ruleth among fools. *Bible.*

81. Not every one that saith unto me, Lord, Lord, shall enter into the kingdom of heaven; but he that doeth the will of my Father which is in heaven. *Bible.*

82. Nature, like liberty, is but restrained
By the same laws which first herself ordained. *Pope.*

83. Nor is it Homer nods, but we that dream. *Pope.*

84. Of all the causes which conspire to blind
Man's erring judgment, and misguide the mind,
What the weak head with strongest bias rules,
Is pride, the never-failing voice of fools. *Pope.*

85. Some to church repair,
Not for the doctrine, but the music there. *Pope.*

86. Some ne'er advance a judgment of their own,
But catch the spreading notion of the town:
They reason and conclude by precedent,

And own stale nonsense which they ne'er invent.
Some judge of authors' names, not works, and then
Nor praise nor blame the writings, but the men. *Pope.*

87. Some praise at morning what they blame at night;
But always think the last opinion right. *Pope.*

88. Fondly we think we honor merit then,
When we but praise ourselves in other men. *Pope.*

89. All seems infected that th' infected spy,
As all looks yellow to the jaundiced eye. *Pope.*

90. In human works, though labored on with pain,
A thousand movements scarce one purpose gain;
In God's, one single can its end produce;
Yet serves to second too some other use. *Pope.*

91. 'Tis but a part we see, and not a whole. *Pope.*

92. And who but wishes to invert the laws
Of Order, sins against the Eternal Cause. *Pope.*

93. And if each system in gradation roll
Alike essential to the amazing whole,
The least confusion but in one, not all
That system only, but the whole must fall. *Pope.*

94. All nature is but art, unknown to thee;
All chance, direction, which thou canst not see;
All discord, harmony not understood;
All partial evil, universal good;
And spite of pride, in erring reason's spite,
One truth is clear, Whatever is, is right. *Pope.*

95. Love, hope, and joy, fair pleasure's smiling train,
Hate, fear, and grief, the family of pain,
These mixed with art, and to due bounds confined,
Make and maintain the balance of the mind. *Pope.*

96. The merchant's toil, the sage's indolence,
The monk's humility, the hero's pride,
All, all alike, find reason on their side. *Pope.*

97. Fixed to no spot is happiness sincere,
'Tis nowhere to be found, or everywhere: *Pope.*

98. Who thus define it, say they more or less
Than this, that happiness is happiness? *Pope.*

99. To whom can riches give repute, or trust,
Content, or pleasure, but the good and just? *Pope.*

100. Who wickedly is wise, or madly brave,
Is but the more a fool, the more a knave. *Pope.*

101. He has no hope who never had a fear. *Cowper.*

102. Seldom, alas! the power of logic reigns
With much sufficiency in royal brains; *Cowper.*

103. The diadem, with mighty projects lined,
To catch renown by ruining mankind,
Is worth, with all its gold and glittering store,
Just what the toy will sell for, and no more. *Cowper.*

104. There is no one who feels anger where the object seems impracticable to his revenge. *Aristotle.*

105. To overcome is pleasant, not to the ambitious only, but even to all. *Aristotle.*

106. Neither splendor of vestments, nor preëminence of beauty, nor the amount of gold, contributes so much to the commendation of a woman as good management in domestic affairs, and a noble and comely manner of life. *Aristotle.*

107. He is free who lives as he likes; who is not subject to compulsion, to restraint, or to violence. *Epictetus.*

108. The cause of all human evils is the not being able to apply general principles to special cases. *Epictetus.*

109. No living being is held by anything so strongly as by its own needs. *Epictetus.*

110. Eloquence is a gift not of mind only, but of lungs and strength. *Cicero.*

111. Except among the virtuous friendship cannot exist. *Cicero.*

112. Friendship is nothing else than a complete union of feeling on all subjects, divine and human. *Cicero.*

113. To whom can life be worth living, who does not repose on the mutual kind feeling of some friend? *Cicero.*

114. We do not use fire and water on more occasions than we do friendship. *Cicero.*

115. Just as a man has most confidence in himself, and as he is most completely fortified by worth and wisdom, so that he needs no one's assistance, and feels that all his resources reside in himself, in the same proportion he

is most highly distinguished for seeking out and forming friendships. *Cicero.*

116. There is no greater enemy to friendship than covetousness of money. *Cicero.*

117. Not only is fortune blind herself, but she commonly renders blind those whom she embraces. *Cicero.*

118. No one person ever was so dear to another as you are to the people of Rome. *Seneca* (to Nero).

119. Trifling evils may cheat us and elude our observation, but we gird up our loins to attack great ones. *Seneca.*

120. It often happens, that even when they (orators who are bad men) speak the truth, belief is not accorded them. *Quintilian.*

121. The idle man excuseth him in winter because of the great cold, and in summer then by reason of the heat. *Chaucer.*

122. Honor is nothing else but to do reverence to another person for the good and virtuous disposition that is in him. *Caxton.*

123. Ofttime battle is advanced more for getting of silver than by the force and strength of men. *Caxton.*

124. There is no man so assured of his honor, of his riches, health, or life but that he may be deprived of either, or all, the very next day or hour to come. *Raleigh.*

125. There are no fewer forms of minds than of bodies amongst us. *Jonson.*

126. Some are fit to make divines, some poets, some lawyers, some physicians, some to be sent to the plow, and trades. *Jonson.*

127. There be some that are forward and bold; and these will do every little thing easily. These never perform much, but quickly. They are what they are on the sudden; they show presently like grain that, scattered on the top of the ground, shoots up, but takes no root; has a yellow blade, but the ear empty. *Jonson.*

128. There want not men of equal authority and credit, that prefer action to be the more excellent (of the two, action and contemplation). *Walton.*

129. There is nothing strictly immortal but immortality. *Browne.*

130. Revolutions of ages do not oft recover the loss of a rejected truth. *Milton.*

131. But when God hath decreed servitude on a sinful nation, fitted by their own vices for no condition but servile, all estates of a government are alike unable to avoid it. *Milton.*

132. That infection which is from books of controversy in religion is more doubtful and dangerous to the learned than to the ignorant. *Milton.*

133. Many boys are muddy-headed till they be clarified with age, and such afterward prove the best. *Fuller.*

134. All the whetting in the world can never set a

razor's edge on that which hath no steel in it. *Fuller.*

135. No man is more miserable than he that hath no adversity. *Taylor.*

136. Of all mankind there are none so shocking as these injudicious civil people. *Steele.*

137. Any affectation whatsoever in dress implies in my mind a flaw in the understanding. *Chesterfield.*

138. Good manners are to particular societies what good morals are to society in general. *Chesterfield.*

139. Men who converse only with women are frivolous, effeminate puppies, and those who never converse with them are bears. *Chesterfield.*

140. No man is ridiculous for being what he really is, but for affecting to be what he is not. *Chesterfield.*

141. Nothing appears more surprising to those who consider human affairs with a philosophical eye than the easiness with which the many are governed by the few. *Hume.*

142. When men act in a faction, they are apt, without shame or remorse, to neglect all the ties of honor and morality, in order to serve their party. *Hume.*

143. This fierce spirit of liberty is stronger in the English colonies probably than in any other people of the earth. *Burke.*

144. How seldom, friend, a good great man inherits

Honor or wealth with all his worth and pains!
Coleridge.

145. It seems little to be perceived, how much the great Scriptural idea of the worldly and the unworldly is found to emerge in literature as well as in life. *De Quincey.*

146. There is always hope in a man that actually and earnestly works; in Idleness alone is there perpetual despair. *Carlyle.*

147. Judgment for an evil thing is many times delayed some day or two, some century or two, but it is sure as life, it is sure as death. *Carlyle.*

148. Among mental as among bodily acquisitions, the ornamental comes before the useful. *Spencer.*

149. Whatsoever every man chiefly loves above all other things, that he persuades himself is best for him. *Boethius.*

150. There is no one that has not need of some addition, except God alone. *Boethius.*

151. How can that be evil which the mind of every man considers to be good, and strives after, and desires to obtain? *Boethius.*

152. Many people show gratitude for trifling, but there is hardly one who does not show ingratitude for great favors. *Rochefoucauld.*

153. A man thinking or working is always alone, let him be where he will. *Thoreau.*

154. No ceremony that to great ones 'longs,
Not the king's crown nor the deputed sword,

The marshal's truncheon nor the judge's robe,
Become them with one-half so good a grace
As mercy does. *Shakespeare.*

155. In law, what plea so tainted and corrupt
But, being seasoned with a gracious voice,
Obscures the show of evil? *Shakespeare.*

156. There is no vice so simple but assumes
Some mark of virtue on his outward parts.
Shakespeare.

157. Our remedies oft in ourselves do lie,
Which we ascribe to heaven. *Shakespeare.*

PART II

DEDUCTIVE INFERENCE

CHAPTER V

IMMEDIATE DEDUCTION

16. **Nature and Kinds of Inference.**—As to their origin, judgments are of two kinds, psychological, called intuitions; logical, called inferences. Intuitions are not derived from other judgments, but are primary facts of consciousness, known through the senses or by the intellect; as the primary laws of thought, the judgment that I exist, that I see color, hear sound, etc. Inferences are judgments derived from one or more other judgments; as when from, all men are animals, we infer, some animals are men; or from, no Greeks are barbarians, and Socrates is a Greek, we infer, Socrates is not a barbarian. Intuitions may be and often are the judgments from which inference is made; but the intuition is not a thought, only the inference is a thought.

There are two kinds of inference, that from a judgment concerning some of a notion to a judgment concerning all of the notion, as when from the judgment based on experience, that some gold melts at 1200 degrees, we infer that all gold melts at 1200 degrees. This inference from some to all

is inductive inference, and is discussed in Part III below.

The other kind of inference, called deduction, infers from all to all, all to some, or some to some of the notion; and it is evident that induction and deduction include all possible inferences. Examples of deduction are the inference from, no iron is soft, to, no soft thing is iron; from, all iron is hard, to, some hard things are iron; and from some iron is brittle, to, some brittle things are iron.

These examples are all cases of immediate deduction, that is, deduction without a medium, or third notion; only the same two notions being used in the original judgment and in the inference derived from it. Mediate deduction is considered in the next chapter.

Sometimes a judgment is implied with or in another, and might seem to be an inference, when it is really not a new judgment, but already thought more or less obscurely with the other. Logicians differ here, but we are at liberty to decide what we shall exclude from the class we have called inferences, so long as no principle is violated. All such cases might be included among inferences, but it is simpler to limit inference as much as we may without manifest error. It is hardly to be said that from, John strikes Henry, we infer, Henry is struck by John; or, if I say, O yes, *some* men are honest, implying by emphasis on " some " that some

are not honest, the latter is not inferred from the former, but thought along with it; it is not inference to say that because man is mortal then man is a mortal being, or the reverse; nor that because James is the son of Joe, therefore Joe is the father of James. There is in such cases no real progress of thought, and we shall therefore not count as inferences (1) the change from active to equivalent passive, and the reverse; (2) the judgment thought together with another, even if not fully expressed or indicated; (3) the change from intensive to extensive thought, or the reverse; (4) the transfer of the thought from one of two correlatives to the other.

Finally, as has been said, deductive inference can not pass from some to all, but only from all to all, all to some, and some to some of a notion. In other words, in deduction the quantity of a term can not be increased.

17. **Methods of Immediate Inference.** The question now arises, by what legitimate methods may we pass immediately from one judgment to another. There are four general ways:

1st. Method. By Combination. The two terms of the given judgment may be combined each with the same mark or concept, or with strictly equivalent marks or notions, thus forming a new judgment. If a house be a building then, a brick house is a brick building; if law be just, then legal ac-

tion is just action; if a college be an institution for higher education, and if definite entrance requirements are beneficial to the schools, then, a college with definite entrance requirements is an institution for higher education with something beneficial to the schools. So, too, may judgments be separated into equivalent components, but only when the same mark is taken from both terms; for the equivalence of other elements than marks is not known from the judgment itself. In either case, absolute equivalence must be the rule. For example, a mouse is an animal, but a large mouse is not a large animal; a carpenter is a citizen, but a bad carpenter is not therefore a bad citizen. This is usually called "determination."

2nd. Method. By Contradiction. By the primary laws of thought (Section 8), if a notion be affirmed of another, its contradictory must be denied of that other, and the reverse. For example, if animals are mortal, it follows that animals are not immortal; if some men are easy to please, then some men are not hard to please; if no member of this class is late, then every member of this class is on time; if some people are not honest, then some are dishonest. Thus each of the four propositions A, I, E, O, as illustrated above, will by this process yield a new form, equivalent to the old in essential meaning, yet a different form of thought, an inference. For when, for example, we say, ani-

mals are mortal, we affirm animals to be contained is the class, mortal beings; but when we say, animals are not immortal, we do not affirm this, but deny that they are in the opposite class, immortal beings. The two thoughts may be together in mind, but they are not identical, either being an inference from the other.

This kind of immediate inference is sometimes called infinitation, sometimes obversion.

3rd. Method. By Conversion. If one notion, the subject, be related to another, the predicate; then the predicate must be in some relation to the subject, and that relation may be affirmed by reversing the proposition, that is, by exchanging its subject and predicate. But, as the predicate of an affirmative is not totally involved, it can not become the subject of a total proposition; while the predicate of a negative being totally involved may be the subject of a total proposition. The process, which is called "conversion," has three varieties, as follows:

First, Simple Conversion. If no misers are happy men, then no happy men are misers; if some trees are living things, then some living things are trees. This simple exchange of subject and predicate is applicable to E, for both subject and predicate of E are total; it is applicable to I, for both subject and predicate of I are partial; it is not applicable to A, for the subject of A is total and the predicate

partial; nor to O, for the subject of O is partial and the predicate total.

Second, Conversion by Limitation. The proposition, all crows are birds, affirms the identity of the subject, crows, with only part of the predicate, birds; that is, we can not say from this statement whether or not all birds are meant, and must therefore "limit" the inference as to birds to, some birds are crows, and the judgment originally total becomes "by limitation" partial. This is also named conversion "per accidens." It may be applied to E, giving O, but as E will give E by simple conversion, it would be absurd to apply this method, when more general truth can be attained by the other. It is therefore especially applicable to A.

Third, the Conversion of O. The truth is, O can not be converted, for it would give O, a negative with a total predicate, and the subject of the original proposition is partial and can not therefore be predicate of O. A similar difficulty in the case of A was overcome just above by reducing the quantity of the subject from total to partial, but the trouble here is with the quantity of the predicate, and as the predicate of a negative is always totally denied, there is no way of reducing that, except by changing the proposition to an affirmative. This is done by the method of using the contradictory (2nd. Method above), which

gives I, and this can then be converted simply. For example, if some engines are not locomotives, we can not say, therefore some locomotives are not engines; because excluding only some engines from the class, locomotives, does not prevent locomotives from being included in some other part of the class, engines. So we adopt the method described above, the use of the contradictory predicate giving, some engines are non-locomotives, and simple conversion of this giving, some non-locomotives are engines.

This is sometimes called conversion by contraposition, but it is evidently not a new method, as shown above. It may be applied to A, as well as to O.

As a predicate must be either a mark or a class, a proposition with an individual subject, such as, Brutus was an assassin, or the earth is a sphere, can not be converted, for the subject of the individual proposition is neither a mark nor a class, and can not become a predicate. The words may be turned around, but the thought is not reversed.

4th. Method. By the Relation of Propositions. Any two of a set of the four kinds of propositions, A, E, I, O, with the same subject and predicate, bear certain fixed relations to each other, such that the truth or the falsity of one involves the truth or the falsity of others. For example, if all grass be green, then it is true that some grass is green, but false that no grass is green, and that some grass is not

green; that is, if A be true, I is true, but E and O are false. Again, if no man be perfect, it is true that some men are not perfect, but false that all men are perfect, and that some men are perfect; that is, if E be true, O is true, but A and I are false. Still again, if some fruits be food, it is false that no fruits are food, and undetermined as to, all fruits are food, and, some fruits are not food; that is, if I be true, E is false, but A and O are undetermined. Lastly, if some animals be not bipeds, it is false that all animals are bipeds, and undetermined as to, no animals are bipeds, and, some animals are bipeds; that is, if O be true, A is false, and O and I are undetermined.

Similarly it will be found that if A be false, O is true, E and I undetermined; if E be false, I is true, A and O undetermined; if I be false, E and O are true, A false; and if O be false, A and I are true, E false.

It appears from the above examination that (1) of the two pairs, A and O, E and I, one proposition in either pair is always true, the other false; according to the primary laws (Sections 10, 11), these are "contradictories;" (2) of the pair, A and E, both can not be true, but both may be false, and they are called "contraries;" for they are in the same relation as any pair of the members of a trichotomy or polytomy (Section 7 b), which exclude each other but leave a third class, or more; as

a tree can not be both oak and pine, but may be neither; (3) of the pair I and O, both may be true, but both can not be false, and they are called "subcontraries;" (4) of the pairs A and I, E and O, if the universal be true, the particular is true; if the particular be false, the universal is false; I and O are "subalternate" respectively to A and E.

Successive application of the above principles to a proposition would produce many derived forms. The following are some of these:

First: "Contraversion," sometimes called "contraposition," is obversion (Section 17, 2nd. Method) followed by conversion, of A, E, or O.

Second: "Contraposition" is obversion, conversion, then obversion again, of A, E, O; or it is contraversion followed by obversion.

Third: "Inversion" is contraposition followed by conversion, then obversion, of A, or E. The resulting proposition has for subject the contradictory of the original subject, and for predicate the contradictory of the original predicate. The various steps indicated are necessary to prove the correctness of the process, but once proven, we may pass to the inverse form directly. A gives I; E gives O.

17 a. **Immediate Inference of Mathematical Propositions.**— The mathematical proposition has both subject and predicate always total, never partial. It follows that the principle of combina-

tion of Section 17 reduces to the familiar axioms: if equals or unequals be added to equals (or subtracted from them, etc.) the results are equals or unequals, respectively.

The principle of using the contradictory applies only in that if two quantities be equal, they are not unequal, and the reverse.

Finally, subject and predicate both being always total, the mathematical proposition may always be converted simply. The sun is the center of the solar system, therefore the center of the solar system is the sun; x is equal to y, therefore y is equal to x; the sum of any two angles of a triangle is greater than the third angle, therefore any angle of a triangle is less than the sum of the other two angles.

PRACTICE ON SECTIONS 16 and 17

Using any of the examples for practice in the preceding section, first reduced to simple propositions in strict logical form, copious practice should be had under the following heads:

1. Select some suitable mark, and form a new judgment by combining it with the two terms of any proposition.
2. Combine assigned pairs of suitable propositions, such as Nos. 5 and 16, 17 and 41, 22 and 24, 40 and 41, 71 and 72.
3. Deny the contradictory of any simple proposition (i. e. "infinitate" it, or give its "obverse").

4. Convert simply any that admit of simple conversion.
5. Convert by limitation any convertible only in that way.
6. Convert any partial negative (O) by infinitating and then converting simply (i. e. by "contraposition").
7. Convert by any of the above methods, and as many as are applicable, any examples assigned.
8. Select any proposition. If it be true, are the other three (of A, E, I, O) with the same subject and predicate, true or false?
9. Suppose each one selected to be false. Are the other three true or false, as above?
10. Contravert any assigned.
11. Invert any assigned, in some showing each step, in others directly.

CHAPTER VI

MEDIATE DEDUCTION

18. **Nature of Mediate Inference.**— Mediate inference is inference through a medium, or "middle term." Three notions are used, and not only two, as in immediate inference. The two notions which are being investigated, are each compared with the third notion, and as a result of the comparison, their relation to each other is determined. For example, all true statesmen are servants of the state rather than of self, most politicians are not servants of the state rather than of self, therefore, most politicians are not true statesmen. Not being able, perhaps, to judge immediately of the relation of the two notions, true statesmen, and most politicians, each is compared with the third notion, servants of the state rather than of self, and one being found to agree with this, the other not, the two are therefore judged not to agree with each other.

19. **The Syllogism and its Parts.**— The full expression of a mediate inference is called a "syllogism," and evidently requires three propositions. The two in which the middle term occurs are called the "premises"; the third, in which the two no-

tions under investigation are compared, is the "conclusion" (Latin, shut up together). The subject of the conclusion is called the "minor" term, because it is affirmed or denied to be contained in the predicate, which is therefore the "major" term. The premise in which the major term is compared with the middle term, is called the major premise; that in which the minor and the middle are compared, the minor premise.

The order of the propositions is unimportant, but for convenience in logical study, the order, major, minor, conclusion, is adopted.

20. **Rules of the Syllogism.**— Some of the following rules are based on what has just been said, the others have additional reasons given.

First. Every syllogism has three terms and no more. It we should compare the major and the minor terms with two other different terms, no conclusion could be drawn. Even the same word or group of words with different meanings, would count as two terms, and make the total four, just as if two different words were used; for the term is not the mere words, but the real meaning. An example is: school children are pupils, pupils are part of the eye, therefore school children are part of the eye.

Second. Every syllogism has three propositions, and no more. This is evident from the nature of the syllogism.

Third. The middle term must be total (or, "distributed") in at least one of the premises. For if we compare the major term with only part of the middle, and the minor term with only part, the two parts might be entirely distinct, and no conclusion would follow. This would be equivalent to having four terms. If chairs be seats, and benches be seats, we can not conclude that chairs are benches, for we have used in each premise only part of the class, seats, and the parts may be, and in this case are distinct; nor, for the same reason, if spheres be round things, and balls be round things, can we conclude that balls are spheres, though we know it be true.

Violation of this principle is called "undistributed middle."

Fourth. No term may be total in the conclusion, unless total in a premise. For that would be to conclude about all of a term from a judgment about only some of it. It is important to remember here that the subjects of A and E, and the predicates of E and O, are always total, or "distributed," while terms in other positions are partial, or "undistributed."

Violation of this principle is called the "illicit process," or proceeding illegally from some to all in thought. If from, all statesmen are patriots, and no self-seekers are statesmen, we conclude, no self-seekers are patriots, the major term, patriot, is par-

tial in the premise and total in the conclusion, and the reasoning is fallacious, though the conclusion is true. This is "illicit major," and can evidently occur only when the conclusion is negative. If from, no self-seekers are statesmen, and some self-seekers are politicians, we conclude, no politicians are statesmen, the fault is "illicit minor," and evidently can occur only when the conclusion is total.

Fifth. If both premises be negative, no conclusion follows. For if neither the major nor the minor term agrees with the middle, we can not judge their relation to each other.

Sixth. If one premise be negative, the conclusion is negative. For then either the major or the minor agrees with the middle term, and the other disagrees, so that they must disagree with each other, which means the conclusion is negative.

To sum up briefly:

Rule 1. A syllogism has three terms, three propositions, and at least one affirmative premise.

Rule 2. If one premise be negative, the conclusion is negative.

Rule 3. The middle term must be total at least once.

Rule 4. A term total in the conclusion, must be total in the premise.

The above four rules constitute the sufficient test of syllogistic reasoning. The general principle justifying the syllogism may be derived as follows:

By the law of affirmation (Section 9) a notion not contradictory to another may be affirmed of it; by the law of denial a notion contradictory to another must be denied of it. From these laws it follows that if two notions agree with a third, so that all of the third is involved once (Rule 3 above) they agree with each other; also that if one of the two agrees with the third, and the other not (Rule 2 above), so that the whole of the third is involved once, then they disagree with each other; and lastly, if neither agrees with the other (Rule 1 above), nothing can be concluded as to their agreement with each other.

These principles are evidently equivalent to the four rules of the above summary. It is of course evident, also, that any notion may be substituted for an equivalent notion.

21. **Syllogisms Incompletely Expressed.**— Complete expression of syllogistic reasoning is rare in the actual conveyance of thought, obvious parts being left to the mind of the reader or hearer to supply; yet for the purpose of critical examination of the thought, the full form is often necessary. Incomplete syllogisms are called "enthymemes" (Greek, in the mind). The logician has of course the right to full expression.

The kind of enthymeme most common in ordinary interchange of thought, and far more common than the fully expressed syllogism, omits one

of the three propositions of the syllogism, the omitted member being readily supplied from general knowledge or from specific circumstances. If we say, all braggarts are cowards, Falstaff is a braggart, therefore Falstaff is a coward, the syllogism is complete; but if we say only, Falstaff is a coward, for he is a braggart, we have an enthymeme, for the major premise is "in the mind"; or if we say, Falstaff is a coward, because all braggarts are cowards, the minor premise is "in the mind"; or, finally, if we say, all braggarts are cowards, and Falstaff is a braggart, the conclusion is "in the mind."

Less common, but still often used, is the enthymeme with two propositions omitted, the major premise being the one expressed, in nearly, if not quite every instance, and the minor being usually, if not always, suggested by the actual circumstances. A proverb or other popular saying, any general statement by way of insinuation, epitaphs, etc., may be the major premise of the enthymeme of only one expressed proposition. Hearing of an attempt on the life of a ruler, we say, "uneasy lies the head that wears a crown"; the minor premise, the head of this ruler wears a crown, being suggested at once. Seeing a clumsy effort to do something more easily done otherwise, we say, "lazy people take the most trouble"; the other propositions being obvious.

22. **Series of Syllogisms.**— Reasoning is seldom limited to one mediate inference, but is continued through a series of connected syllogisms, the conclusion of one becoming a premise of the next, as any conclusion may. The syllogism of which the repeated proposition is the conclusion, is the "prosyllogism," the syllogism of which it is a premise, is the "episyllogism." Usually only one premise of the prosyllogism is expressed, and it is therefore an enthymeme. For example: vice is odious, and avarice is vice, for it makes men slaves; therefore avarice is odious. Here the minor premise is the conclusion of a prosyllogism whose minor premise, avarice makes men slaves, is expressed, but whose major premise, whatever makes men slaves is a vice, is "in the mind." Both premises of the episyllogism may be supported in this way, and the full expression of the reasoning in that case would require three syllogisms; as if above we had said: vice is odious, for whatever exalts the animal above the moral is odious. The name "epichirema" has been given to the reasoning when limited to one pair of pro- and episyllogism; "double epichirema" to the case where each of the two premises of the same episyllogism is supported by a prosyllogism.

If this relation of prosyllogism and episyllogism be continued through several syllogisms, the resulting chain is called a "sorites" (Greek, heap).

Thus, the prudent are temperate, the temperate are constant, the constant are unperturbed, the unperturbed are happy, therefore the prudent are happy. While this reasoning may be fully expressed in a series of pro- and episyllogisms, the mind does not in the actual process stop to form the various intermediary conclusions, but runs through the successive middle terms easily and naturally, sees that each wholly contains the next, and concludes finally that the first term agrees or not with the last. The separate syllogisms would be as follows: first, the prudent are temperate, the temperate are constant, therefore the prudent are constant; second, the prudent are constant, the constant are unperturbed, therefore the prudent are unperturbed; and so on to the end. The arrangement of premises may be reversed: the unperturbed are happy, the constant are unperturbed, the temperate are constant, the prudent are temperate, therefore the prudent are happy.

In the first form, the last premise may be negative; in the second form, of course, the first premise; if any other be negative, illicit process would result. In the first form, the first premise may be partial; in the second form, the last premise; if any other be partial, undistributed middle would result.

PRACTICE ON SECTIONS 19 to 22

The following examples should be supplemented by others, selected from various sources, by the instructor, and especially by the class from their own studies, and used for further practice as follows: 1st. Put each in strict logical form with three terms and three propositions, any missing propositions being supplied. 2nd. Point out the minor, the major, the middle term in that order. 3rd. Indicate the major premise, the minor premise, the conclusion. 4th. Are both premises negative? If so, what follows? 5th. Is the middle term total at least once? 6th. Is any term total in the conclusion? If so, is it also total in its premise? If not, what follows?

As a further exercise, the class should be required to find or invent cases of undistributed middle, illicit major, and illicit minor and to bring examples of the three kinds of enthymemes.

In case any example contains parts of two or more syllogisms, each one should be fully expressed, and tested as above. See especially Section 22.

1. Some wars being justifiable, while all are inexpedient, it is easy to see that not all inexpedient acts are unjustifiable.
2. Since caterpillars have two legs, while worms do not, they cannot be worms.
3. This man, unlike a thief, shares his money with the poor.
4. All men are sinners and yet some of them are not cruel.

5. He must be an atheist, for he holds these opinions that are held by all atheists.
6. All who were pledged voted for him, but as Jones was not pledged, it follows that he did not.
7. No science is perfect, but every science ought to be cultivated, and so the things we ought to cultivate are imperfect.
8. No one is rich who is not content, so of course no miser is rich, for he could not possibly be content.
9. All horned animals are ruminants, and so is the elk, which is therefore horned.
10. Every good citizen is ready to defend his country, and of course is patriotic, and therefore every patriotic man is ready to defend his country.
11. Few of the passengers could swim, and yet not many perished, so that some who were saved could not swim.
12. No plants have the power of locomotion, but the lower forms of animal life are of course not plants.
13. There was heavy dew this morning, so it could not have been a cloudy night.
14. Wisdom is the principal thing; therefore get wisdom. *Bible.*
15. Keep thy heart with all diligence; for out of it are the issues of life. *Bible.*
16. How many syllogisms can be made from these examples from the Bible? The fear of the Lord is the beginning of knowledge. The fear of the Lord is to hate evil. The fear of the Lord pro-

longeth days. The fear of the Lord is a fountain of life. The fear of the Lord, that is wisdom, and to depart from evil is understanding.

17. And Joshua said unto the people: Ye cannot serve the Lord: for he is an holy God; he is a jealous God; he will not forgive your transgressions nor your sins. *Bible.*
18. And he said to David, Thou art more righteous than I: for thou hast rewarded me good, whereas I have rewarded thee evil. *Bible.*
19. Doth Job fear God for nought? Hast thou not made an hedge about him? *Bible.*
20. The Lord is my shepherd; I shall not want. *Bible.*
21. For thy name's sake, O Lord, pardon mine iniquity; for it is great. *Bible.*
22. Fear God, and keep his commandments: for this is the whole duty of man. *Bible.*
23. Repent ye: for the kingdom of heaven is at hand. *Bible.*
24. Blessed are the poor in spirit: for theirs is the kingdom of heaven. *Bible.*
25. John came neither eating nor drinking, and they say, He hath a devil. The Son of man came eating and drinking, and they say, Behold a man gluttonous, and a winebibber, a friend of publicans and sinners. *Bible.*
26. He that is of God heareth God's words: ye therefore hear them not, because ye are not of God. *Bible.*
27. By the deeds of the law there shall no flesh be

justified in his sight; for by the law is the knowledge of sin. *Bible.*

28. Being justified by faith, we have peace with God. *Bible.*
29. Hope that is seen is not hope; for what a man seeth, why doth he yet hope for? *Bible.*
30. Whom he did foreknow, he also did predestinate to be conformed to the image of his Son, that he might be the firstborn among many brethren. Moreover, whom he did predestinate, them he also called; and whom he called, them he also justified; and whom he justified, them he also glorified. *Bible.*
31. For whosoever shall call upon the name of the Lord shall be saved. How then shall they call on him in whom they have not believed? and how shall they believe in him of whom they have not heard? and how shall they hear without a preacher? And how shall they preach, except they be sent? *Bible.*
32. Let every soul be subject unto the higher powers. For there is no power but of God. Whosoever therefore resisteth the power, resisteth the ordinance of God. *Bible.*
33. He that will not apply new remedies must expect new evils; for time is the greatest innovator. *Bacon.*
34. Riches are for spending, and spending for honor and good actions; therefore extraordinary expense must be limited by the worth of the occasion. *Bacon.*

35. He must needs be a wise man, he speaks so much of himself. *Bacon.*
36. Of ambitions, it is less harmful the ambition to prevail in great things, than that other to appear in everything; for that breeds confusion, and mars business. *Bacon.*
37. Let not a man trust his victory over his nature too far; for nature will be buried a great time, and yet revive upon the occasion, or temptation. *Bacon.*
38. Since there must be borrowing and lending, and men are so hard of heart as they will not lend freely, usury must be permitted. *Bacon.*
39. The discommodities of usury are, first, that it makes fewer merchants; for were it not for this lazy trade of usury, money would not lie still, but would in great part be employed upon merchandising. *Bacon.*
40. It (usury) bringeth the treasure of a realm or state into a few hands; for the usurer being at certainties, and others at uncertainties, at the end of the game most of the money will be in the box. *Bacon.*
41. It (usury) beats down the price of land; for the employment of money is chiefly either merchandising, or purchasing, and usury waylays both. *Bacon.*
42. On the other side, in some other respect usury advanceth merchandising; for it is certain that the greatest part of trade is driven by young merchants upon borrowing at interest. *Bacon.*

43. Men had need beware how they be too perfect in compliments; for be they never so sufficient otherwise, their enviers will be sure to give them that attribute, to the disadvantage of their greater virtues. *Bacon.*

44. I grant that men, continuing what they are,
Fierce, avaricious, proud, there must be war.
Cowper.

45. Why has not man a microscopic eye?
For the plain reason, man is not a fly. *Pope.*

46. Wisdom is a most beautiful thing, and Love is of the beautiful; and therefore Love is also a philosopher or lover of wisdom, and being a lover of wisdom is in a mean between the wise and the ignorant. *Plato.*

47. To overcome is pleasant, not to the ambitious only, but even to all; for there arises an imagination of superiority, for which all, either in a faint or more violent degree, have an appetite. But since to overcome is pleasant, it must follow, of course, that amusements where there is field for rivalry, as those of music and disputations, are pleasant; for it frequently occurs, in the course of these, that we overcome. *Aristotle.*

48. Happiness does not consist in amusement; for it is absurd that the end should be amusement. *Aristotle.*

49. To amuse ourselves in order that we may be serious seems to be right; for amusement resembles relaxation. *Aristotle.*

50. He is free who lives as he likes; who is not sub-

ject to compulsion, to restraint, or to violence; whose pursuits are unhindered, his desires successful, his aversions unincurred. Who, then, would wish to lead a wrong course of life? No one. No wicked man, then, lives as he likes; therefore no such man is free. *Epictetus.*

51. Since, then, neither they who are called kings nor the friends of kings live as they like, who, then, after all, is free? *Epictetus.*

52. To whatever objects a person devotes his attention, these objects he probably loves. Do men ever devote their attention then to (what they think) evils? By no means. Or even to things indifferent? No, nor this. It remains, then, that good must be the sole object of their attention; and if of their attention, of their love too. Whoever, therefore, understands good, is capable likewise of love; and he who cannot distinguish good from evil, and things indifferent from both, how is it possible that he can love? The wise person alone, then, is capable of loving. *Epictetus.*

53. You will act in the wisest way, if you deem his piety, virtue, and industry to be your own, to be with you, wherever you are; for those things which we hold in mind are no less ours than those we behold with our eyes. *Cicero.*

54. We ought to watch and avoid the love of money; for nothing so truly characterizes a narrow, groveling disposition as to love riches. *Cicero.*

55. An inordinate passion for glory is likewise to be guarded against; for it deprives us of liberty,

the only prize for which men of elevated sentiments ought to contend. *Cicero.*

56. But, since most persons are of opinion that the achievements of war are more glorious than civil affairs, this judgment needs to be restricted; for many, as generally is the case with high minds and enterprising spirits, especially if they are adapted to military life and are fond of warlike achievements, have often sought opportunities of war from their fondness for glory; but if we are willing to judge truly, many are the civil employments of greater importance, and of more renown, than the military. *Cicero.*

57. In this respect friendship is superior to relationship, because from relationship benevolence can be withdrawn and from friendship it cannot; for with the withdrawal of benevolence the very name of friendship is done away, while that of relationship remains. *Cicero.*

58. Because nature can never change, therefore true friendships are eternal. *Cicero.*

59. He (Scipio) indeed used to say that nothing was more difficult than that friendship should continue to the end of life; for it often happened either that the same course was not expedient to both parties or that they held different views of politics. *Cicero.*

60. When going into exile, he (Tarquin) found out whom he had as faithful friends, and whom unfaithful ones, since then he could no longer show gratitude to either party. *Cicero.*

61. The reason why cruelty is the most hateful of all vices is that it goes first beyond ordinary limits, and then beyond those of humanity; that it devises new kinds of punishments, calls ingenuity to aid it in inventing devices for varying and lengthening men's torture, and takes delight in their sufferings. *Seneca.*

62. An anonymous information was laid before me, containing a charge against several persons, who upon examination denied they were Christians, or had ever been so. They repeated after me an invocation to the gods, and offered religious rites with wine and incense before your statue (which for that purpose I had ordered to be brought, together with those of the gods), and even reviled the name of Christ: whereas there is no forcing, it is said, those who are really Christians into any of these compliances: I thought it proper, therefore, to discharge them. *Pliny.*

63. Anonymous informations ought not to be received in any sort of prosecution. It is introducing a very dangerous precedent, and is quite foreign to the spirit of our age. *Trajan's reply to Pliny.*

64. There needed no licensing of books among them (the Spartans), for they disliked all but their own laconic apothegms, and took a slight occasion to chase Archilochus out of the city, perhaps for composing in a higher strain than their own soldierly ballads and roundels could reach to. *Milton.*

65. Where there is much desire to learn, there of necessity will be much arguing, much writing, many opinions: for opinion in good men is but knowledge in the making. *Milton.*

66. There is scarce any profession in the commonwealth more necessary, which is so slightly performed. The reasons whereof I conceive to be these: First, young scholars make this calling their refuge; yea, perchance, before they have taken any degree in the university, commence schoolmasters in the country, as if nothing else were required to set up this profession but only a rod and a ferula. Secondly, others who are able, use it only as a passage to better preferment to patch the rents in their present fortune, till they can provide a new one, and betake themselves to some more gainful calling. Thirdly, they are disheartened from doing their best with the miserable reward which in some places they receive, being masters to their children and slaves to their parents. Fourthly, being grown rich, they grow negligent, and scorn to touch the school but by the proxy of the usher. *Fuller.*

67. Hard, rugged, and dull natures of youth acquit themselves afterwards the jewels of the country, and therefore their dullness at first is to be borne with, if they be diligent. *Fuller.*

68. The reason that there is such a general outcry among us against flatterers is that there are so very few good ones. *Steele.*

69. The man of business despises the man of pleasure

for squandering his time away; the man of pleasure pities or laughs at the man of business for the same thing; and yet both concur superciliously and absurdly to find fault with the Supreme Being for having given them so little time. *Bolingbroke.*

70. There never can be wanting some who distinguish desert, who will consider that no dictionary of a living tongue can ever be perfect, since, while it is hastening to publication, some words are budding and some falling away. *Johnson.*

71. Foolish men imagine that because judgment for an evil thing is delayed, there is no justice, but an accidental one, here below. *Carlyle.*

72. What, then, is the use of history, and what are its lessons? If it can tell us little of the past, and nothing of the future, why waste our time over so barren a study?

First, it is a voice ever sounding across the centuries the laws of right and wrong. Opinions alter, manners change, creeds rise and fall, but the moral law is written on the tablets of eternity. For every false word or unrighteous deed, for cruelty and oppression, for lust or vanity, the price has to be paid at last, not always by the chief offenders, but paid by some one. Justice and truth alone endure and live. Injustice and falsehood may be long-lived, but doomsday comes at last to them, in French revolutions and other terrible ways.

That is one lesson of history. Another is, that we

should draw no horoscope; that we should expect little, for what we expect will not come to pass. Revolutions, reformations,— those vast movements into which heroes and saints have flung themselves, in the belief that they were the dawn of the millennium,— have not borne the fruit which they looked for. *Froude.*

73. Few things are needed to make a wise man happy; nothing can make a fool content; that is why most men are miserable. *Rochefoucauld.*

74. Thou art not thyself:
For thou exist'st on many a thousand grains
That issue out of dust. *Shakespeare.*

23. **Conditional Propositions.**— Conditional propositions are of two kinds, hypothetical and disjunctive. They assert, not absolutely, as do categorical propositions (Section 14), but dependently on some supposition or alternative. Let us analyze some examples.

First, the hypothetical proposition:

a. With the same subject in the two clauses: if iron be impure, it is brittle; or if iron be a metal, it has luster. The first example is equivalent to the simple proposition, impure iron is brittle; the second is an enthymeme with the major premise "in the mind," and the minor stated, not as a fact, but as a supposition, thus: (metals have luster), if iron be a metal, then iron has luster.

b. With the subject of the first clause as predi-

cate of the second: if metals have luster, carbon is not a metal. This is an enthymeme with the minor premise "in the mind," and the major stated as a supposition, thus: if metals have luster (carbon has not luster), therefore carbon is not a metal. In this form the second clause must be negative, else undistributed middle; as if it were said: if metals have luster, iron is a metal (iron having luster).

c. With the predicate of the first clause as subject of the second: if iron be a metal, some metals are hard; the full syllogism being: (iron is hard), and if iron be a metal, some metal is hard. In this form the second clause must be partial, else illicit minor.

d. With the same predicate in the two clauses: if metals have luster, iron has luster; an enthymeme yielding: if metals have luster, (iron is a metal), therefore iron has luster.

e. With different terms for subjects and predicates of both clauses: if the temperate are constant, the prudent are unperturbed, yields the sorites: (the prudent are temperate), and if the temperate are constant, and (the constant are unperturbed) therefore the prudent are unperturbed.

f. With only two terms as subject and predicate of both clauses. Such propositions express all the forms of immediate inference allowed by Section 17, as:

(1) Combination: if a house be a building, a brick house is a brick building.

(2) Contradiction: if animals are mortal, animals are not immortal.

(3) Conversion in all legitimate forms, as: if no misers are happy men, no happy men are misers, etc.

(4) Relation of propositions: if all grass be green, some grass is green, etc.

It appears, therefore, that the hypothetical proposition is equivalent to a simple proposition, or is an immediate inference, or is an enthymeme subject to the rules of the syllogism.

Second, the disjunctive proposition: as, for example: actions are either right or wrong, evidently a direct application of the primary laws of Sections 9, 10, and 11: of two contradictories, one must be true, the other false. If the division be not dichotomous, the disjunction is still correct, provided the resulting parts exhaust the notion divided, and do not overlap, as: angles are right, acute, or obtuse. Strict logical form would require contradictories: angles are either right or oblique. We speak loosely, however, in ordinary interchange of thought, or we limit possible affirmation to two opposites not strict contradictories by assuming or asking that it be granted that any third possibility be not allowed; as: that tree is a birch or a beech, when it might be neither; or a suicide is either de-

mented or cowardly, when he might be both, or, perhaps, neither.

Every disjunctive is equivalent to four hypotheticals; actions are either right or wrong, yields the following: if they are right, they are not wrong; if they are not right, they are wrong; if they are wrong, the are not right; and if they are not wrong, they are right.

Third, the hypothetical and the disjunctive combined:

a. With the same condition, and different conclusions: if A is B, C is D; or if A is B, E is F.

b. With different conditions, and the same conclusion: if A is B, C is D; or if E is F, C is D.

c. With different conditions, and different conclusions: if A is B, C is D; or if E is F, G is H.

Subjects or predicates might be repeated as in the simple hypothetical above. Being formed of the hypothetical and the disjunctive, no new principles are needed to explain the combination. A division into more than two classes, co-exclusive, and exhaustive would be of the form: either A is B, or C is D, or E is F; this would yield a combined form: if A is not B, C is D; or if A is not B, E is F; and other similar forms. It appears, then, that these compound forms originate in non-dichotomous divisions.

PRACTICE ON SECTION 23

For each conditional proposition in the following: 1st. Is it hypothetical or disjunctive? 2nd. If hypothetical, is it an immediate inference, and of what kind? 3rd. Or is it an enthymeme? If so, complete the syllogisms, and test by the rules of Section 20. In case undistributed middle or illicit process be found, exchanging the subject and predicate of a proposition supplied to complete the syllogism, will probably correct the error. 4th. If disjunctive, test the disjunction, and give at least some of the resulting conjunctives. 5th. If a simple proposition, state it.

1. Men leave their riches either to their kindred or to the public; and moderate portions prosper best in both. *Bacon.*
2. If a man write little, he had need have a great memory; if he confer little, he had need have a present wit; and if he read little, he need have much cunning, to seem to know that he doth not. *Bacon.*
3. Wherever he goes, there is trouble.
4. If you love me, tell me so.
5. If wishes were horses, beggars would ride.
6. He has gone to his cottage or bungalow.
7. Neither money nor threats could make him change his mind.
8. Everything pleasant consists either in the perception of pleasant objects, or in the remembrance of those which have already been, or in the hope

of such as are yet to be; for men exercise perception on present, memory on past, and hope on future objects. *Aristotle.*

9. Unless parents afford their children a fit pattern of life, they will leave them an obvious excuse to quote against themselves. *Aristotle.*
10. If I am wrong in this, that I believe the souls of men to be immortal, I willingly delude myself. *Cicero.*
11. Nothing is more noble and more exalted than to despise riches if you have them not, and if you have them, to employ them in beneficence and liberality. *Cicero.*
12. If it were expediency that cemented friendships, the same when changed would dissolve them. *Cicero.*
13. There is no reason why power should do any harm, if only it be wielded in accordance with the laws of nature. *Seneca.*
14. No man, unless he be good, can ever be an orator. *Quintilian.*
15. The mind cannot be in a condition for pursuing the most noble of studies, unless it be entirely free from vice. *Quintilian.*
16. Virtue is teachable, if it is knowledge; for surely knowledge is teachable.
17. Sorrowful and mishappy is the condition of a poor beggar, for if he asks not his meat he dieth of hunger, and if he ask he dieth for shame; and dire necessity constraineth him to ask. *Chaucer, quoting Innocent.*

18. If we never flattered ourselves the flattery of others would not hurt us. *Rochefoucauld.*
19. Those many had not dared to do that evil
If the first man that did the edict infringe
Had answered for his deed. *Shakespeare.*
20. If ye then, being evil, know how to give good gifts unto your children, how much more shall your Father which is in heaven give good things to them that ask Him? *Bible.*
21. Had ye believed Moses, ye would have believed me; for he wrote of me. But if ye believe not his writings, how shall ye believe my words? *Bible.*
22. If ye believe not that I am he, ye shall die in your sins. *Bible.*
23. If God were your Father, ye would love me; for I proceedeth forth and came from God; neither came I of myself, but he sent me. *Bible.*
24. If a man keep my saying, he shall never see death. *Bible.*
25. Neither hath this man sinned, nor his parents. *Bible.*
26. If this counsel or this work be of men, it will come to nought; but if it be of God, ye cannot overthrow it; lest haply ye be found even to fight against God. *Bible.*
27. If God be for us, who can be against us? *Bible.*
28. If ye were Abraham's seed, ye would do the works of Abraham. *Bible.*
29. I will not let thee go, unless thou bless me. *Bible.*
30. If this which I have mentioned be the meaning of

the word liberty, in the ordinary use of language: as I trust that none that has ever learned to talk, and is unprejudiced, will deny: then it will follow that in propriety of speech neither liberty, nor its contrary, can properly be ascribed to any being or thing but that which has such a faculty, power or property as is called will. *Edwards.*

31. The taxes are indeed very heavy, and, if those laid on by the government were the only ones we had to pay, we might more easily discharge them; but we have many others, and much more grievous to some of us. *Franklin.*
32. If time be of all things the most precious, wasting time must be the greatest prodigality. *Franklin.*
33. If you would have a faithful servant, and one that you like, serve yourself. *Franklin.*
34. If you would know the value of money, go and try to borrow some. *Franklin.*
35. If a man have no heroism in his soul — no animating purpose beyond living easily and faring sumptuously — I can imagine no greater mistake on his part than that of resorting to authorship as a vocation. *Greeley.*
36. If the bell rings, why should we run? *Thoreau.* See 9, page 128.
37. It is worth the expense of youthful days and costly hours, if you learn only some words of an ancient language, which are raised out of the trivialness of the street, to be perpetual suggestions and provocation. *Thoreau.*
38. When works of importance are pressing, generals

themselves may take up the pickax and the spade. *Bolingbroke.*

39. No man would have any reason to fear the fury of a tyrant, if he had no authority over any but from fear; since, as a single man, his bodily force can reach but a small way, and all the further power he possesses must be founded either on our own opinion, or on the presumed opinion of others. *Hume.*

40. If we suffer ourselves to imagine that their senses present to different men different images of things, this skeptical proceeding will make every sort of reasoning on every subject vain and frivolous. *Burke.*

41. But should any man be found who declares that to him tobacco has a taste like sugar, and that he cannot distinguish between milk and vinegar; or that tobacco and vinegar are sweet, milk bitter, and sugar sour; we immediately conclude that the organs of this man are out of order, and that his palate is utterly vitiated. *Burke.*

42. Indeed, my lord, I greatly deceive myself, if in this hard season (after the loss of his son), I would give a peck of refuse wheat for all that is called fame and honor in the world. *Burke.*

43. If it be admitted that a man possessing absolute power may misuse that power by wronging his adversaries, why should a majority not be liable to the same reproach? *De Tocqueville.*

44. When a community actually has a mixed government — that is to say, when it is equally divided

between two adverse principles — it must either pass through a revolution or fall into complete dissolution. *De Tocqueville.*

45. When an individual or party is wronged in the United States, to whom can he apply for redress? If to public opinion, public opinion constitutes the majority; if to the legislature, it represents the majority, and implicitly obeys its instructions; if to the executive power, it is appointed by the majority, and is a passive tool in its hands. The public troops consist of the majority under arms; the jury is the majority invested with the right of hearing judicial cases; and in certain cases, even the judges are elected by the majority. However iniquitous or absurd the evil of which you complain may be, you must submit to it as well as you can.

If, on the other hand, a legislative power could be so constituted as to represent the majority without necessarily being the slave of its passions, an executive so as to retain a certain degree of uncontrolled authority, and a judiciary so as to remain independent of the other two powers, a government would be formed which would still be democratic, without incurring any risk of tyranny. *De Tocqueville.*

46. On a hot sunshiny afternoon came on a sudden storm and spoiled the farmer's hay; and this is called ill luck. We will suppose the same event to take place when meteorology shall have been perfected into a science, provided with unerring

instruments; but which the farmer had neglected to examine. This is no longer ill luck, but imprudence. *Coleridge.*

47. Take away Stonehenge from Salisbury Plain, and it is nothing more than Hounslow Heath, or any other uninclosed down. *Byron.*

48. It cannot be true: if Alexander were dead, the whole habitable world would have smelt of his carcass. *Demades, quoted by Grote.*

24. **So-Called Conditional "Syllogisms."**—Examples are as follows:

First, based on hypothetical propositions: if A is B, C is D; but A is B, therefore C is D: or, but C is not D, therefore A is not B.

Second, based on disjunctive propositions: A is either B or non-B; but A is B, therefore A is not non-B, etc.

Third, based on the combined form: Either if A is B, C is D; or if E is F, G is H; but either A is B, or E is F; therefore C is D, or G is H: or, but either C is not D, or G is not H; therefore A is not B, or E is not F.

We have seen in Section 23 that the hypothetical proposition is itself an incomplete syllogism; furthermore, the above forms have more than three terms, have not major and minor premises as defined for the syllogism in Section 19, in which a major and a minor term are compared respectively with a middle term. These forms are therefore not

syllogisms, and the question arises what is their true nature and their place in logic. Examination of them will show that each constitutes a passage from a supposition or an alternation, that is from a statement of mere dependence, or connection, to an independent statement of exactly the same subject-matter. In the original proposition, if hypothetical, it is affirmed merely that the conclusion follows from the condition, and the question of the truth of the condition or conclusion is not involved; in the second proposition either the truth of the condition or the falsity of the conclusion is affirmed, and conclusion is reached as to the truth of the other clause. Again, if the original proposition be disjunctive, it is affirmed merely that one or the other of two contradictories is true, the other false; but not which is true, and which false; in the second proposition the truth or the falsity of one alternative is affirmed, and the falsity of the truth of the other concluded. This is evidently not an instance of syllogistic reasoning.

Since logic deals with sequence, not with truth, these forms of expression, convenient and frequent as they are, are outside of its proper territory, and are evidently not forms of reasoning, all the reasoning in them being confined to the original proposition, in itself a syllogism. For dealing with these forms, however, it is convenient to express the fact that in a correct syllogism true premises yield a

true conclusion, and a false conclusion means a false premise, in the following rules:

(1) Affirming the antecedent affirms the consequent.

(2) Denying the consequent denies the antecedent.

It will be seen that these rules cover the so-called hypothetical syllogism, while for disjunctive forms the laws of contradiction and exclusion apply directly.

25. **Mathematical Syllogisms.**— Mathematical syllogisms are those whose premises are mathematical propositions (Section 15, end). Just as the methods and rules for immediate inference were seen in Section 17 a to be simplified when applied to the mathematical proposition, so it is with the mathematical syllogism. All terms being total, and equivalent in their quantity, there is no distinction between major and minor term, or therefore between major and minor premise; no possibility of "undistributed middle," or of "illicit process," because these errors depend upon the partial use of a term. Figure and mood (see Appendix, page 118) have no significance.

The rules of the mathematical syllogism reduce to the simple forms: two quantities equal to a third, are equal to each other; and a quantity greater (or less) than another which is greater (or less) than a third, is still greater (or less) than the

third quantity. The mathematical forms of the copula are: "is equal to," "is unequal to," the latter resolving into the two forms: "is greater than," and "is less than." Many expressions such as: "is part of," "is included in," "contains," "is one of," "is above," "is below," or any comparative degree, are combinations of the mathematical copula with other elements, and may easily be put in strict form: John is taller than James, George is taller than John, therefore George is taller than James, would become: the height of John is greater than that of James, etc.

APPENDIX TO CHAPTER VI

Figure and Mood.— As the middle term of a syllogism may be either the subject or the predicate of the major and of the minor premise, it is evident that there are four possible combinations of the position of the middle term in the two premises, determining what are called the "figures" of the syllogism. In the first figure, the middle term is subject of the major premise and predicate of the minor; in the second figure, it is predicate of both premises; in the third, subject of both; and in the fourth, predicate of the major and subject of the minor premise.

Granted the rules of the syllogism in Section 20, it follows that in figure 1 the major premise must be total and the minor affirmative; in figure 2, the

major must be total and one premise negative; in figure 3, the minor premise must be affirmative and the conclusion partial. The proof of these special rules affords a valuable exercise for the student. It is important to note in this connection that the only positions in which a term is thought of totally are the subject of A or E, and the predicate of E or O. The fourth figure is open to criticism, and need not be discussed here.

It is further evident that the major and minor premises in any figure may be various combinations of A, E, I, and O, the conclusion being of course determined by the premises. Sixteen such combinations, called "moods" of the syllogism, are possible: AA, AE, AI, AO, EA, EE, EI, EO, IA, IE, II, IO, OA, OE, OI, OO. It can be shown that EE, EO, IE, II, IO, OE, OI, OO, as premises, would violate the rules in Section 20, the proof of which can be used as an exercise. The only valid combinations, then, are AA, AE, AI, AO, EA, EI, IA, OA.

As a further exercise it can be proved from the rules in Section 20 or from the special rules above, that some of these eight moods are not valid in some of the four figures, leaving only the following: AA in figures 1, 3, and (4); AE in 2, (4); AI in 1, 3; AO in 2; EA in 1, 2, 3, (4); EI in 1, 2, 3, (4); IA in 3, (4); OA in 3. These nineteen possible moods have been named, the vowels in the name

of each being the symbols of its three propositions, and the names of the moods in each figure are grouped together in the following mnemonic hexameters:

BARBARA, CELARENT, DARII, FERIOque prioris:

CESARE, CAMESTRES, FESTINO, FAKOFO, secundae;

Tertia, DARAPTI, DISAMIS, DATISI, FELAPTON,

DOKAMOK,* FERISON habet. Quarta insuper addit

BRAMANTIP, CAMENES, DIMARIS, FESAPO, FRESISON.

In these names the initial consonant is the same as that of the mood (Barbara, Celarent, Darii, or Ferio) in Figure 1, to which the moods in the other figures may be changed by following the directions indicated by these other consonants in their names (for processes, see Section 17):

"s" means, convert simply the proposition whose symbol precedes the "s"; "p," convert by limitation the preceding proposition; "f," infer by contradiction; "k," apply "f," and then "s" to the preceding proposition; "m," exchange the premises.

The other consonants in the names have no meaning. For practice, any syllogism not in the first

*Or Fokmafokf.

figure may be used, e. g., Some wars are justifiable, all wars are inexpedient, and so some inexpedient acts are justifiable, is Disamis, which becomes Darii, as follows: All wars are inexpedient, some justifiable acts are wars, and so some justifiable acts are inexpedient.

CHAPTER VII

DEDUCTIVE FALLACIES

26. **The Nature of Fallacy.**— Any violation of the laws, principles, or rules of logic is a fallacy. The only reason for separate consideration of the subject here is that these errors may be brought together and classified, and their causes, some of which lie outside of logical forms, examined. It must be remembered that there are many false statements which are not fallacies, that fallacy is not all, but only part of error.

A fallacy, therefore, is a violation of one of the following:

(1) The rules of division in Section 7 **b**; (2) the rules of definition in Section 7 **c**; (3) the laws of affirmation, denial, or exclusion in Sections 9, 10, 11; (4) the limits of immediate inference in Section 17; (5) the rules of the syllogism in Section 20; (6) the right to clear expression of the thought.

If therefore we apply correctly these rules, we can detect fallacy. There are, however, some more or less obscure causes of such violation of logical law, that it is helpful to examine closely. The chief

of these are found in the Sections 27 and 28 following.

27. **Ambiguity.**— The fallacy consists in taking the wrong meaning, or in case of a syllogism, in using first one, then the other meaning, which gives four terms. There are two general cases.

First, an ambiguous term.

(1) The term has two meanings, as in: clubs are organized groups of persons, some weapons are clubs, therefore some weapons are organized groups of persons; or, all criminal actions ought to be punished, prosecution for theft is a criminal action, and ought to be punished; or again, a fox is a quadruped, Herod is a fox, therefore a quadruped.

To the countless ambiguities of language are due the frequent instances of this fallacy. Here, too, belongs the duplicity of the pun.

(2) The term is used once collectively, once distributively, as: two and three are even and odd, two and three are five, therefore five is even and odd.

(3) The wrong accent or tone causes ambiguity: A asked the officer to arrest B, and the officer arrested him, or *him*.

(4) The term is once limited in some way, once not, as: relieving pain is right, killing a sufferer relieves his pain, therefore killing a sufferer is right.

Second, an ambiguous sentence, the fallacy being to take the wrong sense.

(1) The sentence has an ambiguous grammati-

cal structure, as: I predict the enemy our troops will defeat; Moses was the daughter of Pharaoh's son; in athletics only he excelled; I will go and return next week; lost, an umbrella by a gentleman with a carved head.

(2) The wrong accent may change the meaning of the sentence, as above of a term; thus, the sentence: no *man* is *very* fond of *receiving useless gifts,* might be given five different meanings by emphasizing in turn each of the underscored words.

(3) Incorrect punctuation may cause this fallacy, as: there were very few occupants who were not injured; and, there were very few occupants, who were not injured.

28. **Misproof.**— Correct proof proceeds from premise to conclusion, according to the laws of logic. If a premise be questioned, or questionable, it must be shown to follow as a conclusion from unquestioned prior premises and these from others, and so on, which means that the ultimate ground of proof is found in the facts of consciousness given to intellect or to sense. These, being self-evident or established by scientific induction, are the sure foundation for all deduced conclusions. Inductive proof is considered in Part III.

But suppose we desire to prove a proposition false, as in debate. Reference to the relation of propositions in Section 17 will show that A is overthrown by its contradictory, O, and E by I. It is easier to

overthrow a total proposition, and to prove a partial proposition.

(1) Misproof occurs when some other than the proposition stated is proved. This may occur from confusion, or may be intentional, as in attacking the character of an opponent (argumentum ad hominem); appealing to the prejudice (ad populum); or to authority without evidence of validity (ad verecundiam).

(2) When we attempt to overthrow a proposition by any other than its contradictory. The fallacy may be disguised by lengthy development of the proof, or by some of the many forms of ambiguity.

(3) Here may be mentioned the fallacy of inferring the falsity of the conclusion from the falsity of a premise, or the truth of a premise from the truth of the conclusion; especially in the form of the so-called conditional syllogisms when the rules of Section 24 are reversed and it is inferred that denying the antecedent denies the consequent or affirming the consequent affirms the antecedent.

(4) "Begging the question" has many varieties, all of which include, however, the assumption of some essential part of what is sought to be proved. In other words, no premise may be used without its truth being conceded or proven.

a. The assumption of the desired conclusion, or of a premise which is afterward proved by the very

conclusion it is supposed to establish. The final conclusion is used as a premise in the course of the argument, and the longer and more involved the reasoning, the more difficult is it to detect the fallacy. Plato in one of his writings seeks to prove the immortality of the soul from its simplicity; in another, its simplicity from its immortality. If we say, glass is easily broken, because it is brittle, we commit the fallacy.

b. The assumption of a universal premise in order to prove a particular conclusion, as: this man is a sinner, because all who suffer are sinners and he is suffering.

c. To assume the particular and from it to argue the universal, is both begging the question and illicit process; if all the parts are assumed one by one, it is begging the question only.

d. The assumption that implication, as in Section 16, is proof.

e. The demand of a yes or no answer to a compound question; as: are you good and stupid? is he wicked and foolish? have I the wrong pig by the ear?

f. The assumption of unproven facts in a question; as: have you ceased to steal chickens? why is a politician always a hypocrite? An imperfect disjunction is of this nature, as: either you have ceased to steal chickens, or you are still stealing them. If, however, the third possibility, the ex-

istence of which renders the disjunction imperfect, be shown or be granted false, no fallacy is involved. In this case the third possibility is: you have not been a chicken thief. And a politician may not always be a hypocrite.

PRACTICE ON SECTIONS 26 to 28

The more obvious fallacies have already been exemplified under the various heads of definition, division, inference, etc. Examine the following examples, and point out what fallacy, if any, is present; classify each fallacy according to the subdivisions of Sections 26, 27, and 28; and, if possible, show how it may be avoided.

1. Since God is Infinite, it follows that the Infinite is God.
2. If John is the uncle of James, and Mary is John's sister, then it follows that James is Mary's nephew.
3. Penny wise, pound foolish.
4. As all animal life comes from eggs, it follows that all eggs are the product of some animal.
5. The duke yet lives that Henry shall depose,
   And him outlive, and die a violent death. *Shakespeare.*
6. Scott's works were read not only by his countrymen, but by all educated people in Europe.
7. "Where's your father, boy?" "He's down at the other end of the field with the hogs. You can tell him by his hat."
8. "Young ladies, here is your new teacher, Mr.

Chase. Tell him what your other teacher did first, so he can go on in the same way." "She kissed us."

9. "Ring the door-bell, Mister, I can't reach it." "Thank you, sir. Now run."
10. If I can have the luxuries of life, I can do without the necessities.
11. If you never succeed in anything you undertake, you can never undertake anything in which you will succeed.
12. Some possible cases are improbable, therefore some probable cases are impossible.
13. He has little natural ability and still less education.
14. He is the very man, of all others, whom I despise most.
15. The secretary and treasurer of the company was both the secretary and the treasurer.
16. Saddle me the ass; and they saddled *him*.
17. "You called me a sneak." "Yes, it is true, and I am sorry."
18. Examine carefully the two next examples, or the next two examples.
19. "Do you know the men on the jury?" "Yes, more than half of them." "Are you willing to swear to that?" "Yes, I know more than all of them."
20. If Crœsus should wage war against the Persians, he would destroy a mighty empire.
21. What is seen is visible, what is heard is audible, therefore what is desired is desirable.
22. All the angles, A, B, and C, of a triangle, are

less than two right angles; therefore A is less than two right angles.

23. All the angles of a triangle are equal to two right angles; therefore A is equal to two right angles.
24. Heat expands bodies, therefore cold contracts them.
25. Beefsteak is wholesome food, and therefore good for fever patients.
26. Gambling is wrong because it is opposed to sound ethical principles.
27. The length of the day for labor ought not to be fixed by law, for all legislation that interferes with right of free contract is bad.
28. Why does not the King of England wish to be buried in a Catholic graveyard?
29. Men of severe climates are hardy, therefore such a climate is desirable.
30. If he did not steal the stuff, why did he hide it so carefully?
31. I will not have a doctor; all who have died of this disease have had doctors.
32. Advice is useless for you must advise a man what he will do or what he will not do.
33. Great minds run in the same channel.
34. Great men have been derided, just as I am now being derided.
35. Iron is becoming rarer, for it is a useful metal, and they are becoming rarer.
36. Epimenides the Cretan says that all the Cretans are liars, and being a Cretan, he is a liar; but being a liar, the Cretans are not liars, because this liar says they are liars; therefore, being a Cre-

tan, he is not a liar, and so on, as the surveyors say, to the beginning.

37. In the meanwhile, the method I have observed toward those who have been brought before me as Christians is this: I asked them whether they were Christians; if they admitted it, I repeated the question twice, and threatened them with punishment; if they persisted, I ordered them at once to be punished; for I was persuaded whatever the nature of their opinions might be, a contumacious and inflexible obstinacy certainly deserved correction. *Pliny.*

38. We have computed the inhabitants and contemplated the public works of the Roman Empire. The observation of the number and greatness of its cities will serve to confirm the former and multiply the latter. *Gibbon.*

39. For sale, an assorted lot of red men's socks.

40. The place contains some two or three hundred houses and twenty-five hundred inhabitants, all standing with their gable ends to the street.

41. If a wife be beautiful, she excites jealousy; if she be ugly, she excites disgust; therefore it is best not to marry.

42. Governments ought to be resisted, for they repress the liberties of mankind.

43. All persons are hereby forbidden to ride or drive cattle through this park.

44. Upon which the Moor, seizing a bolster full of rage and jealousy, smothered the unhappy Desdemona.

45. Erected to the memory of John Phillips, accidentally shot as a mark of affection by his brother.
46. If some people are wise, then, of course, some are foolish.
47. An agnostic believes that nothing can be certainly known.
48. Protagoras taught Euathlus law. Euathlus agreed to pay his tuition when he won his first case. He had no case, and Protagoras sued him, saying, If the judgment of the court be against you, it will give me the fee; if in your favor, you will owe me the fee, for you will have won your first case.

Euathlus replied: "If the decree be in my favor, I need not pay; if adverse, I shall have lost my first case, and shall owe you nothing."

49. Let us compel every able-bodied male member of the community, who is nineteen years of age, and not absolutely indispensable at home, to volunteer as a member of this military company.
50. What should be done with a man who marries his deceased widow's sister?
51. Human thought is bounded only by the infinite.
52. Does one grain of corn make a heap? No? Do two? Three? Etc.
53. If you pull one hair from a man's head, will it make him bald? Will two? Three? Etc.
54. Every object that does not decompose white light, is seen by white light, and therefore white; a black object does not, and is white.

55. Conscience is something within that tells me when I have done wrong; I had it once, and they had to send for the doctor.
56. Nuisances are punishable by law; a noisy dog is a nuisance.
57. Time is either past or future; the past is gone, the future has not come; there is no time.
58. Whoever necessarily goes or stays is not a free agent; but every one necessarily goes or stays, and so no one is free.
59. I love to steal — I love to steal — I love to steal a while away.
60. To pray for rain is to ask for a miracle; but miracles have ceased. But, prayer for rain has often been followed by rain; and men have succeeded in causing rain, and it is therefore impious to suppose God cannot.
61. Prayer is useful if it informs God of what He does not know, or if it effects a change in his purposes; but prayer can do neither, and is therefore useless.
62. Winning a large prize in a lottery is not an uncommon occurrence, and may therefore reasonably be expected.
63. He that is of God heareth the words of God; for this cause ye hear them not, because ye are not of God. *Bible.*
64. Everything of which there is an innate appetite is pleasant; for appetite is a desire of what is pleasant.
65. No man should choose young people to be cap-

tains and governors, forasmuch as there is no certainty in their wisdom. Alexander of Macedon vanquished and conquered Egypt, Judea, Chaldee, Africa, and Assyria unto the marches of Bargmans more by the counsel of old men than by the strength of the young men. *Caxton.*

66. The heavier the fall of snow, the better, for it provides the poor with more work in cleaning it off.

67. "Step over and see how old Mrs. Jernigan is this morning." Later. "She says she was forty-nine her last birthday, and please, ma'am, why did you want to know?"

68. Instead of purity resulting from that arrangement to India, England herself would soon be tainted. *Macaulay.*

69. In one evening I counted twenty-seven meteors sitting on my back porch.

70. "Fred got shot to-day." "Where? How? Was he hurt much?" He got shot in a hardware store.

71. "He's in the quicksand, you say? How far?" "Up to his ankles." "Then, there's plenty of time." "But he went in head first."

72. In order to show the relation of the religion of Israel to that of heathen nations, Kuenen assumes: "The Israelitish religion is one of those religions; nothing less, but also nothing more."

73. At the outset of his book on "Prophets and Prophecy," Kuenen says: "Prophecy is according to this new view, a phenomenon, yet one of the most important and remarkable phenomena,

in the history of religion, but just on that account a human phenomenon, proceeding from Israel, directed to Israel."

74. So soon as we derive a separate part of Israel's religious life directly from God, and allow the supernatural or immediate revelation to intervene in even one single point, so long also our view of the whole continues to be incorrect. *Kuenen.*

75. The patriarchs cannot be taken as individuals. If individuals Reuben, Gad, and Judah never existed, it is plain that individuals Jacob, Esau, and Abraham cannot have any more substantial reality. We have to do here with figures of the poetic or legend-building imagination. *H. P. Smith.*

76. God, in creating, theomorphises man; man, therefore, necessarily anthropomorphises God. *Jacobi.*

77. Bethel, Hebron, Beersheba, and Shechem were regarded with peculiar veneration by the Israelites. Because there were graves at some of these places, Stade thinks their sacredness due to ancestor-worship.

78. A body moves either where it is or where it is not, but it cannot move where it is for lack of room; nor can it move where it is not, for it is not there to move; therefore a body cannot move.

79. Since we are forbidden to kill, capital punishment is wrong.

80. A mouse is an animal, and it follows that a large mouse is a large animal.

81. He who is hungriest eats most, and one who eats

least is hungriest; therefore he who eats least, eats most.

82. What I see as the train recedes grows smaller and smaller, but as the train does not grow smaller, what I see is not the train.

83. No soldiers but those well qualified should be brought on the field; therefore none but veterans should be brought on.

PART III

INDUCTIVE INFERENCE

CHAPTER VIII

THE NATURE AND LAWS OF INDUCTION

29. **Induction and Deduction.**— We have seen in Part II that by inference immediate or mediate one proposition may be concluded from one or two others as premises; also that these premises may themselves be the conclusions of prior inference. The question is thus suggested, where is the end of this process of referring one proposition to another as its higher ground, and that to still another, and so on; where, in short, is the beginning of the chain, where is the original fountain of knowledge?

The sources of knowledge are two, the intellect and the senses. Through intellectual discernment we know, for example, space, time, causation, moral quality, and such truths as: things equal to the same thing are equal to each other; two straight lines cannot enclose an area; one of two contradictories cannot be affirmed of the other; all personal actions are right or wrong; every change has a cause. These intellectual truths and the conclusions derived from them by correct deduction constitute a body of certain knowledge. Of this nature are the

sciences of mathematics, logic, and ethics, and the fundamental principles of all science.

From the other source of knowledge, the senses, comes the knowledge, not of universal, necessary truths like those above cited, but only of individual facts perceived. From these facts, stated in the form of particular propositions, we infer immediately universal propositions, thus reasoning from "some," often only one, to "all" cases of the kind. This is "induction," already mentioned in Section 16. If, for example, we observe that several persons in a place we are visiting speak with a peculiar accent, we infer that others, perhaps all, speak so; if one hot iron burns one finger, we infer that any iron, equally hot, will burn any part of the body.

It is evident that this inference from "some" to "all," which as deduction would be the "illicit process" of Section 20, must therefore be justified by other principles than those justifying deduction. These are treated in Sections 31 and 32.

It is further evident that these inductive universal propositions may be used as premises for deductions, thus constituting a body of knowledge whose truth depends upon the truth of the original inductive premises.

30. **Scientific Induction.**— As was indicated above, induction is an immediate inference from a particular premise to a universal conclusion; that is, from I to A, or from O to E. The two proposi-

tions are either both affirmative or both negative, their subjects and their predicates are the same, the only change being that the "some" of the premise becomes the "all" of the conclusion. The mere inductive step is seen to be very simple, but its sweep takes in the universe, and must be carefully guarded. For an inductive conclusion to be true, it is necessary that (1) the premise be established by correct observation; (2) the conclusion includes cases beyond actual observation, else there is no induction; (3) the step be justified by some authoritative principle. This justification is found in the fact and the laws of causation, and we may define scientific induction as an immediate inference that a particular observed causal connection is universal.

Fuller discussion of causation will be found in the next section. The "observation" mentioned above means attention to what we see, hear, taste, or perceive through any of our senses, including the internal sense by means of which the mind perceives its own states while they are actually present. These "percepts" of the senses are what is meant by "experience;" they are often called "phenomena." The artificial arrangement of circumstances for purposes of observation, is called experimenting. This greatly enlarges the scope of observation, and furthers causal investigations.

The essential properties of things that we observe

in co-existence, those qualities without which things would not be what they are, but something else, these are permanent unchanging relations, and form the basis for the classifications described in Part I. Other co-existing phenomena, and especially successive phenomena, we observe also, and it is these "accidental" properties, or "changes," that form the basis of inductive thought.

Knowledge of essential, permanent qualities, therefore, is the basis of the classification of things into systems of genera and species; knowledge of their non-essential, changing qualities, is the basis of assigning things to their causes. When every body occupying space is properly classified in a system of genera and species, and every change occupying time is explained by reference to its cause, natural science will be complete.

31. **Causation.**— We know that changes are of constant occurrence. What we see, hear, touch, etc., is continually changing. We know that these changes are not brought about by our effort, we know by intellectual discernment that they must have a cause, and therefore we know that the law that every change has a cause, is not a mere law of mind, but is a real fact in the world of things external to mind.

"Every change has a cause." What, then, is a cause? Not a mere condition. A body can not move except in space and time, both conditions,

neither a cause of motion. So the ear is a condition of normal hearing, the eye of sight, yet neither one is the cause. Without the condition, the thing it conditions can not be; given the condition, it still may not be. Given the cause, the change must be. A condition is negative, in that its absence prevents; a cause is positive, in that its presence compels.

The cause is that which actually produces the change, or event. The cause includes all and only those forms and amounts of energy necessary to the change; the effect all and only those resulting from the change. We look at circumstances, material objects, forces, etc., without analysis, and we may select one which interests us, which is added last to those already present, or which attracts attention for any reason, and we call that one the cause. But a cause is usually not single or simple; many circumstances, antecedents, forces, or whatever name be given them, may contribute to the effect, which is likewise complex. We say, a bullet killed him, but another by his side may have been struck by a bullet, and live. The velocity, the spot hit, the condition of health, the strength of the constitution, the skill of the physician, are all circumstances that may and do enter into the total which we may correctly call the cause. Likewise the effect summed up as death, may also, when analyzed, be seen to include the laceration of certain tissues, the rupture of certain blood-vessels, the injury of a

nerve, the fracture of a bone; whence is seen the complexity of the effect also.

It is evidently a practical impossibility to state all the elements of a cause or an effect; but we can approximate closely enough for reasonable certainty.

32. **Uniformity.**— Not only has every change a cause, but we intuitively know that every like change has a like cause, and every like cause has a like effect. In other words, causes differing only in time and place have effects differing only in time and place, and effects differing only so have causes differing only so. This principle of "uniformity" needs no proof, can have none, is self-evident, and universally admitted to be true.

Because of imperfect observation or other reasons, we can not always distinguish causes that are actually unlike, or effects that are. It often seems that the same cause has different effects; for example, heat melts ice, bakes clay, contracts water, expands it, and so on. But the fact that we may not see any difference in the causes does not shake our belief that they are different; we are certain that they are. We speak, however, of such cases as if the same cause had unlike effects. We do this also in cases where we do distinguish differences in the cause. We say, for example, that a rose is beautiful, is red, is fragrant, thus affirming that the one cause, the rose, produces several distinct effects upon

me; but we know that what we call "the rose" is a number of causes, that its form, its reflection of light, its emission of particles which go into the nasal passages, etc., all are different causes having different effects.

The same is true of effects that we can not distinguish as unlike, and therefore speak of as if really like and yet due to unlike causes; and here again we so speak even of effects that we may be able to distinguish by analysis. For example, we say indigestion is due to kind of food, eyestrain, nerve fatigue, grief, etc.; so also of headache, death, motion. Closer analysis would show that when indigestion, for instance, occurs following different irritants, other effects due to their difference, are also present, while the cause of the indigestion alone, if ascertained, will be found to be the same. So in every case where apparently like effects follow unlike causes.

There is then no defect in the laws of uniformity, no exception to them, apparent exceptions being due to our imperfect observation.

CHAPTER IX

THE CAUSAL BASIS FOR INDUCTION

33. **Induction Based on Assumed Causal Connection.**— It is evident that induction itself is extremely simple, and needs few rules, and no elaborate explanation. It is an immediate inference fully warranted by the laws of causation and uniformity. But, to have scientific value, to attain real truth, it must be an inference from "an observed causal connection," as stated at the close of the first paragraph of Section 30. The establishment of causal connection, the basis for scientific induction, is therefore of great importance, for it is only because of this causal fact that we are authorized to make the inductive "leap" from some to all. Deferring consideration of the ways of proving causal connection to the next section, let us here examine two familiar uses of induction, which do not rest on this scientific basis.

33 a. **Enumeration of Cases.**— It is a familiar and accepted fact of mind that when experiences have occurred together, and one recurs, the others tend to recur with it; and because this suggestion of mental states by others originally associated

with them, is so common and familiar, not only do we usually expect this connection in memory, but in the external world. When outside facts, things, forces, impress themselves strongly and frequently upon our minds, and when later one of these associated impressions recurs, we expect the others to recur with it, not merely in memory, but as actual new impressions due to renewed action of the external cause upon us.

The more frequently, therefore, we receive impressions together, the more confidently will we expect the recurrence of one to be attended by the others. The basis of this expectation is, however, as indicated above, not a scientifically established causal connection, but merely psychological, a transfer of the psychological law of suggestion from the inner mental sphere, where it does operate, to the outer material sphere, where it holds no sway. The fact, however, that cause and effect are always found together, justifies at least a supposition that two concurrent impressions may represent a causal connection, though not the belief that they certainly do. This method of multiplying cases of concurrent phenomena, therefore, is valuable in suggesting causal connections among circumstances constantly present, and in furnishing occasions for testing such connections by the methods of Section 34. It is valuable, also, for the many cases in everyday life, where scientific

analysis is impracticable, or not warranted because of the trivial nature of the circumstances to be explained.

Very many of our proverbial sayings, superstitions, and popular rules are inductions based on mere count of cases. They are often incorrect, the cases being too few in number to indicate even plausible connection, or the exceptions when only one of the supposedly connected circumstances occurs, being passed over without notice; e. g., all crows are black, all malaria yields to quinine, all men have their price.

33 b. **Analogy.**— The enumeration may be of concurrent qualities in two cases, instead of pairs of qualities, or marks, in many cases. The two methods are often equally available. From similarity of elevation, latitude, proximity to the sea and to the mountains, we might infer by the method of analogy that one place would have a season like the other. From likeness in appearance, odor, juiciness, consistency of two fruits, we might by analogy infer likeness in another quality, taste. Yet the two might be plum and persimmon. Mere analogy is never proof. It often suggests lines of investigation leading to proof.

Enumeration and analogy may be described respectively as follows: if many cases have two common characteristics, then other cases having one of these two, will probably have the other also; and,

secondly, if two cases have many common characteristics then other characteristics in the one will probably be found in the other. As the "other" characteristics in the inference may be any other, it is equivalent to all others. This, taken strictly, would mean absolute identity, so the expression can not be strictly construed, but is to be considered as merely suggestive.

It is evident that these two modes of induction have no warrant except in the assumption that there is causal connection between the concurring circumstances or characteristics. This connection being assumed, and not proven, the induction is therefore very hazardous, and should be so held, until by some scientific method the assumed causal connection is shown to be real.

33 c. **Probability.**— Such inductions as result from enumeration or analogy are, then, not certain, but only more or less probable. This probability reaches a high degree in cases of phenomena concurring frequently and without exception through a long period. That day and night will continue to follow each other is highly probable, though not certain; so also are changes in the tides, prevailing winds, average weather for different seasons, racial characteristics, revolutions under oppression.

The mathematical doctrine of probability is of service here. By it the "chance," or probability of concurrence of phenomena, without causal connec-

tion, may be estimated; then, if two phenomena occur together either more or less often than chance would explain, they are probably causally connected. If, for example, one bag contains five balls, three of them white, the probability of drawing a white ball is 3-5; if another bag contains seven balls, four of them white, the probability of drawing a white ball from it is 4-7. The probability of drawing two white balls in succession, one from each bag, is 3-5 x 4-7, or 12-35.

If, again, in a certain place, the average frequency of rainy days for many years has been one in three, while the average frequency of east winds has been one in four, then the probability of rain and east wind coming on the same day, without causal connection, is 1-3 x 1-4, or 1-12. If, then, rain and east wind concur on the average more than one day in twelve, the probability is they are causally connected; if less than one day in twelve, that there is counteraction; if just about one in twelve, that there is no causal bond.

In this way we can set aside phenomena probably not causally affecting our investigation, thus narrowing the field of observation of possible causes and effects.

When a real exception occurs, the claim of reality having been very carefully scrutinized, then we must give up our universal, and be content with "many" or "most" or "nearly all."

Statistics covering a great number and variety of cases, as the census, mortality tables, etc., are valuable instances of enumerative probability, forming bases for induction as to the future of population, crops, term of life, etc., thus giving us rules from which we deduce conclusions as to particular periods, or individuals, or groups.

34. **Methods of Proving and Estimating Causal Connection.**— The words, "change," "event," "circumstance," "phenomenon" are used as practical equivalents. A "case," or "instance" is a group of circumstances, including the phenomenon under investigation, or associated with it in some way.

Cause and effect always being found together, the presence of either necessitating the presence of the other, it follows:

(1) If two instances agree in every circumstance but two, these two are cause and effect.

(2) If instances agree in only two circumstances, these two are cause and effect.

(3) If two circumstances always vary together, they are either cause and effect, or effects of a common cause.

(4) If some instances agree only in the presence of two circumstances, while others agree only in their absence, these two are cause and effect.

These methods are discussed in the following sections. Their purpose is to solve the problem:

given a cause, to find its effect; or, given an effect, to find its cause.

34 a. **The Method of Difference.**—"If two instances agree in every circumstance but two, these two are cause and effect." The use of this principle to prove causal connection is called the "method of difference," because the two instances differ only in the presence of the cause and the effect, being alike in every other particular except, of course, time and place. If, then, the phenomenon under investigation, frost, let us say, be present with a number of other circumstances such as clear sky, still air, temperature freezing, dew-point below freezing; while on another occasion, all the circumstances being the same as above, except that the temperature, for example, is above freezing everywhere, and there is no frost; then we conclude that frost and temperature are causally connected. So we might reach a similar conclusion if the second instance differed from the first only in the absence of frost and the presence of high wind, or in cloudy sky and no frost.

Or, if a cause be given to find its effect, as for example the effect of benzoate of soda, as a food preservative, upon health, two men as much alike as possible in every way likely to influence the result, might be kept under the same conditions of diet, exercise, and general hygiene, one being given food with the benzoate, the other the same food

without the benzoate. Should the former show signs of injury to health, and the other not, the conclusion would be that benzoate of soda is the cause.

A room in a locality where there was much yellow fever was divided by a partition of fine wire screen. On one side the bedding and clothes of yellow fever patients who had died, soiled with the foul evidences of the dread disease, were used. On the other side of the screen partition everything was fresh and clean, but some mosquitoes which had bitten yellow fever patients, were introduced. Cases of fever developed on the clean side, where the mosquitoes were; none on the foul side where no mosquitoes were. The presence on one side of the mosquitoes and the fever, and the absence on the other side of only these two circumstances, give an almost ideal instance of the method. The addition of the foul bedding on the side where no fever developed, could not prevent the fever, so that the cogency of the method is not affected; and as no fever followed the use of the contaminated bedding, the presumption is that it is not a cause of the fever.

When Stanley observed in Africa that those of his party who slept under netting to avoid the annoyance of the mosquitoes, did not have malaria, while others not so protected did, he concluded rightly by the method of difference that the netting

had something to do with the freedom from malaria. He supposed, however, that the netting strained the "miasma" out of the air; we now know it kept the malaria-charged mosquitoes from introducing the germs of the disease by their bite.

34 b. **The Method of Agreement.**—"If instances agree in only two circumstances, these two are cause and effect." This principle gives us the "method of agreement." If the phenomenon under investigation, as, for example, indigestion, occurs after dinner for a number of days, some warm, some mild, some cool, the dinner being varied more or less every day, and it is found that the only article of food eaten every day was cabbage, that would be indicated as the cause of the indigestion. It would then be in order to apply the method of difference, not eat the cabbage, and the indigestion not recurring, we should have proof.

But why should we not be content with the evidence of the method of agreement alone? Not because of any defect in theory, but because in practice we can not be sure of having observed all the circumstances that are present and may cause the phenomenon. In the example above, there might be appendicitis, only now become acute, or nervous disorder, or some other circumstance not easily observable; and if the indigestion persists after the cabbage is eliminated, the case must be examined more closely for other circumstances.

The method, therefore, while valuable for its suggestiveness, and often affording practical certainty, yet because we can not always eliminate all but two circumstances in a series of cases, or because we can not always distinguish effects that are actually unlike and therefore due to unlike causes, because, in short, our powers of arrangement, observation, and analysis are not always adequate, is often uncertain in its results.

The greater the number of instances of agreement, the greater is the probability of causal connection, for in a series of many cases the likelihood that an exception will occur is greater, if the two circumstances which have many times concurred are not really cause and effect. If all but a few circumstances have been eliminated in the series of instances examined, experimenting with these in turn may show which is the cause of the effect investigated.

The method goes further than simple enumeration, for it calls for the ultimate exclusion of all but two circumstances, the cause and effect, in the course of the series of cases observed; while enumeration takes note merely of the fact that two circumstances occur together, disregarding the equally significant fact of the presence of others which might be connected with these two by a causal bond.

The method is useful in the many cases where

it is not possible to eliminate the two circumstances, as required by the method of difference, and as has been shown above may finally suggest a way of using that more conclusive method, which is always to be desired.

34 c. **The Method of Variations.**— This is not a different method of establishing causality, but an application of either of the preceding methods to the change in quantity, degree, or intensity of circumstances, instead of the change in presence or absence of the circumstance as a whole.

"If two circumstances always vary together, they are either cause and effect, or effects of a common cause." It often happens that we can in a series of cases eliminate neither the two circumstances which are causally connected, so as to apply the method of difference, nor yet all other circumstances but these two so as to use the method of agreement. In many such cases it happens that the circumstances vary in intensity, or degree; and so, substituting for the circumstance as a whole, its quantity, or degree, substituting for its presence, the amount of its energy, we take this amount for a new circumstance, and proceed by the methods of agreement or difference.

If two circumstances appear in one instance, and in a second also these two appear, each with a different intensity from that of the first instance, no others being changed, then the method of differ-

ence warrants the conclusion of causal connection between the two.

Or if, while several quantities vary in some of a number of instances, yet only two vary in all of these instances, the method of agreement points to causal connection between these two varying quantities.

The method is usually and more conveniently treated as a distinct method, and is called "the method of variations."

When two bodies are rubbed together, and the force exerted is exactly measured, it is found that the heat generated by the friction is exactly in proportion to the force used in rubbing, whence causal connection is inferred.

The tides vary as the position of the moon relative to the earth changes; the mercury rises or falls in the thermometer as the heat of the atmosphere increases or diminishes; if crime be shown to increase or diminish with poverty, causality may be argued; so if earning power increases with school period.

The method of variations is also of great value in determining quantitative relations, the mathematical laws of causes already discovered by other methods. In this way the ratio of causal energy to the energy of the effect is estimated. Care must be taken that there is not some new cause operating beyond the limits observed. It takes a certain

amount of fuel to increase the speed of a steamer one mile per hour, but the additional amount differs according to the amount already attained. It takes more to fatten pork from 200 to 300 pounds, than from 100 to 200. Water contracts with loss of heat as a rule, but expands from 39 to 32 degrees.

34 d. **The Joint Method of Agreement and Difference.**—" If some instances agree only in the presence of two circumstances, while others agree only in their absence, these two are cause and effect." The first clause of this canon is evidently the method of agreement exactly, and causal connection is thereby indicated. For the " others " to add force to the series of instances of this first clause, the circumstances in these " others " should be as much like those in the former series as possible. Were the circumstances in any one instance of the latter series exactly like those in any one of the former series, except for the absence of two that were in the former case, the conditions of the method of difference would be fulfilled, and further instances would be unnecessary. Hence the name of the method above.

But the supposition is that the requirements of the method of difference are not fulfilled, that there are only many points of similarity between the second series of instances and the first, and that while any two or more of these latter cases may agree in

several ways, yet there is nothing common to all of them save the absence of the two circumstances concurring throughout the former series; that is, the second set agree in the absence of the two. The method is therefore called by some, the method of double agreement.

The places in which the famous Albemarle pippin reaches its highest excellence of beauty, flavor, and soundness, agree in elevation, soil, and climate. The same apple has been grown in many other places like the former in many ways, yet not all agreeing in any one particular except in differing considerably from the former places in elevation, soil, or climate; in these latter places the superior excellence of the fruit is notably absent.

In case of merely frequent, not invariable, presence or absence together of two circumstances, there may be causal connection, some unobserved third circumstance being part of the cause or the effect, or operating to counteract the cause; because of its omission, if part of the whole cause, the effect will not appear, even though the other causal circumstance be present; because of its presence, if counteractive, the cause will not produce the effect. Sir John Herschel, for example, is said to have thought that the full moon tends to clear the sky of clouds, because of the warmth radiated from its surface. If this be true, the reason some nights of full moon are not clear would be found

in the presence of some counteracting cause, or in the absence of some circumstance equally necessary to the production of the effect.

35. **Combination of Causes.**— It often happens that after certain parts of a complex effect have been assigned to their causes, a yet unexplained part remains. It is evident that this must be due to some other cause than those already ascertained and a more careful investigation may discover the hitherto unobserved element. This is commonly called the "method of residues," and proceeds according to the following obvious rule: Setting aside the known causes and their effects, any remaining circumstances of a complex case must include all other causes and effects in the case. This is so evident that the principle hardly deserves the name of a method; yet its frequent and great usefulness show its importance.

A stock example is the discovery of Neptune, whose position at a stated time was calculated as the explanation of a certain unexplained perturbation in the movements of Uranus.

The passage of an electric discharge through the air was observed to be attended by a peculiar odor, further investigation of which led to the discovery of ozone, a form of oxygen.

In the second place, in case of causes producing effects of the same kind, such as the velocity of the same body acted upon by several forces, the effect

may often be calculated before it is observed. To state it succinctly: From the laws of several causes acting together, their joint effect, if of the same kind, may be calculated. Given the velocity of a stream and of a boat in still water, the speed up and down stream is easily estimated; a very simple example. Because, however, of balancing forces, the practical use of the principle is often much more difficult than might be expected from its simplicity. The process has been called "the deductive method," the term including the induction leading to the laws of the causes, the deduction from these to the joint effect, and the testing, or verification of this deduction by actual observation.

36. **Hypothesis.**— When a phenomenon interests us for the first time, or in a new way, and we do not know its kind or its cause, we guess. An unusual sound in the house at night, a strange light in the sky, a curious pain, an unexpected coolness on the part of a friend, any circumstance not understood, and sufficient to arouse interest, is followed by an immediate effort of the imagination to explain it by assigning it to its class or its cause. The sound in the house is only a rat, the light must have been a meteor, the pain was a twinge of neuralgia, the coolness of the friend must have been because of a false report.

This tendency is natural, universal, and in trivial affairs, spontaneous. But it may also be de-

liberate, guided by intelligent volition, and of great scientific value. In things we deem unimportant, we are satisfied with a guess. In less trivial cases, we investigate, test, and seek to prove. The scientific use of the imagination in this connection, is to make suppositions regarding causation. A cause or its law may be assumed, or both; or an effect or its law; but the supposition that a certain cause will be followed by such and such an effect has no scientific significance, for the mere use of a cause to learn what effect it would produce, gives us the knowledge without the need of previous supposition. If, however, we are investigating a certain effect, we must suppose some definite cause or other may produce it, or we can not make any progress toward learning the cause, unless it happen to fall under our observation. The use of a cause to see whether it will produce a certain effect implies that we have made the supposition that it may; for if we are sure it will not, we will not try it. A scientific hypothesis, therefore, assumes a cause for a given effect, or a law for a given cause, or a law for a given effect.

Lying in the mind close to the bed-rock principle that every event has a cause, is the tendency to ask and seek answer to the question, what is the cause of this event which interests me? In observing a mere series of cases as in enumeration in Section 33 **a**, we reject some circumstances, on the

hypothesis that they are no part of the cause of the event we seek to explain; and we select others on the hypothesis that they are the cause. In analogy, as described in Section 33 b, we suppose some cause explains the similarity of qualities in the two cases. Especially when we experiment, as for example, in the method of difference, do we make hypothesis that the omission of a certain circumstance will be attended by the disappearance of the phenomenon; and we omit this circumstance. In fact, we can make no progress without the aid of this faculty, imagination, in framing hypotheses.

Despite the legal maxim that the accused is supposed to be innocent until proven guilty, no trial can proceed in seriousness unless the guilt of the accused be supposed at least possible; this much it is the function of the grand jury to decide, and this is the logical significance of the indictment, that the hypothesis of guilt is possible.

Many hypotheses were made and cast aside before astronomy became heliocentric. Many and varied speculations as to the structure of matter preceded the atomic hypothesis, so long and so usefully held, but even now apparently yielding to the pressure of advancing knowledge. If we count dead hypotheses, the science of medicine has buried more than double as many as even a comic paper would insinuate.

The multitude of these discarded relics of prog-

ress suggests the question, asked sometimes in scorn, yet a rightful question: of what value are hypotheses, if so many have proven untrue? The answer has already been suggested above. Hypotheses are the stepping-stones of science, and if now and then one is overturned, or proves too slippery for foothold, or is merely left behind for another in advance, surely here is found argument against neither stepping-stone nor hypothesis. How, then, may true hypotheses be known from false? The answer to this question will be found in the next two sections.

37. **Verification.**— The test known as "verification" is so often thought to establish the truth of an hypothesis, that it should be said at the outset that verification is never proof of the truth of a general hypothesis, but is often proof of its falsity; or it merely leaves the possibility of truth untouched or even strengthened by the fact that a test which might have proven falsity, did not. The value of the process is therefore purely negative, as will appear in the following discussion.

When, as in Section 35, from the known inductive laws of certain causes, we deduce their joint effect, and then by observation with or without experiment we test our deductive conclusion by comparison with the actual case, the process, often called "the deductive method," either "verifies" the conclusion or proves it false. The important point is that

it is the deductive conclusion, the particular fact, that is verified or not, and not the inductive premise, the general proposition. We know from the laws of the syllogism that if the conclusion be false, a premise is false; while if the conclusion be true, nothing follows as to the truth of the premises.

So in the use of hypotheses, when we seek to find, not as above, the effect, but the cause of a phenomenon, the steps in the procedure are the same, the nature of the "verification" the same, and the bearing upon truth or falsity the same. The difference is that instead of having for premise the known inductive laws of causes, we make hypothesis of a cause or its law, deduce from that our conclusion, and test it by observation with or without experiment as in the other case.

The significance of the result is the same. If the observed facts agree with the deductive conclusion, that conclusion is "verified," but we know that the truth of the premise, our hypothesis, does not follow. So the verification is of the single fact, not of the hypothesis. However, repeated deductions from an hypothesis, verified without exception by observation, have a strong tendency to foster belief in its truth; and we must guard against the acceptance of this negative confirmation as proof; it is merely lack of evidence of falsity; it affords presumption of truth, not proof.

On the other hand, if a conclusion correctly de-

duced from an hypothesis, is by observation found contrary to the fact, the hypothesis must be given up; for the falsity of a conclusion does involve the falsity of the premise.

The Ptolemaic hypothesis that the earth is the center around which sun, moon, and planets revolve, was discarded because the consequences deduced from it were not in accord with the facts.

The deduction that, on the hypothesis of the identity of lightning and terrestrial electricity, a spark could be gotten from a kite-string, was verified by Franklin's experiment.

The hypothesis that sound is conveyed by vibratory motion of the air has led to many deductions verified by observation, one of the most striking being the photographic shadow caused by the condensation of air particles in front of the advancing sound wave.

The old hypothesis that nature abhors a vacuum, offered to explain the rise of water in a pump, was overthrown by the fact that the water would not rise beyond a definite height.

Verifications, then, may overthrow an hypothesis, or they may either establish or overthrow a deduction from an hypothesis. They are not proof, yet many accept them as proof. What, then, is proof?

38. **Proof.**— As intimated in Section 34 b, strict proof of causal relation is found only by the

method of difference. However strong may be the presumption of truth, however great our confidence that we have found the truth, yet there is no strict logical proof of causal relation short of exact fulfillment of the rigid requirements of the method of difference. So must it be in the case of an hypothesis, just as in any other case of causation. First, the hypothesis must be shown to explain all the facts; that is, the cause we assume must be found producing all the effects of the kind, deduced from the hypothesis and tested by verification; which corresponds to the first set of circumstances of the method of difference. Secondly, it must be shown that no other hypothesis can explain the facts; that when the assumed cause is absent, the effects will not be found; or that other hypotheses lead to conclusions contrary to facts.

In the example of Section 34 a, for instance, the hypothesis was made that a mosquito which had bitten a yellow fever patient might convey the disease. The experiment showed the hypothesis explained the fact, and the freedom from fever on the other side of the screen, where a rival hypothesis, the contagion of foul bedding, was tried, proved that no other plausible hypothesis would explain the conveyance of the fever. This was proof, and therefore the surgeon-general of the United States Army gave orders that the only special precaution

to be taken in cases of yellow fever thereafter should be the screening of patients so that mosquitoes could not bite them.

When the circumstances of a crime are such that they can be explained only by the guilt of a certain person, he is properly convicted on "circumstantial" evidence. The prosecution will try to prove that no other hypothesis will explain the crime; the defense that some other will. If the defense fail to establish some other tenable hypothesis, or of course, some irreconcilable fact such as an alibi, the hypothesis of guilt prevails, and rightly.

The radical change in the lives of many after profession of Christian faith can be explained only on the hypothesis of a radical change in their nature, and such cases afford logical proof of the vital power of Christianity.

CHAPTER X

RESULTS OF INDUCTION

39. **Discovery.**— Any true induction may lead to the discovery of new facts; for the sweep of the inductive universal includes unobserved cases of the operation of the cause in question; and we may use the induction as a major premise from which to draw a deductive conclusion of some less general truth or some particular fact. Thus we are able to predict that observation will confirm our conclusion; that a fact hitherto unknown will be found true. This is evidently like the process described in Section 35 under the head of "combination of causes," and also that used in verifying hypotheses in Section 37. All these are only instances of deduction from general premises.

In this way the astronomer predicts eclipses, the return of a comet, the position of a new planet; the chemist from his inductive law of progressive qualities predicts new elements; the economist from inductions regarding demand and supply predicts changes in the market, panics, prosperity; the geologist foretells future conditions of river-beds, mountains, plains, valleys, and coasts.

40. **Law.**—A law is the statement of a uniformity. The sources of knowledge being two, as in Section 29, laws are of two kinds: intuitive, discerned by the intellect; inductive, based on observation by the senses. Intuitively discerned law, such as the axioms of mathematics and of logic, being known originally in the form of universal propositions, are thus the source of many subordinate laws derived from them by deduction. Hence they are called "primary laws." Inductively attained law, such as the laws of sound and of heat, being based originally on particular facts, may thus be explained by higher and wider laws, until final explanation is attained in universal laws beyond which the human mind can not reach. These wide inductive universals, because they stand last in the order of attainment are called "ultimate" laws. Though we may be sure there are ultimate laws, we may not be sure whether laws we have reached are those of widest scope, whether they may not be included in some other still wider. It would seem hardly possible to go further than Newton's Laws of Motion. The Law of Gravitation is another notable example of law that so far as we know, is ultimate.

41. **Natural Law.**— Inductive laws depend upon and are formed in accordance with intuitive principles; all concrete knowledge is cast in these abstract forms. Even the axioms of pure mathematics may be applied to definite numbers of con-

crete things; the laws of pure logic are useful only when operative in actual thoughts; the formal principles of ethics do not guide conduct unless effective in the real act; the intuitive laws of causation are of practical value only when connected with particular causes.

Thus, the axioms of uniformity of Section 32 are intuitive, pure, formal, without content; but when applied to the actual causes and effects of nature, the resulting uniformities of concrete cases of causation are natural laws. Natural law is expressive of the uniformities in the sphere of causation, and is logically opposite to moral law, which is expressive of the uniformities in the sphere of freedom; natural law declares what is in nature, moral law commands what ought to be in conduct. Moral law is obeyed or violated; natural law is neither obeyed nor violated. When a rock is thrown upward from the earth, the law of gravitation is not violated, but a new cause, the energy of the muscles, is put into operation according to its own law.

A miracle is not a violation of law. The Maker of the Universe may use either a natural cause or law unknown to us to work what we call a miracle, or He may employ His creative power, itself the cause of all causes.

The question of the possibility of resolving all natural law into a single ultimate law, has been much discussed. Whether or not we shall ever

bridge the chasm between present multiplicity and such a unity, may be doubted, but that there is such unity we may be sure; for, "In the beginning God created the heavens and the earth."

42. **Science.**— The intuitive principles of space and time, developed by deduction, give us the pure science of mathematics; those of thought and causation give logic, which is the pure framework of every science. Sciences of facts and causes, developed according to the intuitive principles controlling induction, but systematizing experiences, give us such empirical sciences as physics and chemistry. Sciences which have intuitive knowledge alone as their object-matter, are pure sciences; those which deal with sensuous knowledge, according to intuitive principles, to be sure, are empirical sciences.

Pure sciences are necessarily deductive, for they descend from the universal, directly known truths of intellect. Empirical sciences are at first inductive, and continue largely so, for they ascend from individual facts to general laws; yet no sooner is the first general law attained than the way is thereby opened for deductions from it to new subordinate laws or facts. As knowledge progresses, therefore, an inductive science becomes more and more deductive. Theoretically, when all the laws of an empirical science have been discovered, the science would cease to be inductive, and be deductive only;

but this theoretical case has not occurred, nor are we likely to reach it. Astronomy, however, for instance, has been developed largely by deductions from the laws of gravitation and motion. There are, therefore, no sciences that are always wholly inductive.

The systematic arrangement in their proper relation of all things knowable — principles, causes, laws, and classes, is the goal of science.

INDEX

Reference to Pages

Deacidified using the Bookkeeper proces
Neutralizing agent: Magnesium Oxide
Treatment Date: Sept. 2004

PreservationTechnologie
A WORLD LEADER IN PAPER PRESERVATIO
111 Thomson Park Drive
Cranberry Township, PA 16066
(724) 779-2111

LIBRARY OF CONGRESS
0 013 123 198 2