PALAESTRA OXONIENSIS

?ALAESTRA LOGICA

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PART III.

PART I.

CHAPTER I.

MEANING AND PARTS OF LOGIC.

Logic is the science of argument, i. e. of 1 inference and proof.

People are constantly arguing: i. e. drawing conclusions, or trying to prove or disprove statements. Arguments are of different types, and fall into different classes, somewhat as plants or animals do. Logic classifies arguments; provides cut-and-dried forms into which arguments will go; and shows why some forms of argument are sound and some are not.

Logic is also the art of correct argument. 2

'A science teaches us to know,' i. e. tells us facts and causes, 'An art teaches us to do,' i. e. gives us rules. Logic is an art as well as a science, because it gives rules for reasoning in correct form and for avoiding incorrect reasoning.

> Logic is not, however, a science in the same sense as chemistry or astronomy, or an art in the same sense as the art of navigation or 'politics, much less a fine art like painting. It is only a science or an art as the grammar of one's own language is.

Inference is the passing of the mind from one (or 3 more than one) judgment, or proposition [§§ 26, 295], to another.

There are two main kinds of inference—Deduction and Induction [1].

Deduction is arguing from a more general truth to a less general truth ('from generals to particulars').

Induction is arguing from a less general truth to a more general truth ('from particulars to generals').

> 'It can't be right to give money to people whom you know nothing about; so it can't be right to give money to street-beggars' is a deductive argument.
>
> 'I have given money to different street-beggars seven or eight times, and it never did them any good; therefore giving money in the streets is not likely to do good,' is an inductive argument.

4   The chief, though not the only, object of Deductive Logic, is to put all possible deductive arguments into a certain cut-and-dried form called 'the Syllogism.' The supposed advantage of doing so, besides clearness, is that when you have got an argument into a syllogistic form, you can see at once, by applying certain rules, whether it is correct or not.

The deductive argument in § 3 will run thus in a syllogistic form :—

> All giving to quite unknown people | is | wrong;
>
> All giving to street-beggars | is | giving to quite unknown people ;
>
> ∴All giving to street-beggars is wrong.

Each of the three sentences in this syllogism is called a *proposition.*

'*Giving to quite unknown people*' is called a *term* ; so is '*wrong*' and so is '*giving to street beggars.*'

5   **Deductive Logic treats—**(1) **Of Terms.**
                   (2) **Of Propositions.**
                   (3) **Of Syllogisms.**

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[1] For 'Traduction,' see § 316.

CHAPTER II.

TERMS.

A Term is a word or set of words which can be 6
used as the name of anything (term = name): e. g.
horse, the House of Commons. The word 'term' (ter-
minus) means that a term is the boundary or end of
a proposition [see §§ 26, 27].

> The first thing we have to do is to distinguish words
> which are not terms from words which are.

A categorematic word is one which can stand 7
by itself as a term: e. g. horse.

A syncategorematic word[1] is one which can-
not stand by itself as a term, but must have other words
with it to make it a complete term: e. g. which, of, and.

> There are a number of distinctions between different 8
> kinds of terms, familiar to us all in practice, which are worth
> knowing because they enable us, in discussions which turn
> upon the meaning of words, to express ourselves shortly.
> 'When you talk about Humanity with a capital H, do you
> mean mankind at large or men's good and bad qualities?'
> '"Anarchy" is generally supposed to mean universal plunder
> and cutting of throats, but in itself it only means not being
> ordered about.' Such ambiguities of language are simplified
> by saying that mankind is a *concrete* and humanity an *abstract*
> term; and that 'anarchy' may be used in a *negative* or
> a *privative* sense.

Kinds of Terms.   9

The four most important divisions of terms are into—

Abstract and Concrete. ·

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[1] σύν, with; κατηγορεῖν, to predicate. There is no such thing as
a 'syncategorematic *term.*'

Singular and **General** (or **Common**). Either a singular or a general term may also be **Collective.**

Positive, Negative and **Privative.**

Absolute and Relative.

10 **A concrete term** is the name of a thing or person : e. g. ' man,' ' square.'

An abstract term is the name of a quality of a thing or person : e. g. ' humanity,' 'squareness.'

An attributive is the logical name for adjectives and participles : e. g. 'blue,' ' running.' *Attributives are usually concrete, not abstract,* because they are usually applied to persons and things, not to qualities : e. g. 'a blue flag,' 'a running deer.'

> N.B.—It is often hard to say whether a term is concrete or abstract. What are we to say about names of *events*, e. g. 'war,' ' battle,' ' dance ' ? An event is neither a thing nor a quality. It is more convenient for the purposes of logic to call such terms concrete, because they are general and ' connotative,' whereas abstract terms are usually treated as singular (§ 14 init.) and non-connotative (§ 23, *b*).

11 **A singular term** is the name of only one person or thing : e. g. ' John' (meaning one particular ' John '), ' the present Prime Minister.'

A common or general term is the name of any one of a number of persons or things *taken separately* : e. g. ' soldier.'

A collective term is the name of a number of persons or things *taken all together* : e. g. ' regiment.'

> A collective term may be singular (e. g. 'the present Privy Council ') or general (e. g. ' army ').

12 **Positive terms** denote the presence of a quality : e. g. ' seeing,' ' visible.'

Negative terms denote the absence of a quality : e. g. ' without sight,' ' invisible.'

Privative terms denote the absence of a quality which might have been expected to be present: e. g. 'blind,' 'vanished.'

Relative terms are those which cannot be under- **13** stood without reference to certain other terms: e g. 'parent' (child), 'teacher' (pupil).

Absolute terms are those which can be understood without reference to a corresponding term : e. g. 'iron,' 'trap.'

Correlative terms are pairs of relative terms.

'Classifying' a given term means applying these four **14** distinctions to it. Suppose you are asked to 'classify' *library*, etc. N.B.—Give a reason for your answer if there is any doubt about it.

Library is *concrete, general* (with regard to all libraries, but *collective* with regard to books), *positive, absolute.*

Application is *abstract, singular* (because it is the name of one quality), *positive, absolute..*

Heavy is *concrete* (because it is an adjective), *general, positive, relative* (to light).

Anarchy is *abstract, singular, negative* or *privative* in form, but really *positive,* because it denotes the presence of certain bad qualities, *relative* (to 'order' or the like [1]).

Refreshment is *abstract* (when it means 'the quality of being refreshed') and *singular* (but *concrete* and *general* when we talk of 'refreshments,' meaning buns, &c.), *positive, absolute.*

Caesar is *concrete, singular* (when used, e. g., of 'Julius Caesar'), or *general* (when used as a title borne by many), *positive, absolute (not* 'relative to Pompey ').

The laity is *concrete, singular* and *collective, positive, relative* to 'the clergy.'

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[1] If, that is, 'relative' be taken in a wider sense to include 'contrary' (§ 15); not in the same strict sense as the instances of correlatives in § 13, which imply a 'series of facts' on which the correlatives are based.

Debtor is *concrete, general, positive, relative* (to creditor).

School is *concrete, general* (in reference to all schools), *collective* (in reference to individual scholars), *positive, absolute.*

Ancestors is *concrete, general* ('our present King's ancestors' would be *collective*), *relative* (to descendants).

Snow is *concrete, collective, singular* (when used as the name of a substance, though resembling a general term), *positive, absolute.*

Other distinctions are—

15 Contrary and **contradictory** terms:

> The **contrary** of a term denotes the quality most opposed to it of the same kind: e. g. the contrary of *white* is *black.*

> The **contradictory** of a term is formed by adding *not* to it, or taking *not* from it. The contradictory of *white* is *not-white,* the contradictory of *not-white* is *white.*

> N.B.—Contrary terms do not include everything between them: many things are neither black nor white. Contradictory terms include everything between them: everything is either white or not-white [§§ 84, 85].

16 Univocal, equivocal, and **analogous** words[1]:

> A word is **univocal** when it is always used in the same sense: e. g. *bright,* used for a quality of light.

> A word is **equivocal** when it is used in different senses: e. g. *bright* of a light, and *Bright* as a proper name: *rent* for a tear in a coat, and for a landlord's income.

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[1] *Words,* not *terms;* because an equivocal word is not one *term* but more than one.

An equivocal word is also called **analogous** when it is used, not (as in the instances above) *in different senses having no connection between them,* but in two *different* but *connected* senses : e. g. a *bright* light or a *bright* idea : a *rent* in a coat or in a political party.

A noun of the first intention is a term in com- 17 mon use : as 'man,' 'animal.'

A noun of the second intention is a technical logical term : e. g. 'term,' 'proposition.'

CHAPTER III.

DENOTATION AND CONNOTATION.

18   Every concrete general name has two different kinds of meaning. 'Dog,' for instance, means all dogs: terriers, bloodhounds, &c., &c.   But it also means the attributes which these dogs all possess, and the possession of which makes us call them dogs.   In this sense 'dog' means a domestic animal which barks[1].

The former of these two meanings is called the denotation of the term 'dog,' the latter is called its connotation.

19   Thus the **denotation** of a term is *the things to which the term is applied:* e. g. 'republic' denotes France, the United States, ancient Athens, and all other republics.

The **connotation** of a term is *the attributes which the term implies*: e. g. 'republic' connotes 'the legal possession of ultimate power by the people.'

Extension is another word for denotation.

Intension is another word for connotation.

20   **Denotation and connotation vary inversely.**

The more denotation a term has, the less connotation it has, and vice versa.

Take a series of classes, each including the next under it : e. g.—

<div align="center">

Animal,
Quadruped,
Cat,
Persian cat.

</div>

[1] Observe that (*a*) the connotation of 'dog' does not include all the qualities of all particular dogs, (*b*) the connotation of a term may be different for different purposes.   To a zoologist, 'dog' would connote quite another set of qualities, not 'domestic' and 'barking.'   'Gold' connotes different qualities to a banker, a savage, and a chemist.

'Animal' denotes more than 'quadruped' because it applies to all animals which are quadrupeds and to a great many more besides. But 'quadruped' connotes more than 'animal,' because it implies all the attributes that 'animal' does, and also the attribute 'having four legs.' And so throughout; as we go down the list we have *fewer* things and *more* attributes.

So with flower, rose, moss-rose; building, house, villa, &c.

A **denotative** name is one which is applied to things. 21

A **connotative** name is one which implies attributes. 'Dog,' e. g. is both denotative and connotative.

A **non-connotative** name is one which does not connote or imply attributes: e. g. ' John Smith.' See § 23 (*a*).

> The distinction of denotation and connotation does not 22 really apply to singular or abstract terms. It may, however, be asked whether proper names and abstract terms have a connotation or not, and the simplest answer is this—

The only terms which may be said to have 23 no connotation are (*a*) **proper names** (where nobody in particular is called by them), (*b*) (most) **abstract terms.**

(*a*) Proper names, when they are not applied to anybody, imply no attributes and mean next to nothing. ' John ' may be the name of a dog, man, or horse.

But when proper names are used of particular people by those who know them, they connote more than any other name *because they denote less* [see § 20]. The name ' John,' to anyone who knows John, implies a great many attributes.

(*b*) Most abstract terms, e. g. 'squareness,' denote attributes and connote nothing [1].

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[1] Or we may say that 'their denotation and connotation coincide.'

They cannot have a denotation and a connotation too. If they denote attributes they can only connote attributes of these attributes: and in most cases 'attributes of attributes' means nothing at all. But a few abstract names have a connotation: viz. names of attributes such as 'virtue,' 'figure,' which are general, not singular terms. There are many virtues (courage, temperance, justice, &c.) and many qualities included under figure (roundness, squareness): and we may say that 'virtue' connotes 'conducing to true welfare': 'figure' 'being the boundary of a solid.'

24   Though *proper names* have not a connotation (when not applied to particular persons), *singular terms which are not proper names*, ' the reigning Czar of Russia,' ' the present Cabinet,' have more connotation than any other terms, like proper names applied to particular persons.

25   We can 'give the extension and intension' of terms thus—

Navvy denotes certain classes of workmen, and connotes 'being employed at rough work on the making or repair of roads, railways, and the like.'

Planet denotes Mercury, Venus, the Earth, Mars, &c., aud connotes 'moving round the sun in an elliptical orbit.'

Policeman denotes a number of individual officials, and connotes 'subordinate employment under the authority of the State for the preservation of civic order.'

Wheelbarrow denotes hand-barrows used in gardening, road making, traffic, &c., and connotes 'being a small uncovered means of transport, having one wheel, and worked by hand.'

CHAPTER IV.

PROPOSITIONS.

A proposition is a sentence which asserts or denies, **26** and therefore can be true or false.

Thus a proposition differs—

  (*a*) From a term ;

  (*b*) From sentences which are not propositions, such as exclamations and entreaties.

   (*a*) Terms like 'sun,' 'red,' are not true or false ; or (*b*) expressions like 'Oh!' or 'Please don't.'

   If I say 'What a red sun !' my exclamation *implies* a proposition : but is not in logical form until I state it as a regular proposition—The sun (*subject*) | is (*copula*) | red (*predicate*).

The *subject* of a proposition is the term of which some- **27** thing is asserted or denied.

The *predicate* of a proposition is the term which is asserted or denied of something.

The *copula* connects the subject and predicate, and consists of the words—*is, are, is not, are not.*

Universal propositions are about *the whole* of their **28** subjects : **Particular** propositions are about *part* of their subjects.

Affirmative propositions assert : **Negative** propo- **29** sitions deny.

The **quantity** of a proposition is universal or par- **30** ticular.

The **quality** of a proposition is affirmative or negative.

31 Thus, propositions are divided, according to quantity, into universal and particular; and, according to quality, into affirmative and negative; and we have:—

Universal Affirmatives, called A propositions.
Universal Negatives, „ E „
Particular Affirmatives, „ I „
Particular Negatives, „ O „

e.g. All men are animals. A.
No men are perfect. E.
Some men are wise. I.
Some men are not wise. O.

Statements of all kinds have to be reduced to one of these four forms before they can be dealt with by logic.

32 Singular propositions are those whose subject is a singular term: e.g. 'Socrates is a bad citizen,' 'Bismarck is not sentimental.'

They are practically universal (A or E), because they refer to the whole of their subjects. We might say, though it would be bad grammar, 'All Socrates is a bad citizen,' 'No Bismarck is sentimental.'

33 Indefinite propositions are those whose quantity is not expressed: e.g. 'Lions are carnivorous,' 'Cotton comes from Cyprus.' We must **quantify** them, i.e. add *all* or *some* to them, according to their meaning: 'All lions are carnivorous,' 'Some cotton comes from Cyprus.'

Infinite proposition = indefinite proposition.

34 Exclusive propositions contain the words 'only,' 'alone,' and the like: e.g. 'Only doctors know this.' This, in its simplest logical form, is 'No not-doctors know this' (E), or 'All who know this are doctors' (A).

35 Exceptive propositions contain the word 'except' or the like: e.g. 'All is lost *save* honour.'

This, in its simplest logical form, makes two propositions:— 'All not-honour is lost.' A.
'No honour is lost.' E.

A **pure** proposition is one which contains no expres- **36** sion of probability or certainty : e. g.

>Oxford will win the race.
>
>Two + two are four.

A **modal** proposition contains an expression of probability or certainty : e. g.

>Oxford will probably win the race.
>
>Two and two are necessarily four.

Modal propositions are sometimes defined as propositions which contain an expression of place, time, or manner (any adverb): e. g.

>Snow will fall *to-morrow.*
>
>John is rowing *fast.*

But this definition is not so strict as the other.

A **verbal** proposition is one which gives the connota- **37** tion or part of the connotation of the subject : e. g.

>All men are rational.
>
>All pigs are animals.

>Anyone who knew what 'man' or 'pig' meant would know that already.

A **real** proposition gives an attribute not contained in the connotation of the subject : e. g.

>All men are descended from ascidians.
>
>All pigs are omnivorous.

A **tautologous** or **identical** proposition is a kind of verbal proposition, and predicates the subject of itself : e. g. Facts are facts.

Such propositions often mean more than they say : e.g. 'Scotchmen are Scotchmen' means that they do not easily lose their national qualities : 'A man's a man for a' that' means that all men are really alike.

Explicative or **Essential** proposition is another name for Verbal proposition.

Ampliative or **Non-essential** proposition is another name for Real proposition.

38   *Exercises in reducing propositions to logical form.*

The predicate sometimes comes before the subject, or the copula is mixed up with the predicate or subject. *Ask yourself what words are really subject or predicate;* and mark them off by a line | from the copula. In other cases a proposition is particular, though it contains the word 'all': or negative in meaning, though not in form.

All M.P.'s are not geniuses.

    = Some M.P.'s | are not | geniuses (O).

N.B.—*This form of sentence* (All X is not Y) *must never be used in logic,* because it is ambiguous : it may mean either 'No X is Y' (E) or ' some X is not Y ' (O).

To be weak is to be miserable.

    = All weakness | is | misery,
    or All weak·| are | miserable (A).

Great is truth and will prevail.

    = Truth | is | great and sure to prevail (A, singular).

Eggs are good.

(This means more than 'some eggs are good,' and less than 'all eggs are good.')

    = 'All average eggs ' or ' all eggs *as* eggs | are | good things ' (A).

All is not gold that glitters.

    = All that glitters is not gold.
    = Some glittering things | are not | gold (O).

 When the cat's away the mice will play.

('When' means '*only* when': and the proverb is really negative in meaning.)

    = No mice will play before the cat : or, more strictly, No mice | are | things that will play before the cat (E).

No news is good news.

This is not an E proposition, but means—

    All (or *this*) absence of news | is | a sign that nothing
    bad has happened (A).

Most men are weak.

= not merely — Some men | are | weak (I) : but more than this : viz.

The majority of men | are | weak; a proposition more like A than I, but really neither[1].

There are Irishmen and Irishmen.

= Some Irishmen | are | unlike other Irishmen (I).

Honesty is certainly the best policy !

= That honesty is the best policy | is | certain (A).

Heads, I win !

= If heads turn up, I win.

= All cases of heads turning up are cases of my winning (A).

Few statesmen are bookworms.

= The statesmen who are bookworms are few (A, singular ?).

Or, ' Most statesmen | are not | bookworms' (E, singular ?)

Many troubles are blessings.

= Some troubles | are | blessings (I); and also—

Troubles which are blessings | are | many (A, singular ?).

Defeat means death.

= This defeat | is | sure to be fatal (A, singular).

Folk are such fools !

= The folly of many people | is | astonishing (A, singular).

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[1] The fact is that ' Most (few, many) A are B' cannot really be reduced to any of the forms A, E, I, or O.   Cp. instances below.

CHAPTER V.

DISTRIBUTION OF TERMS.

39 This is a very important part of technical logic, because the rules by which we test 'conversion' (chap. x.) and 'syllogisms' (Part II, chap. i.) depend on it.

A term is **distributed** when it is applied to all of a class.

It is **undistributed** when it is applied to some of a class.

40 The rules for the distribution of terms in propositions are :—

A propositions distribute subject, not predicate.
I   „   „   neither.
E   „   „   both.
O   „   „   predicate, not subject.

Distributed terms may be marked *long* (‾) : undistributed terms *short* (˘).

All $\bar{X}$ is $\breve{Y}$.

Some $\breve{X}$ is $\breve{Y}$.

No $\bar{X}$ is $\bar{Y}$.

Some $\breve{X}$ is not $\bar{Y}$.

These rules may be remembered by the word—
AsEbInOp.

A distributes subject (s).
E   „   both (b).
I   „   neither (n).
O   „   predicate (p).

N.B.—Distribution of Terms falls under the head of Propositions, not of Terms, because you cannot tell

whether a given term is distributed or not until you have put it into a proposition. Connotation and Denotation, on the other hand, fall under the head of Terms: because you can say what the connotation or denotation of a given term is without putting it into a proposition.

It is obvious that— 41

In universal propositions the subject is distributed.

In particular ,, ,, undistributed.

But it needs proof that— 42

In affirmative propositions the predicate is undistributed.

In negative propositions the predicate is distributed.

Proof that **affirmative propositions do not dis- 43 tribute the predicate.**

If I say 'All X is Y' or 'Some X is Y,' Y need not mean *all* Y. E. g. All men are animals.

Here 'animals' means 'some animals,' for there are other animals than men.

Some dogs are black.

'Black' means 'some black things,' for there are black things other than black dogs.

Proof that **negative propositions distribute the 44 predicate.**

If I say 'No X is Y,' or 'Some X is not Y,' Y means *any* Y. E. g. No dogs are cats.

Here 'cats' means 'any cats,' and dogs are excluded from the whole class 'cats.'

Some dogs are not terriers.

Here, 'terriers' means 'any terriers,' and some dogs are excluded from the whole class 'terriers.'

c

45   N.B.—In some cases the predicate of an A proposition may be distributed as a matter of fact. E. g. 'All men are rational animals': 'all equilateral triangles are equiangular.' We know of no rational animals but men: and there cannot be equiangular triangles which are not equilateral. But you cannot tell about this from the form of the proposition ; it depends upon other knowledge.

CHAPTER VI.

THE PREDICABLES.

We can predicate of a term like 'dog' various kinds of **46** attributes, more or less important. 'Dogs bark': this predicate is part of the meaning of 'dog.' 'Dogs are useful watchers:' this and other attributes follow from 'barking.' 'Some dogs have curly tails': this attribute is less important than the others. We want names for these different kinds of attributes: these names are the Predicables.

The **Predicables** or **Heads of Predicables** are **47** the different kinds of attributes which can be predicated of a given subject: they differ in their relation to the connotation of the subject.

The Predicables are Genus, Species, Difference, Property, Accident.

N.B.—The Predicables belong to the part of Logic which deals with the Proposition, not to that which deals with the Term: because you cannot tell which of the Predicables a given term is until you put it into a proposition. E.g. in 'All men are animals,' *animal* is *genus*; in 'Some black things are animals,' it is *separable accident.*

Genus is the attributes of a larger class when predi- **48** cated of a smaller class: e.g. men are *animals*, wheelwrights are *mechanics.* Animal, mechanic, is the *genus* of men, wheelwrights.

Species is the attributes of a smaller class which is **49** included in a larger class. *It can only be predicated of individuals:* e.g. Socrates is a man: John is a wheelwright.

50　Differentia is the attribute or set of attributes which distinguishes a species from other species of the same genus: e.g. Man is *rational:* a wheelwright is *a maker of wooden wheels.*

N.B.—Genus, species, difference, *belong to the connotation;* property and accident do not.

51　Property is an attribute which is not part of the connotation of a term, but follows from its connotation: e.g. *capacity for progress* is a property of man following from rationality; *use in navigation* is a property of the magnet, following from polarity.

52　Accident is an attribute which is not part of the connotation of a term, and does not follow from any part of its connotation.

Inseparable accidents (of *classes*) are those which belong to the whole class (though we know no reason why they should): e.g. *blackness,* of coal; *chewing the cud,* of horned animals.

Separable accidents (of *classes*) belong only to part of the class: e.g. *tallness,* of man.

Inseparable accidents (of *individuals*) always belong to them: e.g. *Athenian,* of Socrates.

Separable Accidents (of *individuals*) belong to them at some times, and not at others: e.g. Socrates is *silent.*

53　Technical Terms connected with the Predicables.

A **summum genus** is the largest class in any particular division of things: an **infima species** is the smallest, or one of the smallest: e.g. 'figure' is the summum genus in geometry: 'equilateral triangle' and 'scalene triangle' are infimae species; 'building' is the summum genus in architecture: 'modern French Gothic building' is an infima species.

Real kinds are classes of things divided from each 54
other by an indefinite number of differences: e. g. 'horse,'
'ape.' Classes which are not real kinds are only divided
by one difference and the consequences of that differ-
ence: e. g. 'Liberals' and 'Conservatives,' 'tables' and
'chairs.'

55

```
                        Thing
                          |
            ┌─────────────┴─────────────┐
         Living                       Lifeless
            |
     ┌──────┴──────┐
  Animal          Plant
     |
 ┌───┴───┐
Man    Brute
```
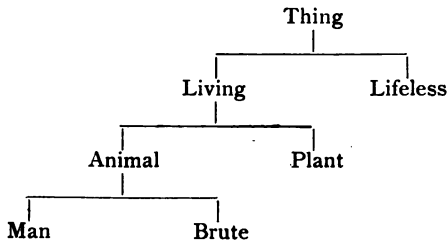
Proximate Genus is the genus next above a given 56
species: e.g. 'animal' (in the above table) is the proxi-
mate genus to man, not 'living thing.'

A **subaltern genus** or a **subaltern species** is 57
any class between the summum genus and the infimae
species: e.g. *animal* is a subaltern genus to *man*, and a
subaltern species to *living thing*.

Cognate species are species falling under the same 58
genus: e.g. *animal, plant,* falling under *living thing*.

Sui generis. Anything so peculiar as to form a 59
class by itself is 'sui generis': e.g. the rings of the
planet Saturn, or the unicorn of fable.

A **generic property** follows from the *genus* of a 60
given term: e.g. *liability to death* is a generic property
of 'man,' following from 'animal nature.'

A **specific property** follows from the *differentia*:
e.g. *capacity for progress* is a specific property of 'man,'
following from 'rationality.'

A **specific difference** means the same as the *differentia* of a given species.

61 A **peculiar property** belongs to one class only : e.g. 'capacity for progress' is a peculiar property of man ; 'use in navigation' is not a peculiar property of magnets, as many other things are useful in navigation.

62 **Give Predicables of 'money,'** &c.

Money is a commodity (*genus*), serving as a medium of exchange (*difference*). A *property* of money is 'object of general desire' A (separable) *accident* of money is 'being made of metal.'

A Conservative is a member of a political party (*genus*) which is anxious to avoid the dangers of social change (*difference*). A *property* is 'being unpopular with discontented classes.' An *accident* is 'being in favour of protection' or 'of free-trade,' 'led by Mr. Balfour.'

Logic is a science (*genus*) which deals with inference (*difference*). A *property* is 'difficult for beginners.' An *accident* is 'taught at Oxford.'

Planet is a celestial body (*genus*) moving round the sun in an ellipse (two *differences*). A *property* is 'subject to day and night.' An *accident* is 'attended by satellites.'

We need not give the *species*, for money, &c., are themselves species. N.B. *It is impossible to find inseparable accidents for all terms.*

Under what Heads of Predicables would you class the predicates of the following propositions, and why ?—

    (*a*) Some men are poets.

    (*b*) Triangles are three-sided figures.

    (*c*) Men can combine for joint action.

    (*d*) Some books are pernicious.

    (*e*) All material bodies have weight.

    (*f*) Gaul is France.

Answer :—

(*a*) *Species*, because the class poet is included in, and smaller than, the class man. In an A proposition, species can only be predicated of an individual, e. g., ' Shelley is a poet.'

(*b*) 'Figure' is part of the *genus* (plane figure); 'three-sided' is part of the *difference* (bounded by three straight lines).

(*c*) *Property*, following from the differentia 'rational.'

(*d*) *Separable accident*: some books are pernicious and some are not.

(*e*) *Inseparable accident* if we do not know *why* ; *property* if we do.

(*f*) *Inseparable accident*, of an individual.

CHAPTER VII.

DEFINITION.

63 **Definition** gives the attributes which make up the connotation of a term.

64 There are five rules of definition.

(1) *Definition must be by genus and difference :* e. g. ' Man is a rational animal.' ' Animal' is the genus, ' rational' the differentia ; the two together mark off the species ' man ' from everything else. If this rule is broken, we have a description, not a definition [§ 66].

(2) A definition *must not contain the term to be defined or a term which has the same meaning :* e. g. ' A *monarch* is the head of a *monarchy*,' ' *Ethics* is the science of *morality*.' A definition which breaks this rule is a **circulus in definiendo.**

(3) A definition *must be neither wider nor narrower than the term defined :* e.g. ' A republic is a free state ' is too wide; ' A republic is a state where everyone is equal ' is too narrow.

(4) A definition must not be *obscure* (e.g. ' morality is self-realisation '), or *metaphorical* (e.g. ' law is the harmony of the world '), or *ambiguous* (e. g. ' socialism is the possession of capital by *all*,' where *all* may mean all collectively or all individually). If our definition is more obscure than the term defined, we are said to define **obscurum per obscurius,** or **ignotum per ignotius.**

(5) A definition must not, if possible, be *by negatives :* e. g. ' heat is the absence of cold.'

What terms cannot be defined ?   65

(1) *Proper names* : for either they have no connotation or too much [§ 23 (*a*)].   Definitions are only of *classes.* .

(2) *The names of our simplest sensations and ideas* : e.g. heat, colour; being, time; for the meaning of such terms cannot be explained, but only felt or perceived.

Distinguish **Definition** from **Description.**   66

Definition is by genus and difference : *Description* or 'accidental definition' may be by property, e.g. 'Man is an animal that cooks his food,' or accident ; e.g. 'Man is a featherless biped.'

Terms which cannot be defined can be described. So with simple sensations or ideas, 'Heat is a form of motion among the minute particles of bodies.' So also with proper names : e.g. 'John is a tall man who passes our window at nine every morning.'

Distinguish **Provisional** from **Complete** or **Final** 67 Definition.

Provisional definitions are of real kinds [§ 54], and may be improved as knowledge advances : e. g. those of 'electricity' or 'vegetable.' *Complete or final* definitions are those of terms distinguished by one definite attribute and its consequences, and are already as good as they can be made : e.g. definitions of 'ship,' 'Radical.'

Distinguish **Real** from **Nominal** or **Verbal** Defini- 68 tion.

Real Definition takes for granted the existence of the thing defined : *nominal* or *verbal* definition does not : e. g. definitions of ghost, fairy.

Define trade-union, garden, cynicism.   69

A *trade-union* is an association (*genus*) of wage-earners for the purpose of maintaining their interests as wage-earners (*difference*).

A *garden* is a piece of ground (*genus*) set apart for the careful cultivation of small trees, flowers, or vegetables (*difference*).

Cynicism is a form of character (*genus*) which enjoys the contemplation of the bad side of people or things (*difference*).

70 Criticise the following definitions :—

    (1) Life is the sum of the vital functions.

    (2) Happiness is the crown of virtue.

    (3) Happiness is the reward of virtue.

    (4) Definition is the analysis of the connotation of a term.

    (5) A gentleman is one who has no visible means of sub-sistence.

    (1) Really repeats the word defined; 'vital' means 'of life.'

    (2) Is metaphorical.

    (3) Defines 'happiness' by property : not by genus and difference.

    (4) Is right in logic, when we have already explained 'con-notation'; but is really 'obscurum per obscurius.'

    (5) If meant for a definition, is both too wide and too nar-row : and defines by a separable accident. It is only meant to satirize 'idle gentlemen.' N.B.—A definition should not be complimentary or abusive.

CHAPTER VIII.

DIVISION.

Division gives the classes which make up the deno- **71** tation of a term : e.g. 'material substance' may be divided into solid, liquid, and gaseous.

The class which we divide is called the **divided whole** (totum divisum). The classes into which we divide it are called the **dividing members** (membra dividentia), or the **constituent species.**

There are three rules of division :   **72**

   (1) *The parts taken together must be neither greater nor less than the whole.*
   (2) *We must be able to* predicate *the whole* of *the parts.*
   (3) *There must be only one principle of division :* so that *the constituent species may not overlap.*

Rule (1) would be broken if we divided Europeans **73** into French, Germans and Russians : or if we included Egyptians.

Rule (2) distinguishes logical division from partition [see § 78].

Rule (3) forbids a 'cross division.'

A **cross division** proceeds on more than one prin- **74** ciple, so that the divisions overlap : e. g. a division of dogs into terriers, pugs, mad dogs, and other dogs. We divide on two different principles : breed and health; and mad dogs might include some terriers.

The **fundamentum divisionis,** or 'basis of divi- **75** sion,' is the principle on which we divide : e.g. if churches are divided into Gothic, classical, and others, *style of architecture* is the basis of the division.

76 **Exhaustive** or **adequate division** includes the whole of the class divided (see rule 1).

> The easiest way of dividing a class is to give a few of the smaller classes of which it is made up. E. g. trees into oaks, elms, ashes, &c. But it would be difficult to give all the kinds of trees. This difficulty is supposed to be met [1] by 'dichotomy.'

77 **Division by dichotomy** is division into successive pairs of *contradictory terms:* e. g. to divide *money*, and to make sure of including all that is ever used for money, divide thus :—

    Money
    |
Metallic—not-metallic
            |
    Paper—not-paper
                |
        Shells—not-shells.
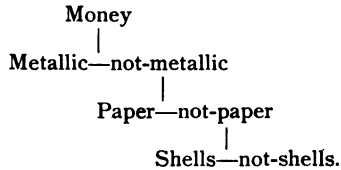
Division by dichotomy is *exhaustive.* Here, every other kind of money, e. g. salt (so used in Africa), comes under 'not-shells.'

78 **Partition** enumerates the parts of which a thing is made up: e. g. when we divide a tree into roots, trunk and branches.

Metaphysical Division enumerates the qualities of a thing: e. g. when we say a tree has greenness, tallness, beauty, &c.

Logical Division (e.g. of trees into evergreens and deciduous) differs from both, because the term divided can be predicated of the terms into which it is divided: e.g. we can say 'evergreens are trees,' but not 'roots are trees' or 'greenness is a tree.'

---

[1] In reality it is only evaded. The instance below comes to no more than dividing 'money' into 'metallic, paper, shells, etc.'; and 'etc.' makes the division as 'exhaustive' as 'not-shells.'

Divide:—   PARTY

```
                        PARTY
            ┌─────────────┴─────────────┐
         Liberal                    Conservative
      ┌─────┴─────┐              ┌───────┴───────┐
   Radical     Moderate        Tory         Moderate
               Liberal                      Conservative
```

Or—

```
                        PARTY
            ┌─────────────┴─────────────┐
        Free-traders              Protectionists
```

```
                       VIRTUE
        ┌──────────┬─────┴──────┬──────────┐
     Prudence   Courage    Temperance   Justice
```

(the old Greek division.)

Or—

```
                      VIRTUE
            ┌───────────┴───────────┐
      Mainly regarding self    Mainly regarding others
```

```
                       SHIP
        ┌──────────┬─────┴──────┬──────────┐
   Propelled by  Propelled by  Propelled by  Propelled by
      oars          sails         steam       electricity
```

```
                      SCHOOL
        ┌─────────────┼─────────────┐
    Elementary     Secondary      Higher
        │
    ┌───┴────┐
 Provided  Non-provided[1]
```
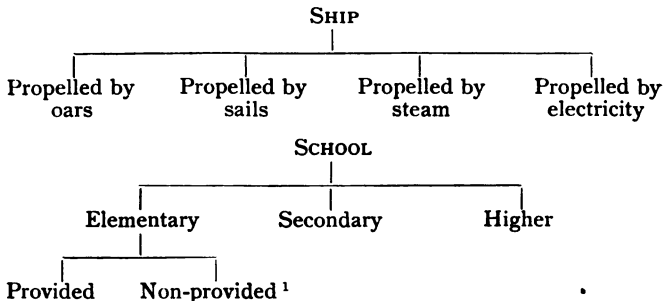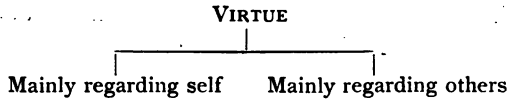
N.B.—Never divide by *dichotomy* (which is of no real use) un-less asked to do so.

[1] Jan., 1904.

80   Criticise the following divisions :—

(1) *Wales* into North Wales, South Wales, and Monmouthshire.

(2) *A room* into roof, floor, walls and ceiling.

(3) *Snakes* into poisonous snakes, harmless snakes, and blindworms.

(4) *Farms* into highland, lowland, arable, pasture.

Answer :

(1) Is a partition. You cannot say 'South Wales is Wales.'   Also Monmouthshire is not part of Wales. You can divide *Welshmen* into 'natives of North Wales' and 'natives of South Wales.'

(2) A partition.

(3) Includes blindworms, which are not snakes, and does not include all snakes; for the boa is neither poisonous nor harmless.

(4) Two principles of division, cultivation and position, and consequent overlapping.

CHAPTER IX.

IMMEDIATE INFERENCE : OPPOSITION.

Immediate inferences pass from one proposition 81
to another without the help of a third : e.g. No cats are
dogs; therefore no dogs are cats.

Mediate inferences pass from one proposition to
another by help of a third; e.g. All men are fallible and
all kings are men ; therefore all kings are fallible.

There are three chief kinds of **Immediate infer-** 82
ence :—

(1) **Opposition**; (2) **Permutation** or **Obversion**;
(3) **Conversion**.

Opposition is an immediate inference in which two 83
propositions, having the same subject and predicate,
differ in quality or quantity or both.

From the truth of one such proposition you can often
infer the truth or falsity of the other: this is why oppo-
sition is a form of immediate inference.

[For the 'square of opposition,' which should be learnt by heart, see
next page.]

Contradictory opposition is between A and O: 84
All men are liars, Some men are not liars; or between
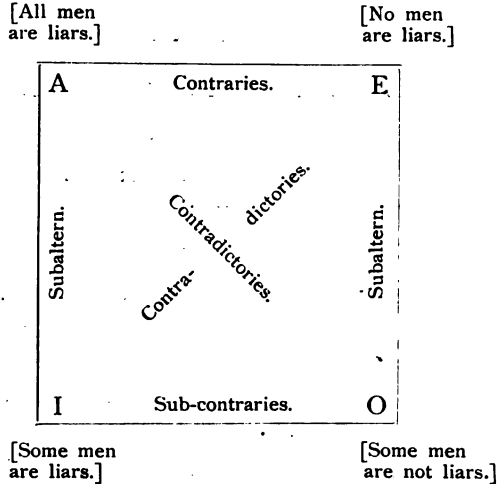E and I : No men are liars, some men are liars.

Contrary opposition is between A and E: All 85
men are liars, No men are liars.

Only these two would be called Opposition in ordinary
language.

N.B.—Do not confuse contradictory and contrary *oppo-
sition* with contradictory and contrary *terms* [§15].

86   SQUARE OF OPPOSITION.

[All men   [No men
are liars.]   are liars.]

A   Contraries.   E

Subaltern.   Subaltern.

Contradictories.

Contra-

Sub-contraries.

I   Sub-contraries.   O

[Some men   [Some men
are liars.]   are not liars.]

87   **Subaltern opposition** is between A and I : All
men are liars, Some men are liars; or between E and O :
No men are liars, Some men are not liars.

88   **Sub-contrary opposition** is between I and O :
Some men are liars, Some men are not liars.

89   N.B.—In strict logic 'Some men are wise' does not imply
     that other men are not : they may be wise or not.   So too
     'Some men are not wise' does not imply that others *are*
     wise.

90   *Sub-contraries may both be true : but they cannot both be
     false.*   E.g. if 'some men are quadrupeds' (I) is false, its
     contradictory, 'no men are quadrupeds' (E), is true; and
     ∴ its sub-contrary, 'some men are not quadrupeds,' is true.

N.B.—In answering questions like 'If E is true (or false) **91** what follows about A, I, O?' always begin with the *contradictory* of the proposition set. If *any* of the other three propositions are *uncertain* or '*indeterminate*,' it is always two of them.

E.g. If No Tories are wise (E) is *true*,
　　　　Some Tories are wise is *false*,
　　　　Some Tories are not wise is *true*,
　　　　All Tories are wise is *false*.

If No Tories are wise (E) is *false*,
　　　　Some Tories are wise is *true*,
　　　　All Tories are wise is *uncertain*,
　　　　Some Tories are not wise is *uncertain*.

If Some Tories are wise (I) is *true*,
　　　　No Tories are wise is *false*,
　　　　All Tories are wise is *uncertain*,
　　　　Some Tories are not wise is *uncertain*.

If Some Tories are wise (I) is *false*,
　　　　No Tories are wise is *true*,
　　　　Some Tories are not wise is *true*,
　　　　All Tories are wise is *false*.

The most perfect kind of opposition is contradictory **92** *opposition* (not contrary).

At first sight A and E seem more completely opposed than A and O, or E and I.   But—

(1) A and E cannot both be true, but they can both be false.   A and O, E and I, cannot even both be false; if one is false, the other is true.

(2) Suppose you want to disprove 'All vivisection is wrong' (A); the contradictory, 'Some vivisection is not wrong' (O), disproves it, as well as the contrary, 'No vivisection is wrong' (E), and is easier to prove. (Besides, E might be false, as well as A.)

CHAPTER X.

PERMUTATION, CONVERSION, &c

93 **Permutation** is a form of immediate inference in which (1) the quality [§ 30] of the proposition is changed, (2) the contradictory of the predicate [§ 15] is put for the predicate. **Obversion** is another name for permutation.

> E. g. All snow is white. (A)
> (1) No snow is white.
> (2) No snow is not-white.
>
> No men are perfect. (E)
> (All men are perfect.)
> All men are imperfect.
>
> Some dogs are black. (I)
> (Some dogs are not black.)
> Some dogs are not not-black.
>
> Some dogs are not terriers. (O)
> (Some dogs are terriers.)
> Some dogs are not-terriers.

94 The permutation of O is very important, because it is wanted in conversion [§ 102]. It can be done shortly thus—

> Some French are not Parisians. (O)
> Some French are not-Parisians. (I)

95 **Conversion** is an immediate inference in which the subject and predicate of a proposition change places. E. g.

> (1) No men are perfect.
>
> (2)∴ No perfect beings are men.

(1) is called the *convertend*, (2) is called the *converse*.

The *rule of conversion* is, that *no term must be first* **96** *undistributed* (*in the convertend*) *and then distributed* (*in the converse*). If it were, you would argue from part of a class to the whole.

There is no harm in having a term first distributed and **97** *then undistributed.* For we not only *may* but *must* argue from the whole of a class to a part.

There are four chief **kinds of conversion.** **98**

(1) **Simple conversion,** in which the quantity of the proposition is not altered.

(2) **'Conversio per accidens,'** or **'conversion by limitation,'** in which a universal proposition becomes particular.

(3) **Conversion by negation** [§ 102].

(4) **Conversion by contra-position** [§ 103].

E and I can be converted simply, because E **99** distributes both subject and predicate, and I distributes neither; and therefore conversion of E or I makes no change in distribution. E.g.—

> No wise men are cynics,
> ∴ No cynics are wise men.

> Some clever men are cynics,
> ∴ Some cynics are clever men.

A cannot be converted simply, because the pre- **100** dicate of A would be first undistributed and then distributed. E. g.—

> All men are animals,
> ∴ All animals are men.

Here 'animals' is undistributed in the convertend, and distributed in the converse.

A must therefore be converted *per accidens*:

> All men are animals,
> ∴ Some animals are men.

101   O cannot be converted simply, because the subject of O would be first undistributed and then distributed.   E. g.—

<p style="text-align:center">Some dogs are not terriers,
Some terriers are not dogs.</p>

Here 'dogs' is undistributed in the convertend, and distributed in the converse.

Do not say 'O cannot be converted simply, because (e. g.) "terriers" is first distributed and then undistributed' [§ 97].

102   O cannot be converted like A, per accidens, because O is a particular proposition already. To convert O, we must use **conversion by negation,** that is, permutation + conversion.

<p style="text-align:center">Some dogs are not terriers. (O)</p>

Permute [§§ 93, 94]—

<p style="text-align:center">Some dogs are not-terriers. (I)</p>

Convert simply—

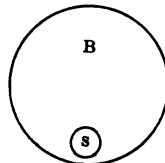<p style="text-align:center">Some not-terriers are dogs.</p>

103   Conversion by contraposition = permutation + conversion + permutation. (In A and O, change the subject and predicate to their contradictories, and convert simply.)

<p style="text-align:center">E. g. All men are animals. (A)
All not-animals are not-men.</p>

[The principle of contraposition, in A, may be shown by circles, thus—

<p style="text-align:center">All swans are birds :—</p>

∴ All not-birds are not-swans. For whatever is out-side the circle *B* is, *a fortiori*, outside the circle *S*.]

       Some men | are not | black. (O)   **104**
      ∴ Some not-black things | are not | not-men.

       No cows are horses. (E)   **105**
      Permute : All cows are not-horses.
      Convert *per accidens* : Some not-horses are cows.
      Permute : Some not-horses are not not-cows.

I cannot be converted by contraposition.   **106**

        Some men are black. (I)
      Permute : Some men are not not-black. (O)

    This can only be converted by negation [§ 102], i.e. per-muted and converted simply. But if you permute you get back to ' Some men are black.'

N.B.—A can sometimes be converted simply *as a* **107** *matter of fact :* when the subject and predicate are co-extensive [§ 45]. E.g.—
        X is the Prime Minister.
      . ∴ The Prime Minister is X.
     Goodness is the best thing in the world.
     ∴ The best thing in the world is goodness.

The simple converse of an O proposition is often **108** true : but it does not follow from the original O pro-position. E.g.—
        Some dogs are not black.
        Some black things are not dogs.

In taking an instance of O, always take one like   **109**
        Some dogs are not terriers,
        Some Frenchmen are not Parisians,
where the subject includes the predicate.

Propositions are frequently set to be put into strict **110** logical form and converted. The following are the converse of the propositions set in § 38.

Some not-geniuses are M.P.'s.
Some miserable are weak.
One thing great and sure to prevail is truth.
Some good things are average eggs.
Some not-gold glitters.
Nothing that will play before the cat is mice.   ·
One sign that nothing bad has happened is (this) absence
     of news.
Some weak things are the majority of men.
Some who are unlike other Irishmen are Irishmen.
One certain thing is that honesty is the best policy.
Some cases of my winning are cases of heads turning up.
{ One small class is statesmen who are bookworms.
{ No bookworms are (any of) a majority of statesmen.
·   { Some blessings are troubles.
    { One large class of things is troubles which are blessings.
One thing sure to be fatal is this defeat.
One astonishing thing is the folly of many people.

111   N.B.—Before you convert a proposition (1) *put it into logical
form* (A E I or O), if it is not so already ; (2) *see what the pre-
dicate is.*   The converse of ' All the brave deserve the fair,' is *not*
'All the fair deserve the brave'; or of 'A knocked B down,'
' B knocked A down.'

Convert the following propositions—

                     All the brave deserve the fair,
Converse.   Some who deserve the fair are brave.

                     A knocked B down,
Converse.   Some one who knocked B down was A,

                     Some boys are not diligent.   -   .
Converse.   Some not-diligent persons are boys.

' Some diligent persons are not boys' would be true, but it
would not follow by conversion, because 'boys' would be first
undistributed and then distributed [§ 108].

                     None but the brave deserve the fair.
Logical form.   No not-brave deserve the fair.
Converse.   None who deserve the fair are not-brave.
   [Or --
Logical form.   All who deserve the fair are brave.
Converse.   Some brave deserve the fair.]

He jests at scars who never felt a wound.
(i.e. He *only* who never felt a wound jests at scars.)

Logical form.　None who have felt wounds jest at scars. (E)
Converse.　None who jest at scars have felt wounds.

The better the day the better the deed.

Logical form.　All better days make better deeds. (A)
Converse.　Some things that make better deeds are better days.

112 Draw all the conclusions you can, by immediate inference, from ' All sheep are animals.'

　All sheep are animals.

(1) *By opposition.　If this be true,*
Some sheep are not animals is false.
No sheep are animals is false.
Some sheep are animals is true.

　If it be false.
Some sheep are not animals is true.

(2) *By permutation.*
No sheep are not-animals.

(3) *By conversion per accidens.*
Some animals are sheep.

(4) *By contraposition.*
All not-animals are not-sheep.

There are other forms of immediate inference, e. g.

Immediate inference by relation. This covers **113** such obvious and natural inferences as,

　　A is greater than B.
　∴ B is less than A.

　　London is north of Brighton.
　∴ Brighton is south of London.

Immediate inference by added determinants is an inference like

　　All metals are elements,
　∴ All heavy metals are heavy elements.

But such inferences may be fallacies, e. g.

A mouse is an animal,
∴ A large mouse is a large animal,

for 'large' does not mean the same thing in the subject and predicate.

114   Immediate inference by complex conception is an inference like

A mouse is an animal,
∴ The head of a mouse is the head of an animal.

But such inferences may be fallacies, e. g.

An M.P. is an Englishman,
∴ A majority of M.P.'s is a majority of Englishmen.

PART II.

CHAPTER I.

SYLLOGISMS.

A **Syllogism** is an inference in which a relation **115** between two terms is proved by their relation to a third term. E.g.

> All men are fallible (A),
> All kings are men (A),
> ∴ All kings are fallible (A).[1]

Here the relation between 'kings' and 'fallibility' is proved by their relation to 'humanity.'

The **conclusion** of a syllogism is the proposition **116** which is inferred. The **premisses** are the two propositions from which the conclusion is inferred. The **middle term** is the term which comes in both premisses.

The **minor term** *is the subject of the conclusion.* **117**

The **major term** *is the predicate of the conclusion.*

In an A conclusion, like 'all kings are fallible,' the **118** predicate usually denotes more than the subject. There are more 'fallible beings' than 'kings.' Hence, *the subject of the conclusion* (kings) *is called the* **minor** *or lesser term, and the predicate* (fallible) *is called the* **major** *or greater term.*

The subject of an E, I, or O conclusion is likewise called the minor, and the predicate the major term,

---

[1] A syllogism of this form is called for shortness A A A.

though they need not be 'lesser' or 'greater' than each other.

In a syllogism which proves an A conclusion, the middle term (e. g. men) denotes more than the minor (kings) and less than the major (fallible beings).

119 The **major premiss** is the premiss which contains the major term, and **always comes first.**

The **minor premiss** is the premiss which contains the minor term, and **always comes second.**

120 The Canons of the Syllogism.

The validity of the Syllogism depends on two principles : (1) When two terms agree with a third term [1] they agree with each other ; (2) When one of two terms agrees, and the other does not agree, with a third term, [1] these two terms do not agree with each other.

121 There are eight **Rules of the Syllogism.**

I. A syllogism must have three terms only.

To prove a relation between two terms you must compare them with *one and the same* third term. From 'all *men* are fallible' and, 'all kings are *rulers*,' nothing follows directly about kings being fallible.

122 Breaking Rule I = **Fallacy of Four Terms** or '**Quarternio Terminorum.**' E. g. 'Aspasia rules Pericles : Pericles rules Greece ∴ Aspasia rules Greece.' Here there are four terms :—(1) Aspasia, (2) what rules Pericles, (3) Pericles, (4) what rules Greece : nothing follows about Aspasia ruling Greece.

123 II. A syllogism must have three propositions only.

Viz. one to compare the middle term with the major term, one to compare it with the minor, one to compare the major with the minor.

[1] 'With a third term' must be understood to mean 'with *the same part of* a third term'; otherwise the syllogisms in §§ 125, 127, 128 would be valid.

Rules III and IV are about distribution.

III. **The middle term must be distributed at** 124 **least once, and must not be ambiguous.**

> For, in order to connect the two other terms, the middle term *must be one and the same.* If it were undistributed in both premisses, or if it were ambiguous, it might denote different things in each premiss, and there would really be four terms. E. g.

Undistributed Middle : 125

> All Tories are loyal,
>
> Some Radicals are loyal,
>
> ∴ Some Radicals are Tories.

The middle term 'loyal' denotes two different sets of loyal people, and ∴ will not connect Radicals and Tories.

> (If you could say in the major premiss, 'All loyal people are Tories,' you could conclude 'Some Radicals are Tories,' for '*all* loyal' would cover the 'some loyal' who are Radicals).

Ambiguous middle : 126

> No designers are trustworthy,
> All engravers are designers,
> ∴ No engravers are trustworthy.

IV. **Any term which is distributed in the** 127 **conclusion must be distributed in the premisses.**

> For otherwise you would argue from part of a class to the whole. E. g.
>
> All the Jacobins were violent,
>
> All the Jacobins were Radicals,
>
> ∴ All Radicals are violent.

Here the minor term is undistributed in the minor premiss and distributed in the conclusion. This is called 'Illicit Process of the Minor,' or **Illicit Minor.**

128　Again :

> All science improves the mind,
> No classics are science,
> ∴ No classics improve the mind.

Here, the *major* term is distributed in the conclusion, but not in the major premiss. This is called 'Illicit Process of the Major,' or **Illicit Major.**

129　*Rules V and VI are about negatives.*

V. **Two negative premisses prove nothing.**

> For, if neither of two terms is connected with a third term, you cannot tell whether the two terms are connected or not.　E. g.
>
> > No cats are birds,
> > No dogs are birds,
> > ∴ No dogs are cats.

Premisses and conclusion are all true, but the conclusion does not follow from the premisses, any more than it follows from ' No cats are birds, No tabbies are birds,' that ' No tabbies are cats.'

130　VI. **If one premiss is negative, the conclusion must be negative.　If the conclusion is negative, one premiss must be negative.**

> For, if the middle term is connected with A and not with C, it must follow that A is not connected with C.　And, conversely, if you conclude that A is not connected with C, one of them must be connected with the middle term, and the other not.

131　*Rules VII and VIII are about particulars.*

> N.B.—They are proved in a different way from the first six : you take all possible cases which break them, *expressed in letters*, and show that they are all invalid by the first six rules.　It is longer and harder to prove them by *instances* in words.

VII. **Two particular premisses prove nothing.** 132

As the letters I and O stand for any *particular* pro-position, the letters O O, I I, O I, stand for all possible pairs of particular premisses.[1] We can show that they prove nothing.

Try O O. Two negative premisses (Rule V).

Try I I. I I distributes no terms, and, ∴ would give an 'undistributed middle' (Rule III).

	Sub-ject.	Predi-cate.	
I	◡	◡	
I	◡	◡	
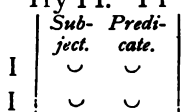
Try O I. *How many terms do the premisses distribute?* *One* (predicate of O). *How many terms ought they to dis-tribute? Two*; one the middle term (Rule III), the other the major term, because the conclusion must be negative (Rule VI) and distribute its predicate, which ∴ must be distri-buted in the premisses (Rule IV). So you will have *undistributed middle or illicit major.*

	Sub-	Predi-	
O	◡	–	
I	◡	◡	
		–	

Instance of two particular premisses : 133

> Some men are wise,
> Some poets are men,
> ∴ Some poets are wise.

The conclusion is true, but does not follow from the premisses, any more than it would follow from 'Some men are wise, Some fools are men,' that 'Some fools are wise.'

VIII. **If one premiss is particular, the con-** 134 **clusion must be particular.**

> N.B.—It is *not* true that if the conclusion be particular, one premiss must be particular.

---

[1] O I must be taken to include I O; similarly I A, E I, A O, in § 134, must be taken to include A I, I E, O A, though, for the sake of shortness, the 'plans' corresponding to I O, A I, I E, O A have been omitted.

As A, E stand for universal and I, O for particular propositions, I A, E I, A O stand for all possible pairs of premisses of which one is particular and the other universal. (E O would be two negative premisses), We can show that they only prove particulars.

Try I A. It must have an affirmative conclusion (Rule VI) A or I. We want to show that it cannot prove A.

Try I A A. *How many terms do the premisses distribute? One* (subject of A). *How many ought they to distribute? Two*; the middle term, and the minor term, because the minor term is distributed in the conclusion A. So we have *undistributed middle* or *illicit minor.*

I	‿ ‿	*distribute? Two*; the middle term, and
A	·— ‿	the minor term, because the minor term is
A	— ‿	distributed in the conclusion A. So we

Try E I or A O. They must have negative conclusions (Rule VI) E or O. We want to show that they cannot prove E.

Try E I E or A O E. *How many terms do the premisses distribute? Two*; subject and predicate of E, or subject of A and predicate of O. *How many ought they to distribute? Three*; the middle term, and the major and minor terms, which are both distributed in the conclusion E. So you will have *undistributed middle* or *illicit major* or *illicit minor.*

E	— —	
I	‿ ‿	
E	— —	
A	— ‿	
O	‿ —	
E	— —	

135 The rules of syllogism are therefore :—

1. A syllogism must have three terms only.
2. A syllogism must have three propositions only.
3. The middle term must be distributed at least once, and must not be ambiguous.
4. Any term distributed in the conclusion must be distributed in the premisses.
5. Two negative premisses prove nothing.
6. If one premiss is negative, the conclusion must be negative, and *vice versâ.*
7. Two particular premisses prove nothing.
8. If one premiss is particular the conclusion must be particular.

These rules are given in the lines :— **136**
   ' Distribuas medium neu. quartus terminus adsit ;
   Utraque nec praemissa *negans* nec *particularis.*
   Sectetur partem conclusio deteriorem,
   Et non distribuat, nisi cum praemissa, negetve.'

'You must distribute the middle term, and not have a fourth :
both premisses must not be negative or particular.   The con-
clusion must follow the weaker part of the premisses' (i.e. must
be particular or negative if one of the premisses is), 'and must
not distribute a term or be negative unless one premiss does
the same.'

When will two particular premisses prove a conclusion ? **137**
When the subjects of the premisses are qualified by
a word like *most*, or any words implying a *majority*.
Thus, from

        Most Tories are Imperialists,
        Most Tories are Churchmen,

you can prove

        Some Churchmen are Imperialists.

[Such propositions are really particular for some pur-
poses, and universal for others.]

CHAPTER II.

MOODS AND FIGURES.

138   Every possible syllogism can be represented by three letters, each of them being either A E I or O, one standing for the major premiss, another for the minor, and the third for the conclusion; and showing the quality and quantity of each: AAA, AEE, EIO, &c. These forms are called 'moods.' A '**mood**' is thus a form of the syllogism depending on the quantity and quality of the premisses and conclusion.

139   As the letters A E I O can be arranged, three together, in 64 different ways, there are 64 *possible* moods or forms of the syllogism. But many of these are not *valid*, because they break one or more of the syllogistic rules. E. g. E E I has two negative premisses, and also an affirmative conclusion; A I A has a particular premiss and a universal conclusion: and so on.

140   Going through all the possible moods in this way we find only 11 valid moods. [The only difficulty is with I E O.

Mark the distribution of terms in I E O. The major

	Sub-ject.	*Predi-cate.*
I	‿	‿
E	‒	‒
O	‿	‒

term is distributed in the conclusion, and should ∴ be distributed in the major premiss. But the major premiss is I, which distributes no terms: ∴ I E O always involves *illicit major*.]

141   Each of these 11 valid moods will go into 4 figures.

A **figure** is a form of the syllogism depending on the place of the middle term in the premisses.

A syllogism in any given mood, e.g. A A A, can be

arranged in four different forms, according to the place of the *middle term*: and these forms are called figures.

1. The middle term may be subject of major premiss and predicate of minor — *first figure,*

2. or predicate of both — *second figure,*

3. or subject of both — *third figure,*

4. or predicate of major and subject of minor — *fourth figure,*

Call the major term P (predicate), the middle term M, the minor S (subject). Then you have four figures :

First figure		*Second figure.*	
M	P	P	M
S	M	S	M
S	P	S	P

Third figure.		*Fourth figure.*	
M	P	P	M
M	S	M	S
S	P	S	P

Eleven valid moods in each of the 4 figures, make **144** 44 possible moods. But some of these are not valid.

Try, e.g. A A A in all the figures.

All $\overline{\text{M}}$ is $\overset{\smile}{\text{P}}$
All $\overline{\text{S}}$ is $\overset{\smile}{\text{M}}$ First figure: *valid,* it breaks no rules.
∴ All $\overline{\text{S}}$ is $\overset{\smile}{\text{P}}$

All $\overline{\text{P}}$ is $\overset{\smile}{\text{M}}$
All $\overline{\text{S}}$ is $\overset{\smile}{\text{M}}$ Second figure: *invalid: undistributed middle.*
∴ All $\overline{\text{S}}$ is $\overset{\smile}{\text{P}}$

E. g. All Londoners are Englishmen,
All Yorkshiremen are Englishmen,
∴ All Yorkshiremen are Londoners !

E

All $\overline{\text{M}}$ is $\overset{\smile}{\text{P}}$
All $\overline{\text{M}}$ is $\overset{\smile}{\text{S}}$ | Third figure : *Invalid: illicit minor.*
∴ All $\overline{\text{S}}$ is $\overset{\smile}{\text{P}}$ |

E. g. All mice like cheese,
All mice are animals,
∴ All animals like cheese !

All $\overline{\text{P}}$ is $\overset{\smile}{\text{M}}$ |
All $\overline{\text{M}}$ is $\overset{\smile}{\text{S}}$ | Fourth figure : *Invalid: illicit minor.*
∴ All $\overline{\text{S}}$ is $\overset{\smile}{\text{P}}$ |

E. g. All dictionaries are books,
All books are things,
∴ All things are dictionaries !

In the same way we should find that of the 44 possible moods, only 24 are valid.

143   But, of the 24, five **subaltern moods** are useless. They *prove less than might be proved*; and are called '*subaltern moods*,' because their conclusions follow by subaltern opposition [§ 87] from the proper conclusions. They are said to have ' **weakened conclusions.**'

E. g. All men are mortal,
All soldiers are men,
∴ *Some* soldiers are mortal.

That is A A I in the first figure and is valid : but why conclude that *some* soldiers are mortal, when you might conclude that *all* soldiers are mortal ?   (A A A)

So E A O in the second figure—

No rabbits are birds,
All pheasants are birds,
∴ Some pheasants are not rabbits,

—you can conclude No pheasants are rabbits (E A E). So you have *nineteen valid moods* left.

144   To recapitulate : there are 64 possible moods.   Of these all but 11 are invalid, because they break the rules of the syllogism.   These 11 will each go into 4 figures,

which gives 44 possible moods. Of these 20 are invalid, which leaves 24 valid moods. And of these, 5, though valid, are useless; which leaves 19 valid (and useful) moods. This process is called **'constituting' the valid moods.**

The valid moods can be remembered by the *vowels* in **145** the lines—*which must be known by heart*—

' Barbara Celarent Darii Ferioque *prioris* :
Cesare Camestres Festino Baroko *secundæ* :
Tertia Darapti Disamis Datisi Felapton
Bokardo Ferison *habet : quarta insuper addit*
Bramantip Camenes Dimaris Fesapo Fresison [1].'

Two more lines are sometimes added :—

' Quinque Subalterni totidem generalibus orti
Nomen habent nullum, neque, si bene colligis, usum.'

' Five *subaltern* moods arising from five moods with universal conclusions have no name, and, if you infer rightly, no use.'

Here are specimens of syllogisms in each Figure :— **146**

Celarent, in Fig. 1.

E   Nothing which is dull is popular,
A   All squad drill is dull,
E .·. No squad drill is popular.

Festino, in Fig II.

E   No good men are cynics,
I   Some geniuses are cynics,
O .·. Some geniuses are not good men.

Datisi, in Fig. III.

A   All orderly states are respectable,
I   Some orderly states are republics,
I .·. Some republics are respectable.

---

[1] 'Barbara,' etc., are moods of the 1st figure ; 'Cesare,' etc., of the 2nd ; the 3rd includes 'Darapti,' etc. ; the 4th adds besides 'Bramantip,' etc.

Camenes, in Fig. IV.

A   All seals are warm-blooded,
E   No warm-blooded things are fish.
E .·. No fish are seals.

147 Knowledge of ‘Barbara Celarent,’ etc., will give the answer to many questions: e. g.

148 *What are the nineteen valid moods?*

In Fig. I	A A A	E A E	A I I	E I O	
,, II	E A E	A E E	E I O	A O O	
,, III	A A I	I A I	A I I	E A O	O A O E I O
,, IV	A A I	A E E	I A I	E A O	E I O

149 *What are the five subaltern moods?*

Every mood which proves A or E, with I or O put instead, i.e.:

The two first in Fig. I	A A I	E A O	
,, ,, ,, II	E A O	A E O	
The second ,, IV	A E O.		

150 *Why are there no subaltern moods in Fig. III?*

Because Fig. III only proves particulars, I or O [§ 172].

What moods occur (1) *in all the figures,* (2) *in one of them only,* (3) *in two of them,* (4) *in three of them?*

(1) E I O occurs in all [1].

(2) A A A only in Fig I.
A O O only in Fig. II.
O A O only in Fig. III.

(3) E A E occurs in Figs. I, II.

A I I	,,	,,	I, III.
A E E	,,	,,	II, IV.
A A I	,,	,,	III, IV.
I A I	,,	,,	III, IV.
E A O	,,	,,	III, IV.

(4) There is no mood which occurs in three of them only.

---

[1] *If subaltern moods be included,* then E A O occurs in *all* the figures (not in *two* only), A A I in *three* (I, III, IV), A E O in *two* (II, IV).

A is the hardest to prove, because it can only be done in one
mood, Barbara. Consequently, its contradictory O is the hardest
to disprove.   O is the easiest to prove (it can be done in eight
ways) and ∴ A is the easiest to disprove.

These are the 11 out of the 64 possible moods [§ 139] which
are obtained by rejecting all which break any of the eight rules.

To find them more quickly, go through ' Barbara '—leaving
out all that occur twice—

A A A	E A E	A I I	E I O
A E E	A O O		
A A I	I A I	E A O	O A O

This gives us only 10.   The other is the only subaltern mood
[§ 143] which does not occur as a useful mood in one of the
figures, viz. A E O.

CHAPTER III.

TESTING MOODS AND FRAMING SYLLOGISMS.

153 Suppose you are asked 'Are the following moods valid, and why—A I O, I O I, I E O, E A E, A A I, A E E, E A O?'

First see if any of them are invalid in *all the figures*. A I O breaks Rule VI; I O I breaks Rules VI and VII; I E O involves illicit major [§ 140].

Try the rest in the different figures. Say in which they are valid, and why they are invalid in the others.

E A E is valid in I (Celarent) and II (Cesare).

Invalid in III.				Invalid in IV.		
E	$\overline{M}$	$\overline{P}$	Illicit Minor	E	$\overline{P}$	$\overline{M}$
A	$\overline{M}$	$\breve{S}$		A	$\overline{M}$	$\breve{S}$
E	$\overline{S}$	$\overline{P}$		E	$\overline{S}$	$\overline{P}$

with "Illicit Minor" bracketed for both.

A A I is *valid* in I, but *subaltern* to Barbara (hence it does not occur in 'Barbara Celarent'): and valid in III (Darapti), IV (Bramantip).

Invalid in II (undistributed middle):

	A	$\overline{P}$	$\breve{M}$
	A	$\overline{S}$	$\breve{M}$
	I	$\breve{S}$	$\breve{P}$

A E E is valid in II and IV (Camestres, Camenes).

Invalid in I.				Invalid in III.		
A	$\overline{M}$	$\breve{P}$	Illicit Major	A	$\overline{M}$	$\breve{P}$
E	$\overline{S}$	$\overline{M}$		E	$\overline{M}$	$\overline{S}$
E	$\overline{S}$	$\overline{P}$		E	$\overline{S}$	$\overline{P}$

with "Illicit Major" bracketed for both.

E A O is valid in III and IV (Felapton Fesapo); valid but subaltern (to Celarent and Cesare) in I and II.

Directions for framing syllogisms in words. 154

Suppose you are asked to frame a syllogism in Cesare. Put down, one under the other, the vowels E A E, which show you what the quality and quantity of the premisses and conclusion must be.

If you remember your 'Barbara,' you will know that Cesare is in Fig. II. Write a 'plan' of Fig. II, as under—

E | P M | Now think of a conclusion to be proved,
A | S M | of the form E, and write it down opposite
E | S P | S P. E.g. 'No birds are quadrupeds.'

Then write out, guided by the letters, as much of the premisses as you can, leaving a space for the middle term (M). *Mind you put the major term* (P) *in the first premiss.*

E | P M | No quadrupeds are ————,
A | S M | All birds are ————.
E | S P | No birds are quadrupeds.

'Winged' will do for a middle term ; or anything that no quadrupeds are and all birds are.

Try *Ferison.* It will be in the third figure : 155

E | M P | No ———— are statesmen.
I | M S | Some ———— are politicians.
O | S P | Some politicians are not statesmen.

Then find a class of men, none of whom are states-men and some of whom are politicians; say 'knaves' or 'self-seekers.'

Try *Felapton :* 156

E | M P | Take the same conclusion and major
A | M S | premiss (without the middle term), but for
O | S P | the minor premiss you have to find a class
none of whom are statesmen and *all* of whom are politi-

cians, and that is not so easy. You might take some class of politicians whom you disliked—Tories or Social-ists. But if you remember that *a singular proposition is really a universal,* you can make a middle term out of *any* politician who is (or was) not a statesman—say Wilkes—or out of two or more.

E | M P | Wilkes and Marat were not statesmen.
A | M S | Wilkes and Marat were politicians.
O | S P | ∴ Some politicians are not statesmen.

157   (You can do Darapti on the same principle).

158   If you are asked to frame syllogisms in any mood of the *fourth* figure, begin with the premisses, and be satis-fied with commonplace premisses. If you are asked to prove a given conclusion in the fourth figure, proceed as above.

159   E.g. Frame a syllogism in Dimaris.

I | P M | Some animals are cats.
A | M S | All cats are sly.
I | S P | Some sly things are animals.

160   Prove by a syllogism in Camenes that 'No persecution is justifiable.'

A | P M | All justifiable things are ————.
E | M S | No ———— are persecutions.
E | S P | No persecution is justifiable.

'Rational' or 'conscience-respecting' will do for a middle term.

161   If you are given a conclusion to prove, first see that it is in strict logical form, A, E, I, or O. Then choose a mood out of the nineteen in 'Barbara Celarent' which will prove a conclusion of that particular form.

If you are given a conclusion to prove or disprove, and want to disprove it, prove its contradictory.

E. g. Prove or disprove 'All rebellions are not justi-
fiable.'

This means : Prove 'Some rebellions are not justifia-
ble (O),' which can be done in Ferio, Baroko, &c.: *or*
Prove 'All rebellions are justifiable,' which must be done
in Barbara.

Singular propositions like 'My own college is the
best,' or 'The law of libel is not equitable' are equiva-
lent to A or E propositions.

CHAPTER IV.

SPECIAL RULES AND USES OF THE FIGURES.

163 Do not confuse these rules with the general rules of the syllogism [§§ 121, ff.]. In proving them, begin by drawing a plan of the particular figure, and supposing that the rule is broken. Remember the rules of distribution given in §§ 41, 42, especially that—

In affirmative propositions the predicate is undistributed (and, vice versâ,) if the predicate is undistributed, the proposition is affirmative.

In negative propositions the predicate is distributed (and, vice versâ,) if the predicate is distributed the proposition is negative.

164 Rules of the Figures :—

Fig. I.   1. The minor premiss must be affirmative.
          2. The major premiss must be universal.

Fig. II.   1. One premiss must be negative.
          2. The conclusion must be negative.
          3. The major premiss must be universal.

Fig. III. 1. The minor premiss must be affirmative.
          2. The conclusion must be particular.

Fig. IV.   1. If the major premiss is affirmative, the minor is universal.
          2. If the minor premiss is affirmative, the conclusion is particular.
          3. If the conclusion is negative, the major premiss is universal.

165 If you forget what the rules of the first three figures are, they can be recovered by writing out the moods of each, by help of 'Barbara,' so that all the major premisses will come in the first line, and so on. E. g.

Fig. I.	A E A E	Universal.
	A A I I	Affirmative.
	A E I O	

But this will not do for a *proof* of the rules.

Prove the Rules of Fig. I.

M P | (1) *The minor premiss must be affirmative.* **166**
S M | Suppose S M negative. Then the conclusion
S P | S P is negative, P is distributed in the con-
clusion, and ∴ in M P: ∴ M P is negative: *two negative premisses.*

M P | (2) *The major premiss must be universal.* **167**
S M | Suppose M P particular. Then M is undistri-
S P | buted in M P. ∴ it must be distributed in S M
∴ S M is negative ∴ (as above) S P is negative, M P
is negative: *two negative premisses.*

Prove the Rules of Fig. II.   **168**

P M | (1) *One premiss must be negative.* Suppose
S M | P M, S M both affirmative. Then M is not dis-
S P | tributed in either ∴ *undistributed middle.*

  (2) *The conclusion must be negative.* Suppose S P **169**
affirmative. Then P M, S M are both affirmative; *un-distributed middle.*

P M | (3) *The major premiss must be universal.*
S M | Suppose P M particular. Then P is undistributed
S P | in P M. ∴ P is undistributed in S P (or you
would have illicit major). ∴ S P is affirmative ∴ P M,
S M are both affirmatives: *undistributed middle.*

Prove the Rules of Fig. III.   **171**

M P | (1) *The minor premiss must be affirmative.*
M S | Suppose M S is negative. Then S P is negative
S P | ∴ P is distributed in S P ∴ P is distributed in
M P ∴ M P is negative: *two negative premisses.*

M P | (2) *The conclusion must be particular.* Sup- **172**
M S | pose S P universal. Then S is distributed in
S P | S P and ∴ in M S ∴ M S is negative ∴ S P is
negative ∴ P is distributed in S P and ∴ in M P ∴
M P is negative: *two negative premisses.*

173 Prove the Rules of Fig. IV.

P M | (1) *If major premiss is affirmative, minor is*
M S | *universal.* For, if minor premiss is particular,
S P | the middle term is distributed in neither.

174 (2) *If minor premiss is affirmative, conclusion is particular.* For if conclusion is universal, there is illicit minor.

175 (3) *If conclusion is negative, major is universal.* For if major is particular, there is illicit major.

176 Special uses of the figures :—
The *first* figure is called (*a*) *the scientific figure,* because it is the only figure which proves A propositions : i.e. general truths such as science seeks ; (*b*) *the perfect figure,* because it alone follows from the ' Dictum de omni et nullo' [see §§ 181, 182].

177 The *second* figure proves *negative* propositions only, and is therefore useful for proving *distinctions.*

178 The *third* figure proves *particular* propositions only, and is therefore useful for proving *instances* and *exceptions.*

179 It is useful especially where you want to prove the contradictory of your opponent's general proposition [§ 92], or where you prove a conclusion by individual instances. For names of individuals, which are in this case your middle term, are most naturally the *subject,* not the predicate of the proposition ; and the middle term in the third figure is always the *subject.* See, for an instance, § 156.

180 [The fourth figure (sometimes called the Galenian Figure) is an awkward figure and has no special use.]

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CHAPTER V.

REDUCTION.

The ' **Dictum de Omni et Nullo** ' is the principle **181** ' Whatever is true or false of a class, is true or false of everything in that class.'

Now the validity of the first figure follows directly **182** from the ' Dictum de Omni et Nullo.'

[Take Barbara and Darii.

> All men are mortal,
> All kings are men,
> .·. All kings are mortal.

> All men are mortal,
> Some animals are men,
> .·. Some animals are mortal.

As ' mortality' is true of the whole class *men*, it must be true of everything in the class *men*, and.·. of 'all kings' and ' some animals.'

Take Celarent and Ferio.

> No men are perfect,
> All kings are men,
> .·. No kings are perfect.

> No men are perfect,
> Some animals are men,
> .·. Some animals are not perfect.

As 'perfection' is false of the whole class *men*, it must be false of everything in the class men, and therefore of all kings and some animals].

But the validity of the three other figures does not **183** follow directly from the Dictum. Hence the first figure was once thought to be the only perfectly valid and

safe figure. It was called the **perfect figure**; the other three were **imperfect figures.** The moods in it were called **direct moods**; those in the other figures, **indirect moods.**

184 So a process called **Reduction** was devised, by which any conclusion in Figs. II, III, IV, could be proved in Fig. I.

185 Now this was a mistake The other three figures, though not so neat as the first, are quite as valid; and though their validity does not depend directly on the 'Dictum de Omni et Nullo,' it can be proved by the canons of the syllogism [§ 120].

The real use of Reduction is only to put a syllogism in the neatest and most obvious form.

186 The formula ' Barbara Celarent ' is so contrived that all the capital letters in it, and the letters s, p, m, k, help in Reduction: the other consonants mean nothing.

The initial letter of each mood shows that it can be reduced to the mood, in the first figure, which begins with the same letter. E. g. Festino to Ferio: Disamis to Darii. (In Baroko and Bokardo the B means something rather different, § 189).

The letter s (Camestres, Datisi, etc.) means that the proposition indicated by the *preceding* vowel is to be converted *simply.*

The letter p (Darapti, Felapton, etc.) means that the proposition indicated by the *preceding* vowel is to be converted *per accidens.*

The letter m (Camenes, Bramantip, etc.) means that the premisses are to be transported (m = ' muto ').

The letter k (Baroko and Bokardo only) means that these moods have to be reduced *per impossibile* [see § 192].

187 There are two kinds of Reduction, Ostensive Reduction and Reduction per Impossibile.

Ostensive Reduction is effected by conversion or **188** transposition of premisses.

Reduction per Impossibile proves that the con- **189** clusion is true by showing that its contradictory is false. This is done *by means of* a syllogism in Barbara: hence Baroko and Bokardo, the two moods usually reduced in this way, begin with B. But they are not reduced *to* a syllogism in Barbara.

Frame and reduce a syllogism in Camestres. 190

Camestres { All science is fact,
No fictions are fact,
∴ No fictions are science.

Convert simply the minor premiss and conclusion :—

All science is fact,
No facts are fictions,
∴ No science is fiction.

Transpose the premisses :—

No facts are fictions,
All science is fact,
∴ No science is fiction.

This is Celarent of the first figure, and the conclusion of the original syllogism in Camestres follows from its conclusion by simple conversion.

∴ No fictions are science.

Frame and reduce a syllogism in Bramantip. 191

All men are animals,
All animals are mortal,
∴ Some mortals are men.

Transpose the premisses :—

All animals are mortal,
All men are animals.

From these premisses you can conclude :—

∴ All men are mortal :

and, by conversion per accidens :—

     .∴. Some mortals are men.

 p in Bramantip means 'change I into A,' not, as usual, 'change A into I.'

192 Two moods, *Baroko* and *Bokardo*, are usually reduced per impossibile.

 The reason is that in ostensive reduction no kind of conversion was allowed but simple or per accidens. But to reduce Baroko and Bokardo ostensively you must use permutation or conversion by negation [§§ 94, 102].

193 **Frame and reduce a syllogism in Baroko.**

    All honest men are candid,
     Some lawyers are not candid,
    .∴. Some lawyers are not honest.

 Your opponent says 'I grant your premisses but do not accept your conclusion, because you have not proved it in the first figure.'

 You reply, 'Very well; I will assume my conclusion false. Then its contradictory must be true; i.e. "All lawyers are honest" is true. I make this the minor premiss of a new syllogism[1]; and keep my original major, which you admit—

    All honest men are candid,
    All lawyers are honest,
    .∴. All lawyers are candid.

 But the conclusion is the contradictory of the original minor premiss "Some lawyers are not candid"—which you admit.

 Therefore the new conclusion is false.

 But the *major* premiss is correct; for it is one of our original premisses, which you admit.

---

 [1] You know it is the *minor* premiss, because *k* in Baroko is in the *second* syllable.

∴ the *minor* premiss "All lawyers are honest" must be false;

∴ its contradictory "Some lawyers are not honest" is true.'

And this is our original conclusion, which we have therefore proved by the help of the first figure.

Frame and reduce a syllogism in Bokardo. 194

> Some poets are not wise,
> All poets are geniuses,
> ∴ Some geniuses are not wise.

If the conclusion be false, its contradictory is true. Assume the conclusion false. Then it is *true* that

> *All geniuses are wise.*[1]

But, by the minor premiss, whose truth we have a right to assume—

> *All poets are geniuses.*

It follows that

> *All poets are wise.*

But the conclusion is the contradictory of our original major premiss—some poets are not wise—and is therefore false.

But the new minor premiss is granted true; ∴ the new major premiss is false, ∴ the original conclusion is true: and it has been proved true by a syllogism in Figure I.

N.B.—The other moods of Figs. II, III, IV, can also **195** be reduced per impossibile.

Baroko and Bokardo can also be reduced by help of **196** permutation [§ 94], conversion by negation [§ 102], and conversion by contraposition [§ 103].

---

[1] *Major* premiss of the new syllogism, because *k* in Bokardo, is in the *first* syllable.

197 Reduce Baroko ostensively.

> All honest men are candid,
> Some lawyers are not candid,
> .·. Some lawyers are not honest.

Convert the major premiss by contraposition :—

> *All who are not-candid are not-honest.*

Permute the minor premiss :—

> *Some lawyers are not-candid,*
> *.·. Some lawyers are not-honest.*

Permute this conclusion :—

> Some lawyers are not honest.

—the original conclusion which we have proved in the first figure—Darii.

198 Reduce Bokardo ostensively.

> Some poets are not wise,
> All poets are geniuses,
> .·. Some geniuses are not wise.

Convert the major premiss by negation; and transpose the premisses :—

> *All poets are geniuses,*
> *Some who are not-wise are poets,*
> *.·. Some who are not-wise are geniuses.*

Convert simply and permute :

> Some geniuses are not wise.

This is the original conclusion, which we have proved in the first figure, Darii.

N.B.—Remember, in the case of Baroko, to begin by *applying the hardest form of conversion,* viz. contraposition, *to the major premiss*; in the case of Bokardo, to begin by *transposing the premisses.* It will be easy to recall the other steps if you remember that you have to get a syllogism in Fig. I, Darii.

CHAPTER VI.

SORITES.

If a premiss of a syllogism is proved by another syllogism, **199** and so on, the argument may be put in a neat form called a Sorites (σωρός, a heap).

A **Sorites** is a series of propositions, such that the **200** predicate of each becomes the subject of the next, and the *last* predicate is proved true of the *first* subject.

<div align="center">

All A is B,
All B is C,
All C is D,
All D is E,
∴ All A is E.

</div>

<div align="center">

All Skyes are terriers,
All terriers are dogs,
All dogs are animals,
All animals need air,
∴ All Skyes need air.

</div>

Every Sorites may be resolved into a series of syllog- **201** isms : e.g. those given above = three syllogisms in Barbara.

<div align="center">

(1)   All B is C,
All A is B,
∴ All A is C.

(2)   All C is D,
All A is C,
∴ All A is D.

(3)   All D is E,
All A is D,
∴ All A is E.

</div>

    (i)   All terriers are dogs,
         All Skyes are terriers,
    .·. All Skyes are dogs.

    (ii) All dogs are animals,
         All Skyes are dogs,
    .·. All Skyes are animals.

    (iii) All animals need air,
          All Skyes are animals,
    .·. All Skyes need air.

202   N.B.—In resolving a Sorites into a series of syllogisms, *begin with the second proposition* and go back to the first. When you have got your first syllogism, go on to the *third* proposition in the Sorites, and for the minor premiss use the conclusion of the first syllogism. This is necessary in order to get syllogisms of the first figure.

    There will be as many syllogisms as there are propositions between the first and the last in the Sorites, and the intermediate propositions will always be major premisses.

203 **Rules of the Sorites.**

    In a Sorites no premiss but the *first* can be *particular*, and no premiss but the *last* can be *negative*.

204   Suppose any premiss but the first particular; e. g.

          All A is B,
          Some B is C,
          All C is D,
      .·. Some A is D.

    Reduce to syllogisms—

          Some B̆ is C, ⎫ Undistributed
          All A is B̆. ⎭ middle.
          Nothing follows.

205   Suppose any premiss but the last negative; e. g.

          No A is B,
          All B is C,
          All C is D,
      .·. No A is D.

Reduce to syllogisms—

<div align="center">

All B is C̆,

No A is B,

∴. No A is C̅.
</div>

Illicit process of major.   Nothing follows.

Thus, if any premiss but the *first* is particular, we **206** have undistributed middle: if any premiss but the *last* is negative, we have illicit process of major.

> ' Show that only one premiss in a Sorites can be particular or negative,' does *not* mean 'show that you cannot have *two* particular or *two* negative premisses': it means 'show that only one premiss, viz. the first, can be particular, and only one premiss, viz. the last, can be negative.'

It follows from the rules of the Sorites that no **207** Sorites can contain a *premiss* of the form O. For O cannot be the first premiss, because it is negative, nor the last because it is particular, nor any other because it is both.

We may have a Sorites with the first premiss parti- **208** cular and the last negative: the conclusion must be O.

A **pro-syllogism** is a syllogism which proves a **209** premiss of another syllogism. E. g., in § 201.

<div align="center">

(i)   All terriers are dogs,

All Skyes are terriers,

∴. All Skyes are dogs,
</div>

is a pro-syllogism to

<div align="center">

(ii)   All dogs are animals,

All Skyes are dogs,

∴. All Skyes are animals.
</div>

An **epi-syllogism** is a syllogism one of whose pre- **210** misses is proved by another syllogism. E. g. in the instance above, (ii) is an epi-syllogism to (i).

211 An **'epicheirema** (lit. 'an attempt,' and so an attempt at proof) is a syllogism in which the reason for one or both premisses is given.

> E. g. All dogs need air because they are animals,
>   All Skyes are dogs because they are terriers,
>   .·. All Skyes need air.

This epicheirema can be resolved into the second Sorites in § 201.

212 An **enthymeme** is a syllogism in which (as is usually the case in books and conversation) one premiss or the conclusion is left out or only expressed *in* the *mind*—ἐν θυμῷ—whence the name.

> E. g. All kings are men and therefore fallible (enthymeme *of the first order*: major premiss suppressed).
>   All men are fallible and therefore kings are (*second order*: minor premiss suppressed).
>   All men are fallible, and kings are men (*third order*: conclusion suppressed).

213 Enthymeme in Aristotle means something different: viz. 'an argument from probabilities or indications,' not always valid.

> E. g. This man is thirsty, for he has fever (valid).
>   This man has fever, for he is thirsty (invalid).

CHAPTER VII.

CONJUNCTIVE SYLLOGISMS.

Propositions are divided as follows :—   **214**

```
                        Propositions
                             |
        ┌────────────────────┴────────────────────┐
     Simple ·                              Complex
                                              |
                              ┌───────────────┴───────────────┐
                         Conjunctive                    Disjunctive
```
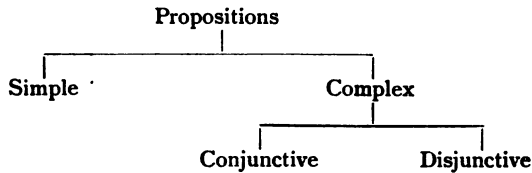
A **simple** proposition merely affirms or denies : e. g. **215** All men are mortal.

A **categorical** proposition is another name for a simple proposition.

A **complex** proposition affirms or denies with a con- **216** dition, or with an alternative : e. g.

> If it thunders, it lightens.
> It will either rain or snow.

A **conditional** proposition is another name for a complex proposition.

A **conjunctive** proposition affirms or denies with a **217** condition : e. g.

> If it thunders, it lightens.

A **hypothetical** proposition is another name for a conjunctive proposition.

A **disjunctive** proposition affirms or denies with one **218** or more alternatives, e. g.

> It will either rain or snow.

19 The first part of a conjunctive proposition is called the **antecedent,** the second part the **consequent.** E. g., in § 217, 'If it thunders' is the antecedent; 'it lightens' is the consequent.

220 A **conjunctive** or **hypothetical syllogism** is one of which the major premiss is a conjunctive proposition, and the minor premiss and conclusion are simple propositions. E. g.

> If it rains I shall not go out.
> It will rain.
> ∴ I shall not go out.

221 **Rules of the conjunctive syllogism.**

You may affirm the antecedent or deny the consequent : but you must not affirm the consequent or deny the antecedent.

Common sense will show this in a simple instance. You say to yourself 'If I have influenza, my eyes water.' You may argue from this premiss in four ways—two good and two bad. 'I *have* influenza, therefore my eyes water' is a good argument; and so is 'My eyes do not water, therefore I have not got influenza.'

But you cannot argue 'My eyes water, therefore I have influenza,' or 'I have not got influenza, therefore my eyes do not water.' For an ordinary cold, or a blow, might make your eyes water.

22 The conjunctive (or hypothetical) syllogism has two moods.

In the **constructive hypothetical syllogism,** or **modus ponens,** or **affirmative mood,** the minor premiss affirms the antecedent. E. g.

> If A is B, C is D,
> A is B,
> ∴ C is D.

> If the south wind blows, the snow will melt,
> The south wind does blow,
> ∴ The snow will melt.

In the **destructive hypothetical syllogism**, or **223** **modus tollens**, or **negative mood**, the minor pre-miss denies the consequent. E. g.

> If A is B, C is D,
> C is not D,
> ∴ A is not B.

> If that is forked lightning, there is thunder,
> There is no thunder,
> ∴ That is not forked lightning.

N.B.—Two points may cause a difficulty in this and **224** the next two chapters. (1) 'If A is B, C is D' includes propositions like ' If I stop in, I get a headache,' which might be expressed 'If A is B, it is D.' (2) 'If it does not rain, I shall go out: it does not rain.' ∴. I shall go out,' is *affirming* the antecedent, not *denying* it : for it is negative already. ' It does rain, ∴. I shall not go out,' would be the fallacy of *denying* the antecedent by taking away the ' not.'

Proof of the rules of the conjunctive syllo- 225 gism.

Affirming the consequent = Undistributed middle.

Denying the antecedent = Illicit major.

We can prove that affirming the consequent = undis- **226** tributed middle by reducing the conjunctive syllogism to a simple or categorical syllogism.

> If A is B, C is D,
> C is D,
> ∴ A is B.

This is equivalent to

All cases-of-A-being-B | are | cases-of-C-being-D.

This | is | a-case-of-C-being-D.

∴ This | is | a-case-of-A-being-B.

By marking the distribution of terms we see that the middle term (cases-of-C-being-D) is undistributed, so that nothing follows.

N.B.—The minor premiss is a singular affirmative proposition, and therefore is an A proposition, which does not distribute the predicate.

227　　　If the sky falls, we shall catch larks,
　　　　　We shall catch larks,
　　　　.˙. The sky will fall!

This is equivalent to
　　　All cases of the sky falling are cases of lark-
　　　　catching,
　　　This is a case of lark-catching,
　　.˙. This is a case of the sky falling.

—Undistributed Middle. Granting that we should catch larks if the sky fell, we can catch them under other circumstances! Most things have more than one possible cause or reason.

228　In the same way we can prove that denying the antecedent = illicit major.
　　　　　　If A is B, C is D,
　　　　　　A is not B,
　　　　.˙. C is not D.

This is equivalent to
　　All cases-of-A-being-B are cases-of-C-being-D,
　　This is not a case-of-A-being-B,
　.˙. This is not a case-of-C-being-D.

The major term, 'cases-of-C-being-D,' is undistributed in the major premiss and distributed in the conclusion.

N.B.—The major premiss and conclusion, being singular negative propositions, are equivalent to E propositions, and therefore distribute their predicate.

If the south wind blows, the snow will melt, **229**
The south wind will not blow,
∴ The snow will not melt.

This is equivalent to

All cases of the south wind blowing are cases of
the snow melting,
This is not a case of the south wind blowing,
∴ This is not a case of the snow melting.
—Illicit major: the major term, 'cases-of-the-snow-melting,' is undistributed in the major premiss and distributed in the conclusion. There are more possible causes than one of the snow melting: it might melt with a west wind.

CHAPTER VIII.

DISJUNCTIVE SYLLOGISMS.

230   A **disjunctive syllogism** is one in which the major premiss is a disjunctive proposition, and the minor premiss and conclusion are usually simple propositions.

The disjunctive syllogism has two moods—

231   (1) The **modus ponendo tollens** (mood which by affirming denies) or **affirmative mood.**

> Either A is B or C is D,
> But A is B,
> ∴ C is not D.

This is called the affirmative mood, though the conclusion is negative, because the *minor premiss is affirmative.*

232   E. g. He is either a Liberal or a Conservative.

> He is a Liberal,
> ∴ He is not a Conservative.

233   (It would be equally valid to argue

> Either A is B or C is D,
> But C is D,
> ∴ A is not B.

It makes no difference which part of the major premiss comes first : therefore we do not speak of antecedents and consequents in a disjunctive, but only in a conjunctive, proposition).

234   (ii) The **modus tollendo ponens** (mood which by denying affirms) or **negative mood.**

> Either A is B or C is D,
> But A is not B,
> ∴ C is D.

This is called the negative mood, because the *minor premiss* is negative.

> E. g. Either history is misleading, or it is hard work to **235**
> make a democracy permanent.
> But history is not misleading,
> ∴ It is hard work to make a democracy permanent.

We can thus argue 'disjunctively' in four ways from the **236** premiss

Either A is B or C is D.

  (1) A is B . ∴ C is not D.   ⎫
  (2) C is D . ∴ A is not B.   ⎬ *Modus ponendo tollens.*
  (3) A is not B . ∴ C is D.   ⎫
  (4) C is not D . ∴ A is B.   ⎬ *Modus tollendo ponens.*

Disjunctive syllogisms are liable to a fallacy—but it **237** affects only the *modus ponendo tollens* (*affirmative mood*).

> E. g. Either you or I am wrong,
> You are wrong,
> ∴ I am not wrong.

Here the alternatives stated in the major premiss can *both* be true, and nothing follows from asserting one of them. The possibility of their both being true may be tested if you add the words 'or both.'

E. g. 'This animal is either cat or dog;' the meaning shows it cannot be both. But to 'This book is either tiresome or useless,' you could obviously add 'or both.'

Thus the modus ponendo tollens is necessarily valid *only when the alternatives are mutually exclusive.*

This fallacy does not affect the *modus tollendo ponens* : **238**

> E. g. 'Either you or I am wrong,
> I am *not* wrong,'—it must follow that—
> 'You are wrong.'

Show that a disjunctive syllogism can be reduced to a **239** hypothetical syllogism, and ∴ to an ordinary syllogism.

He is either a Liberal or a Conservative,
He is a Liberal,
∴. He is not a Conservative.

= If he is a Liberal, he is not a Conservative,
He is a Liberal,
∴. He is not a Conservative.

= No cases of his being a Liberal are cases of his
being a Conservative,
This is a case of his being a Liberal,
∴. This is not a case of his being a Conservative.

= No Liberals are Conservatives,
He is a Liberal,
∴. He is not a Conservative.

CHAPTER IX.

THE DILEMMA.

A **Dilemma** is a complex syllogism, of which the **240** major premiss is a hypothetical proposition with more than one antecedent or more than one consequent,[1] and the minor premiss a disjunctive proposition.

The dilemma has four forms :—

(1) **Simple Constructive Dilemma.** 241

If A is B or C is D, E is F,
But either A is B or C is D,
.·. E is F.

If I tell the truth or if I tell a lie, I shall get into
    trouble,
I must either tell the truth or tell a lie,
.·. I must get into trouble.

(2) **Complex Constructive Dilemma.** 242

If A is B, C is D ; if E is F, G is H,
But either A is B or E is F,
.·. Either C is D or G is H.

If I stay at home I get a headache ; if I go out I
    get a cold,
But I must either stay at home or go out,
.·. I must either get a headache or a cold.

---

[1] The words ' or more than one consequent ' must be added to the definition if the ' simple destructive dilemma ' is to be included in it. See § 243 and footnote.

243 (3) **Simple Destructive Dilemma.**

> If A is B, C is D and E is F, (obs. '*and*,' not '*or*.')
> But either C is not D or E is not F,
> ∴ A is not B.[1]

> If I carry out my plan, I must keep my pupils and
>   write my book,
> But either I must drop my pupils or I must drop my
>   book,
> ∴ I cannot carry out my plan.

244 (4) **Complex Destructive Dilemma.**

> If A is B, C is D : if E is F, G is H,
> But either C is not D or G is not H,
> ∴ Either A is not B or E is not F.

> If you are rich, you are able to give me £5, and if
>   you are kind, you are willing to do so,
> But you are either unable or unwilling,
> ∴ You are either not rich or not kind.

245 A Simple Destructive Dilemma *with two antecedents in the major premiss* is impossible; because it does not admit of a disjunctive minor premiss: it enforces no choice between alternatives.

---

[1] The Simple Destructive Dilemma is sometimes said not to be a dilemma at all, because it differs from the three other forms in not having more than one antecedent in the major premiss. But it is a real dilemma, 'with horns,' i. e. enforcing a choice between two alternatives; and it ought not to be denied the name on this merely formal and arbitrary ground; see Keynes, 'Formal Logic,' § 208. It is true that the minor premiss could also be expressed (to take the instance given above) in the form 'I cannot both keep my pupils and write my book:' which gives us a conjunctive syllogism. But (1) the alternative is really latent in the words 'not both;' and (2) the minor premiss of the *Complex* Destructive Dilemma can be expressed in the same form. E. g.

> If you are *rich*, you are *able* to give me £5, and if you are *kind*, you
>   are *willing*,
> But it cannot be that you are both able and willing,
> ∴ It cannot be that you are both rich and kind. (See Stock, 'Logic,'
>   §§ 383, 385-6).

E.g. If A is B or C is D, E is F,
　　But E is not F,
　.˙. A is not B and C is not D.

If the people are discontented, or if violent opinions
　　are gaining ground, a revolution is probable,
But a revolution is not probable,
.˙. The people are not discontented, and violent opinions
　　are not gaining ground.

This is not a dilemma; because the minor premiss is
not disjunctive: it is only a double conjunctive syl-
logism.

(We cannot get a disjunctive minor premiss by saying
'Either A is not B or C is not D.' For nothing follows
from denying the antecedent.)

A **dilemma can be met** in two ways. 246

(i) By showing that the major premiss does not ex-
haust the alternatives; i.e. that the minor premiss is
not true in the sense required by the major premiss.

E.g. If emigrants are useless, they are a burden to
　　　the colonies; if they are useful, they are a
　　　loss to the mother country,
　　But emigrants are either useless or useful,
　.˙. Emigration is either a burden to the colonies or
　　　a loss to the mother country.

But an emigrant may be useless at home but usefnl
in a colony.

Or (ii) a *complex* dilemma may be **rebutted**; i.e. an- 247
other dilemma may be constructed from the same
premisses leading to an opposite conclusion.

E.g. If books in public libraries are common, it is
　　　unnecessary to let them be taken out; and if
　　　they are rare it is dangerous,
　　But they are either common or rare,
　.˙. To let them out is either unnecessary or dan-
　　　gerous.

G

To *rebut* this, *transpose* and *deny* the consequents.

> If books are common, it is safe to let them out;
> if they are rare, it is useful,
> But they are either common or rare,
> ∴. Letting them out is either safe or useful.

248 Rebutting a dilemma is of little real use: the other refutation, showing that the minor premiss is not really true, is more useful in argument.

N.B.—Only a complex dilemma can be rebutted; not a simple dilemma.

CHAPTER X.

FALLACIES.

A **Fallacy** is an argument which seems to prove **249** something which it does not prove.

Fallacies are divided into

  (1) *Purely logical.*

  (2) *Semi-logical;* or · fallacies '*in dictione,*' in expression.

  (3) *Material;* or fallacies '*extra dictionem,*' outside the expression.

(1) **Purely logical** fallacies break the rules of the **250** syllogism. They are Four Terms, Undistributed Middle, Illicit Major or Minor. They can be detected by putting them into syllogistic form.

Invalid forms of Sorites, Conjunctive and Disjunctive Syllogism, and Dilemma; also of Immediate Inference; may be classed with them.

Semi-logical are those in which the same words **251** are used in different senses. They can be detected by enquiring into the meaning of words.

Material are those in which something is assumed **252** or proved that ought not to be assumed or proved. They require knowledge of the subject-matter for their detection.

The semi-logical and material fallacies were originally formu- **253** lated by Aristotle ; some of them are very trifling, because they are only the verbal puzzles which the Greek 'sophists' were

fond of using in disputation. But Composition, Division, Accident and Converse Accident answer to real sources of error in the mind: Ignoratio Elenchi and Petitio Principii are real forms of unfair reasoning: False Cause comprehends all inductive fallacies: Non sequitur comprehends all loose and vague arguments. The rest are trivial forms of 'equivocation' or 'ambiquity.'

254   The Six Semi-logical Fallacies.

(1) Equivocation.

(2) Amphibology.

(3) Composition.

(4) Division.

(5) Accent.

(6) Figure of Speech (including Paronymous Terms).

255   (1) Fallacy of Equivocation or Ambiguity.

Where the same term is used in two senses.
E. g. No courageous creature *flies,*
All eagles are courageous,
∴ No eagle *flies.*

256   Where the ambiguity is in the *middle* term, the fallacy of equivocation=ambiguous middle [§ 126].

257   (2) Fallacy of Amphibology.

Where a proposition may be taken grammatically in two senses. E. g. 'The duke yet lives that Henry shall depose' (Shakespeare), which may mean that the duke will depose Henry or Henry the duke.

N.B.—In the fallacy of Equivocation the ambiguity is in a *term*; in the fallacy of Amphibology it is in the *construction of a sentence.*

258   (3) Composition.

When a term is used first distributively, then collectively. E. g. 'I can afford to set up a carriage, travel in Italy, and stand for Parliament (i. e. I can afford *any one* of these); therefore I can afford to do all three together.'

'Two and three are odd and even; five ⁚is two and three, .·. five is odd and even.'

(4) Division. 259

Where a term is used first collectively, and then distributively. E.g. 'The Irish people are unhappy; therefore Mr. A., who is one of the Irish people, is unhappy.'

'All the men in the room are thirteen; I am a man in the room, .·. I am thirteen.' ('All' in the major premiss is collective, but the minor premiss assumes that it is distributive).

N.B.—*A term used collectively and distributively* is quite different from *a term distributed and undistributed.* 'All men' is distributed, 'some men' is undistributed. 'All men,' meaning 'mankind,' is collective; 'all men' (i.e. each single man) is distributive.

(5) Accent. 260

Where undue stress is laid on a word. E.g. 'We must not bear false witness *against* our neighbour,'— would imply that we may give false evidence *for* him.

(6) Figure of Speech. 261

A confusion between similar grammatical forms which differ in meaning. E.g. 'Regitur' means 'he is ruled'; therefore 'utitur' means 'he is used.'

Paronymous Terms or Fallacy of Etymology. 262

(Generally substituted by modern logicians for Figure of Speech.) When two words connected in derivation are wrongly supposed to be connected in meaning, E.g. Mr. A. does not *conform* to the rules of society: .·. he is a Nonconformist.

The Seven Material Fallacies are:— 263

(1) Fallacy of Accident (or '*A dicto simpliciter ad dictum secundum quid*': 'arguing from an absolute statement to a relative statement').

    (2) Converse Fallacy of Accident (or '*A dicto secun-
        dum quid ad dictum simpliciter*' : ' arguing
        from a relative statement to an absolute
        statement ').

    (3) Ignoratio Elenchi.

    (4) Petitio Principii.

    (5) Non Sequitur.

    (6) False Cause (or Non causa pro causâ).

    (7) Many Questions (plurium interrogationum).

264 (1) **Fallacy of Accident.**

Arguing from a general rule to a special case.
     E.g. Killing people is murder,
         Soldiers kill people,
       ∴. Soldiers commit murder.

265 (2) **Converse Fallacy of Accident.**

Arguing from a special case to a general rule.
     E.g. ' The race is not to the swift' (or ' The
        Tortoise in the fable beat the Hare '),
       ∴. A slow horse is most likely to win a race.

266   Composition and Division are often confused with Accident
and Converse Accident. The former are fallacies in *expression*,
(' all together' being confused with 'all separately '): the mistake
is about *quantity*. The latter are fallacies in *substance*: the
mistake is about *circumstances* of actions or *qualities* of things.

267   The simplest instance of Composition and Division is the old
story of the bundle of sticks. ' I can break each stick separately;
therefore I can break all together,' is the Fallacy of Composition.
' I cannot break the bundle, therefore I cannot break any of the
sticks,' is the Fallacy of Division.

268   The simplest form of Accident is, keeping to a rule and re-
fusing to allow for exceptions : e.g. applying the principle of the
' chose jugée' to the revision of a sentence which subsequent
evidence has shown to be unjust. The simplest form of the
Converse Fallacy of Accident is, turning an exception into a rule ;
e. g. presuming the innocence of every prisoner from instances of
the miscarriage of justice.

Another form of Accident and Converse Accident is the con- **269** fusion between a thing in itself and its accidental or acquired qualities. E. g. 'What we eat grew in the fields; loaves of bread are what we eat; .∴ loaves of bread grew in the fields.' This is a fallacy of Accident, because it assumes that what is true of our food *per se*, is true of our food in its prepared form. The converse fallacy would be 'What I eat has crust and crumb; last year's harvest is what I eat; .∴ last year's harvest had crust and crumb.'

(3) **Ignoratio Elenchi,** or ' arguing off the point.' **270**

An irrelevant argument leading to a different conclusion from that which you are bound to prove. Literally, 'ignorance of the proper refutation.' E.g. 'Protective duties ought not to be imposed, because Mr. Chamberlain was once a Free-Trader.'

Various forms of Ignoratio Elenchi are called **' argu- 271 mentum ad hominem '** (*'you* talk about the cruelty of pigeon-shooting ?—you couldn't hit a pigeon yourself!'), **'argumentum ad populum '** ('the flowing tide is with us, and therefore the measure is sound '), **' ad baculum '** ('I'll knock you down '), **' ad verecundiam '** (' You are too young to contradict me ').

N.B.—' Elenchus ' (ἔλεγχος) or refutation means strictly **272** ' the contradictory of your opponent's statement.'

(4) **Principii.** **273**

Where you assume as a premiss the conclusion which you wish to prove (generally in different words). E. g. 'All men should be free, for liberty is the universal right of humanity.'

N.B.—Petitio principii = τὸ ἐξ ἀρχῆς αἰτεῖσθαι, i.e. **274** asking your opponent to admit the statement proposed for discussion.

'Question-begging epithets,' i.e. complimentary **275** or abusive terms which assume the conclusion, are a kind of Petitio Principii: e.g. 'To pass this measure would be to call in question an *irrevocable* law.'

276 **Arguing in a circle** (a form of Petitio Principii) is saying, 'A is B because C is D, and C is D because A is B.' E.g. 'This belief is heresy because it has been condemned by the Church—I don't know when, but it must have been condemned by the Church because it is heresy.' This is called **circulus in probando.**

277 N.B.—In Petitio Principii you have a premiss which is *identical with* the conclusion; in arguing in a circle one of the premisses *has to be proved by* the conclusion.

278 (5) **Non Sequitur** is an argument so vague that it cannot be called by a special name. E.g. 'Well may this place be called "Stony Stratford," for I was never so bitten by fleas before in all my life!'

N.B.—Never call an argument a Non-Sequitur unless it is too unfounded to come under any other head.

279 (6) **False Cause** (or Non Causa pro ·Causâ) is an argument in which A is assumed to be the cause of B when it is not. E.g.; a comet has appeared, therefore some calamity is at hand.

280 One form of this fallacy is ' **Post hoc, ergo propter hoc** ': because B happens after A you take for granted that A was the cause of B. E.g. 'The weather has been much worse since the new Government came in:—just like them!'

281 N.B.—'False Cause' really means any syllogism based on a bad induction, the object of induction being to ascertain the true cause of anything [§ 313].

282 (7) '**Many Questions**' (fallacy 'plurium interrogationum') is asking more than one question as if it were only one. E.g. 'Have you half-a-crown that you could lend me?' It may be awkward to say either Yes or No.

This is really a fallacy 'in dictione,' and ought to come under 'Semi-logical fallacies.'

Instances of Fallacies.

When asked to 'examine arguments,' which, as set, are generally, but not always, fallacies, (1) try to find the point by common sense first: (2) make sure what the *conclusion* is, for, as the argument stands, it often comes *first*: (3) get every statement into its simplest form. If asked to put the argument into syllogistic form, be careful to get each proposition into strict logical form, A E I or O. Remember that immediate inferences, conjunctive or disjunctive syllogisms, dilemmas, etc., may be set, as well as the three kinds of Fallacies: and also *analogies* and '*induction by simple enumeration,*' which are discussed under Induction [§§ 379 ff., 320 ff.].

(1) 'The acquirement of a foreign language is part of a good education : therefore the acquirement of Arabic is part of a good education.'
Supply as a minor premiss, 'The acquirement of Arabic is the acquirement of a foreign language.' 'A foreign language' in the major premiss means 'some foreign language or other;' in the minor premiss ' one particular foreign language.' Fallacy of Division, § 259.

(2) 'Only warm countries produce wines: Spain is a warm country, and therefore produces wines.'

   All wine-producing countries are warm (§ 111).

   Spain is warm,

  .˙. Spain produces wines. § 124.

(3) 'He must be a man of great moderation of views, for he abhors extreme opinions,' § 262. 'Moderate' opinions, i. e. not extreme, may be held with violence.

(4) 'He must know a great deal, for he says so little.'

   All who know much, say little.

   He says little.

  .˙. He knows much. § 124.

(5) 'I know this to be a genuine antique, for I was told so by the man who sold it me,' § 279. Or § 264: there is a special reason for not trusting him.

(6) 'Every man has his price, for money is a standard of value which all recognise.' § 255 or § 273.

(7) 'If one premiss of a syllogism is particular, the conclusion is particular. Therefore if the conclusion is particular one pre-·miss is particular.'

      All cases of a particular premiss are cases-of-a-particular-conclusion.

.·. All cases-of-a-particular-conclusion are cases of a particular premiss. Simple conversion of A, § 100. *Or,* affirming consequent of a conjunctive syllogism, § 226.

(8) 'Few Dukes do any work, for they are all rich : rich men can be idle without discomfort, and it is ordinary human nature to be idle if you do not suffer by it.'
All Dukes are rich : all rich men can be idle without discomfort : *most* men who can be idle without discomfort are so ; .·. most Dukes are idle.—Sorites with a particular premiss other than the first, § 203.

(9) 'The inhabitants of the island gained a precarious living by taking in each others' washing.' § 258. A may live by washing for B, or B by washing for A : but not both.

(10) 'Brighton always reminds me of Switzerland, because at Brighton there's sea and no monntains, and in Switzerland there's mountains and no sea.' § 278.

(11) 'Dryas Octopetala cannot be a rosaceous plant, for its flowers have eight petals, and all the plants of that family which I have seen have either four or five.' § 320.

(12) '*Anne*—"No beast so fierce but knows some touch of pity."
    '*Gloucester*—"But I know none, and therefore am no·beast." '

        No beasts are pitiless.
        I am pitiless,
     .·. I am not a beast.

A correct syllogism in Cesare. But really Fallacy of Equivo-·cation [§ 255]. For Anne means that Gloucester, if pitiless, is *worse than* a beast; Gloucester means that he is *better than* a beast.

(13) 'If the honourable gentleman ever comes within ten miles of my house, I hope he will stop there all night.' § 257.

(14) 'He who calls me an animal speaks truly; he who calls me a donkey calls me an animal; ∴ he who calls me a donkey speaks truly.'

Fallacy of Accident [see § 269] : arguing from ' calls me an animal' as such to ' calls me a ' particular kind of ' animal.'

(15) 'No practical people are men of genius, because all geniuses are unpractical.'

> All geniuses are unpractical,
> ∴ No geniuses are practical: [by permutation, § 93].
> ∴ No practical men are geniuses [by simple conversion, § 99].
>
> Correct inference by immediate opposition.

(16) 'It is wasteful to leave food uneaten, because so many poor people would be glad to have it.'

> Throwing away what many poor would be glad of is wasteful.
> Leaving food uneaten is throwing away, etc.
> ∴ Leaving food uneaten is wasteful.

Ignoratio Elenchi, § 270. The mention of 'the poor' is irrelevant; and suggests the obvious retort 'Then give it to them: they won't get it if I eat it.' (There are other flaws in the argument; cp. § 263).

(17) ' Caesar and Pompey both desired to be supreme in the state; and those who desire the same object must be agreed.' § 258.

(18) 'We must be guided by the opinion of our ancestors, because old age is wiser than youth.' False Analogy, §§ 379, 380.

(19) ' I will have no more doctors, for I see that all the people who have died this winter have had doctors.'

> All who have died have had doctors,
> ∴ All who have doctors, die.
> Illicit conversion of A (§ 100).

(20) 'To pass this measure would be to prefer the wisdom of yesterday to the wisdom of centuries.' Division, § 259. 'Yesterday' compared with ' centuries' is not simply one day compared with many : the wisdom of yesterday may sum up the wisdom of centuries.

(21) ' Do you really mean to support the infamous policy of the Government ? ' § 282.

(22) ' Mr. A. denies the truth of the story about him; but I do not attach much weight to his denial, for a man capable of

such conduct would not hesitate to tell a lie.' § 276. Mr. A. is guilty because his denial is a lie ; it is a lie because he is guilty.

(If there were independent evidence, [§ 288], of the truth of the story, you might fairly inquire whether Mr. A. was likely to do anything but deny it).

(23) 'His imbecility of character might have been inferred from his proneness to favourites, for all weak princes have this failing.'

All weak princes have favourites,

He had favourites,

.·. He was a weak prince. § 125.

(24) 'Germany was in the wrong in going to war with France in 1870; so France must have been in the right.' § 237.

(25) 'Dr. Johnson told Boswell that rapid driving in a post-chaise was not happiness, "because you were driving rapidly *from* something or *to* something."' § 260.

(26) 'All demand creates supply: war creates a demand for food; .·. war creates a supply of food.'

(By immediate inference [§ 114] it only follows that 'war creates something which creates a supply.' Or better, Accident [§§ 264, 268], the 'demand' meant in the premiss is ordinary commercial demand.

(27) 'The fly sat on the carriage-wheel and said "What a dust I raise!"' § 279.

(28) 'No man is a hero to his valet.' Hence it follows that all men are hypocrites. §§ 265, 268.

(29) The masses cannot be trusted, for they have not had a thorough education.

All educated men can be trusted.

The masses are not educated,

.·. The masses cannot be trusted. § 128.

(30) 'When men are good, laws are needless; when men are corrupt, laws are broken.' §§ 242, 246. Supply minor premiss, 'Men are either good or corrupt.' But many men are neither so good as to need no laws, or so corrupt as to break them : hence conclusion 'laws are either needless or broken' is worthless.

(31) 'Socrates being a lover of truth was persecuted: therefore all philosophers are the objects of popular hatred.'

Socrates was persecuted : Socrates was a philosopher; .·. all philosophers are persecuted. § 127.

(32) 'In moral matters we cannot stand still; ∴ he who does not go forward is sure to fall back.'

Verbally a correct disjunctive syllogism. 'We must in moral matters either stand still, go forward, or fall back : A cannot stand still, and does not go forward ; ∴ A falls back.' Really a petitio principii ; anyone who denied the conclusion would deny the premiss.

(33) 'Lias lies above red sandstone : red sandstone lies above coal ; therefore lias lies above coal.'

Valid. Apparently four terms [as in § 122]. But by altering the form we get a correct syllogism with a true major premiss—

What lies above something-above-coal, lies above coal.
Lias lies above something-above-coal,
∴ Lias lies above coal.

(34) 'Oxford can be seen from Cumnor Hurst, and Cumnor Hurst can be seen from the White Horse Down ; ∴ Oxford can be seen from the White Horse Down.'

Invalid. Not only are there four terms, but, if we make a syllogism with three terms, the major premiss will be false, viz.

'What can be seen from a place visible from the White Horse Down can itself be seen from the White Horse Down.'

PROBABLE REASONING.   LAWS OF THOUGHT.

284   ' **Probable Reasoning** ' is an argument in which the conclusion is modified by an expression of ' probability.'

> E. g. Most Germans are learned,
> A is a German,
> ∴ A is probably learned.

> Or—Some Germans are learned,
> A is a German,
> ∴ A is possibly learned.

285   N.B.—In the word ' probability ' there is an ambiguity. In ordinary language ' probable ' means ' more likely to happen than not.'   In logic and mathematics· ' probable ' means ' that which *may* happen, whether the chance of its happening is great or small.'   E. g. we can say ' the probability of this is as one to ten,' meaning ' it is ten to one against this.'

286   Thus, '*In the popular sense of the word "probable,"* *two probable premisses do not always give a probable* *conclusion.*'

> E. g. Most Scotchmen are Liberals,
> Most Liberals are Radicals,

will not, if granted, prove that

> Most Scotchmen are Radicals,

but only that *some* are.   Or again,

> ' Most of the army will join in the charge,
> Most of those who join in the charge will fall,'

does not prove that most of the army will fall.

When you have two such probable premisses, one **287**
dependent on the other, the conclusion is weaker than
either of them. And when you have a sorites or *chain*
of probable premisses, forming a '**chain of reason-
ing**,' the longer the chain, the weaker is the conclusion.
'A is probably B, B is probably C, C is probably D,' will
seldom prove more than 'A is possibly D.'

In '**circumstantial**' or '**cumulative**' evidence, **288**
on the other hand, you have more than one probable
argument, each argument pointing to the same con-
clusion, and independent of the others. Many probable
arguments thus combined do not weaken but strengthen
the conclusion.

E.g. A is probably the murderer, because he was
seen running away from the place soon afterwards—
because there was blood on his clothes—because he
had a quarrel with the deceased—because he had been
seen with a knife such as inflicted the wound.

What are the **principles on which syllogistic 289
reasoning depends ?**

(1) ' The three Laws of Thought.'

(2) The *Dictum de Omni et Nullo* [§ 181].

(3) The Canons of the Syllogism [§ 120].

Explain Law of **Identity**—Law of **Contradiction 290**
—Law of **Excluded Middle.**

What are the three '**Laws of Thought ? '**

(1) All A is A, the 'law of identity.'

(2) No A is not-A, the 'law of contradiction.'

(3) Everything must be either A or not-A, the
'law of excluded middle.'

The 'law of contradiction' means e.g. that 'nothing **291**
can be *white* and *not-white*': we must add 'in the same
time and at the same place': for a thing may be white
in one place and not in another, etc.

292 The 'law of excluded middle' means that 'everything must (e.g.) be either white or not-white.' Here again we must add 'at the same place and time': and we must remember that 'not-white' includes everything *to which the word white does not apply*, as well as things *which are of some other colour than white*. E.g. '*Music* is either white or not-white' is true, if 'not-white' includes things to which names of colours, like 'white,' do not apply.

293 The Laws of Thought are so obvious that they are of no great practical importance in logic: hardly anyone would be careless enough to neglect them. For some cases in which they may mislead, see Preface.

CHAPTER XII.

WHAT LOGIC IS AND WHAT IT IS NOT.

Logic and Psychology.

Psychology is the science of the operations of the **294** mind. With our minds we *feel*, *think* or *know*, and *will*. Feeling includes sensation, desire, emotion, etc. Thinking and knowing begin with sensation and perception, and include imagination, reflection, etc. Exercise of the will accompanies deliberate action.

Logic has nothing to do with the feelings or the will, but only treats of the intellectual operations of the mind, i.e. thinking and knowing ; and even of these only *in so far as they can be performed rightly or wrongly under the direction of certain rules.*

E. g. how, from various sensations, and from perceptions of particular roses, we get the general idea of a rose, is a question for psychology. How rightly to classify and define and draw inferences about roses (*given the facts*) is a question for logic.

Some logic books speak of (i) concepts, judgments, **295** and inferences; instead of (ii) terms, propositions, and syllogisms. The only difference is that (i) are names for actions of the mind in itself; (ii) are names for the expression in language of these acts of the mind. Those who wish to confine logic as much as possible to the acts of the mind in itself, i.e. to formal logic [see §§ 298, 299] prefer (i): those who wish to connect logic as much as possible with language and things prefer (ii).

Logic and Grammar.   **296**

(1) Logic deals with thought, grammar with language, or the expression of thought.

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(2) Language expresses feeling and will as well as thought; hence grammar deals with interjections, entreaties, etc.; logic, which has nothing directly to do with feeling or will, does not.

(3) There is only one *logic*, but as many *grammars* as there are languages.

(4) Logic speaks of terms and propositions, grammar of words and sentences.

Definitions of Logic.

297 (i) **Logic is the science and art of Reasoning.**

But (*a*) the term Reasoning is not precise enough. (*b*) The definition is too narrow: that part of logic which deals with terms and propositions, including definition and division, is not exactly about *reasoning*.

298 (ii) **Logic is the science of the formal laws of thought.**

[A *formal* or *necessary* law of thought is a law which (*a*) deals with the *form* or way in which we think, not with the *matter* which we think about, (*b*) *must be always* true, like an axiom in mathematics. E. g.—'All planets shine by reflected light, therefore Mars does'—and 'All Englishmen are fit for freedom, therefore Londoners are'—are arguments of the same *form*, but about different *matter:* and the law on which they depend, viz., the Dictum de Omni et Nullo [§ 181] is *necessary*].

299 This is a correct definition of Deductive Logic. The 'three laws of thought' and the Dictum de Omni et Nullo, with the canons of the syllogism, are formal and necessary laws, and Deductive Logic is the science of their application.

But (*a*) logic is an art as well as a science [§ 2]; (*b*) The principles of Induction [§§ 310, 311] have not the same formal and necessary character; they are more like Laws of Things than Laws of Thought. Yet a definition of logic should include Induction.

(iii) **'Logic is the science of the operations of 300 the understanding which are subservient to the estimation of evidence,'** (and the art of conducting them rightly). Mill's definition.

This is the best definition, because it includes (i) clearness in the framing of terms and propositions, and in definition and classification, (ii) inductive logic, which tells us when particular facts are sufficient evidence for a general conclusion.

We may express it more simply by saying that logic is the science and art of inference and proof, and of any mental operation which assists them and can be guided by rules.

The Value of Logic.

(1) As a *science*, logic may be of some value, without being of **301** any practical *use*. All sciences are valuable if they are based on reality, not on fancy (like astrology), or on caprice (like heraldry). Logic tells us what the different kinds and principles of inference are, and how far we can be certain of different kinds of knowledge.

(2) As a *study*, logic is useful because (i) it gives us practice **302** in thinking clearly about abstract subjects, our knowledge, and our own minds, (ii) the 'book-work,' as it is called, e. g. conversion, proving the rules of the four figures, reduction, is good for us in the same way as mathematics : what we do must be either right or wrong.

(3) The value of logic as an *art* may be exaggerated. Every- **303** one admits that it is possible to reason rightly without a knowledge of logic, and that logic *by itself* will not make you reason rightly. It tells you how to get a conclusion when the premisses are given. But for good reasoning you have to *find* the premisses, and have them ready when you want them : and for that a knowledge of the subject about which you are reasoning is the first thing necessary.

Logic will, however, help to cure certain faults in the mind **304** which lead to erroneous reasoning. People often say, 'I know what I mean, but I cannot express myself.' This is the difficulty out of which a knowledge of logic may help us. (i) Our *conceptions*, and the *terms* by which we express them, are often indistinct. The rules for Definition and Division will do something to correct this, and also the distinctions of denotation and

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connotation, and of the various kinds of terms. (ii) Our *judg-ments* and *propositions* are often confused: we do not see, when we make a statement, exactly how far it will carry us. Exercise in reducing propositions to logical form, in opposition, conversion, etc., will help us to 'discern rapidly and surely' whether different words mean the same thing or not. (iii) An unsound inference or a merely verbal argument may sometimes be more readily detected if we recognise in it an 'undistributed' or 'ambiguous middle,' or an 'illicit process.' Unsound dilemmas and 'denying the antecedent' or 'affirming the consequent' are not uncommon, 'fallacies of accident' or 'ignoratio elenchi' are exceedingly common in political and other arguments. The doctrine of Fallacies at any rate, (setting aside mere verbal catches, 'quibus qui falli potest, debet'), may be 'useful as an art.'

305   As to the *relative* value of logic, whether as a science or an art, people will always disagree. Whether the use of logic in reasoning can be fairly compared to that of medicine in preserving health or chemistry in dyeing;—how much of popular error arises from want of logic or of the reasoning power which logic may strengthen ; how much from ignorance and prejudice—causes of error which, as experience shows, the study of logic does not always remove—everyone must decide for himself.

306   To sum up—Logic as a science deals with facts and is valuable for this reason alone, though it does not, like some sciences, discover new facts.

Logic as a study trains us in thinking with precision about abstract subjects, in a way which no other study does.

Logic as an art, though it will not of itself secure correct reasoning, will help to cure defects which are answerable for a great deal of bad reasoning

307   Explain ' Logic is the science of sciences,' or the ' Ars Artium.'

This old saying does *not* mean that logic is the greatest of the sciences: or that you cannot study other sciences without studying logic first : but that the other sciences are the subjects which logic studies: as entomology is the science of *insects*, so logic is (or ought to be) the science of *sciences*. It studies reasoning and inference : and in all the sciences there is reasoning and inference.

PART III.

INDUCTION.

CHAPTER I.

UNIFORMITY OF NATURE.

APPARENT INDUCTION.

Relation of Induction to Deduction.   **308**

Every syllogism must have at least one *universal* premiss.
How is such a universal premiss to be proved? Occasionally
it is self-evident, like an axiom in mathematics, or can be
deduced from a self-evident truth. Much more often it has to
be inferred from particular facts: Inductive logic tells us when
and how such an inference can be drawn.

The following diagram will roughly illustrate the way in
which a syllogism involves an induction, and *vice versâ*. Take
a syllogism like—

> All men are mortal.
> The Prime Minister is a man,
> ∴ The Prime Minister is mortal.

We know that the major premiss is true, because so many par-
ticular men have been known to die that the physical cause of
death must be one of the attributes of humanity.

Thus we argue from the death of Socrates, Plato, etc., up to
'All men are mortal,' and down again from 'All men are mortal'
to the mortality of men now living.

UNIVERSAL MAJOR PREMISS.

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            ┌─────────────┐
            │ All men are │
            │ mortal.     │
            └─────────────┘
   INDUCTION ↗         ↘ DEDUCTION

      * * * *             * * * *
  ┌─────────────┐     ┌─────────────┐
  │ Men who     │     │ Men now     │
  │ have died.  │     │ living.     │
  └─────────────┘     └─────────────┘
```
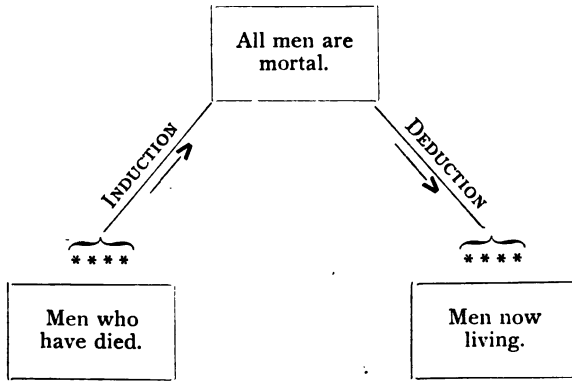
309 Induction is arguing from a less general to a more general truth, or from particular facts to general truths. The principles on which Induction rests are—

310 (1) The **Law of Causation,** viz. 'every phenomenon has a cause.'

311 (2) The **Law of the Uniformity of Nature,** viz. 'the same cause (under the same conditions) always produces the same effect.'

312 When are we justified in arguing from a few members of a class to the whole class ?

When we have got hold of a *cause*, and can apply the principle that 'the same cause always produces the same effect.'

313 It is the application of this principle which distinguishes true Induction from all other processes : true Induction (i) discovers causes or effects ; and therefore (ii) leads to new truths.

There are three processes which resemble Induction **314** but are not Induction : (1) ' Perfect Induction ' (so-called), (2) Geometrical Induction, (3) Colligation.

(1) '**Perfect Induction**,' where we *examine all the* **315** *cases* before coming to a conclusion about them. E.g. Sunday, Monday, Tuesday . . . Saturday, are derived from names of heathen deities, ∴ all the days of the week are derived from names of heathen deities.

This is not true Induction, because the conclusion is **316** not more general than the premisses. It is one of an unimportant class of arguments called neither induction nor deduction, but **Traduction** : because in them the premisses and the conclusion are *equally* general. [Another instance of Traduction would be—

> Mr. Balfour is the present Conservative leader.
>
> The author of ' Philosophic Doubt ' is Mr. Balfour.
>
> ∴ The author of ' Philosophic Doubt ' is the present Conservative leader.

Here the premisses and the conclusion are all singular propositions.]

Perfect Induction is so called only because of its **317** absolute certainty : it tells us nothing which we did not know already. It must be carefully distinguished from **Imperfect Induction.** Imperfect induction, in spite of its name, is **true** or **scientific** induction. It is only called 'imperfect' because it is possible to raise arguments about its absolute validity. A typical instance of a scientific induction would be, 'a mixture of tartaric acid and carbonate of soda will always effervesce because this one does.' ('Method of Difference,' § 339.)

(2) **Geometrical Induction**, or **Induction by** **318** **parity of reasoning**, is not true induction either. It is a *deductive* proof assisted by a particular instance. E.g. you describe a triangle A B C, and by the help of

your diagram you prove that the three interior angles of a triangle = two right angles. Is not this an induction from one triangle A B C to a general law about all triangles? No: because you prove your conclusion, not *from* the triangle A B C, but *from* the axioms of geometry *by means of* the triangle A B C: you could prove it, *by similar reasoning*, of any triangle.

319   (3) **Colligation** again is not induction, but only a summing up of particular facts under a general conception.   E.'g. you sail round a piece of land in the sea, observe it from different points, and conclude that it is an island.

When Kepler took various points on the orbit of Mars, and concluded that it was an ellipse, this was colligation.   If you went on to argue that because Mars moved in an ellipse, the rest of the planets probably did so, this would be a kind of induction [§ 320].

These three processes then are not induction, because the conclusion is not more general than the premisses.

320   There is another process in which the conclusion *is* more general than the premisses, but which is not scientific induction because it does not discover a *cause*.

Induction by simple enumeration is an inference from previous experience alone.   Because B has always accompanied A, therefore it always will.

321   This form of induction is not valid because it does not ascertain a cause, like true induction.   B may always in our experience have accompanied A, but until we know that A is the cause of B we cannot tell that it always *will*.   'All swans are white' was an induction by simple enumeration, based on thousands of instances, which was disproved after the discovery of Australia where black swans were found.

322   Such inductions are always ʻexposed to peril from an instance to the contrary' (Bacon): but—

(1) They have some value when there is good reason

to believe that if there were an instance to the contrary we should have met with it. 'The sun will rise to-morrow,' or the 'Law of the Uniformity of Nature' itself, are only inductions by simple enumeration.

(2) An empirical [§ 323] law may be of use by suggest-ing an experiment. Newton observed that many bodies which possess high refractive powers (turpentine, olive oil, etc.) are combustible. As the diamond is highly refractive, it occurred to him to try whether it might not also be combustible, and it proved to be so.

A law founded on induction by simple enumeration is **323** called an **empirical law.** .

E. g. Horned animals always chew the cud.

> Alloys are almost always more fusible than the separate metals of which they are com-posed.

The name of **empirical law** is also given to laws founded on scientific induction but not yet explained by being derived from other laws (§ 394 ff.). E. g., we know that quinine is a cure for ague, but we do not know *why*: though we may be said to have proved by the Method of Agreement, or even of Difference (§§ 337, 339) that quinine is a cause of the cure.

So an **empirical law** is best defined as an invariable co-existence or sequence of phenomena (§ 390), *either* not known to be one of cause and effect, *or* not yet explained.

The practical point is that an empirical law is one which we hesitate to rely on under changed conditions.

An empirical law in the first sense is opposed to a **law of causation**[1], in the second sense, to a derivative law (§ 392).

[1] I. e. any case in which we have discovered a cause.

CHAPTER II.

CAUSE AND EFFECT. OBSERVATION AND EXPERIMENT.

324 A **phenomenon** (φαίνεσθαι) is any thing, attribute, or event, manifest to the senses.

325 An **antecedent** is a phenomenon occurring before any other phenomenon [1].

326 A **consequent** is a phenomenon occurring after any other phenomenon.

327 A **cause** is a necessary antecedent, i.e. an antecedent which must be, if a given consequent is to follow.

328 An **effect** is a necessary consequent, i.e. a consequent which must follow a given antecedent.

329 N.B.—A cause is more than an 'invariable antecedent,' because, e.g., night invariably precedes day but is not the cause of it.   If you define cause as 'an invariable *unconditional* antecedent,' you repeat the word to be defined, because a condition means a part of a cause : see next section.

330 Distinguish **Cause, Condition, Occasion.**

When a gun is fired we say that *pulling the trigger* is the *cause* of the discharge. Really it is the *occasion*.

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[1] The word is sometimes extended to a phenomenon coexisting with another phenomenon, but conceived of as its *cause*.

For the discharge depends on a number of other circumstances, the powder, the cap, etc. These are the *conditions* of the discharge : and the *condition* + the *occasion* make up the whole *cause*.

Thus a **condition** is one of the previously present, **331** or less striking, parts of a cause : an **occasion** is the part of a cause which immediately precedes the effect and attracts our notice.

However we constantly use the word *cause*, even in scientific discussions, to denote the *occasion*.

Elimination is the dismissal of antecedents which **332** are not causes, or of consequents which are not effects. A change of the moon may often be an *antecedent* to a change in the weather : but if we **generalise**, i.e. widen our experience, we soon notice that a new phase of the moon may not be followed by a change in the weather, and therefore is not a *cause* of it.

Distinguish **Observation from Experiment.** **333**

In **Observation** we watch nature as it works : in **Experiment** we make nature, as far as possible, work for us, and observe the result. *The advantages of experiment over observation* are that (1) we can separate or *analyse* phenomena which nature only gives us *combined* : (2) we can *isolate* phenomena from disturbing elements ; e.g. sounds which we wish to study from other sounds : (3) we can get phenomena in manageable and definite quantities : and (4) we can make an event take place when we wish, instead of having to wait for it. For examples, compare what could have been discovered about electricity by observing thunderstorms, with what has been discovered by the electric machine.

The advantages of observation over experiment are (1) it **334** can be used when experiment cannot ; some phenomena it is physically or morally impossible to produce, e. g.

an earthquake, or a famine: and (2) observation must be resorted to whenever you know the *effect*, and want to discover the cause. For if you do not know the cause, you cannot by experiment produce the effect.

335 To what errors is observation liable ?

We are apt (1) to confuse facts observed with inferences from those facts; e.g. people long supposed that they *saw* the sun go round the earth: (2) to observe only what confirms our previous ideas and to neglect what does not; e.g. people notice cases that confirm popular superstitions and neglect cases in which 'nothing happened.'

CHAPTER III.

THE INDUCTIVE METHODS.

There are five methods of applying observation or **336** experiment to phenomena in order to find the cause of a given effect, or the effect of a given cause.

I. Method of Agreement.   337

The principle on *canon* of this method is ' *The sole invariable antecedent of a phenomenon is probably its cause* ': i. e. if a number of instances of a phenomenon agree in one circumstance and in nothing else, that circumstance is probably the cause of the phenomenon.

Suppose we want to discover the cause of the disagreeable sensation which accompanies an east wind. We try to find some phenomenon present in all east winds, however much they differ in other ways. East winds may be hot or cold, wet or dry, gentle or violent, etc. ; but they all agree (in Western Europe) in having blown for a great distance over the surface of land. This is probably the cause of the disagreeable sensation, because it is the only thing in which they all agree.

' The Method of Agreement is liable to be 338 vitiated by the Plurality of Causes.'

The Plurality of Causes means that the same phenomenon may be produced by different causes on different occasions: e. g. a blister may be produced by great heat or great cold.

> N.B.—The plurality of causes does *not* mean that the same effect may be produced by many causes acting together ; for this, see §§ 401 ff.

To illustrate the plurality of causes: suppose you mix three different kinds of poison with water and give it to three people : they all die, but you cannot argue that the water is the cause of death, though it is the only invariable antecedent.

The ' plurality of causes ' can often be obviated by the Double Method of Agreement [§ 345].

339   II. Method of Difference.

Canon. Two groups of phenomena are exactly alike, except that an antecedent and a consequent are present in one and absent in the other. That antecedent is a cause of that consequent, or a necessary part of its cause.

In using this method we generally use experiment: we generally *make* the two groups of phenomena which it requires, by adding or taking away an antecedent, and observing that a consequent appears or disappears.

E. g. Ring a bell in a receiver full of air. Exhaust the air and ring the bell again. No sound will be heard. Therefore the presence of air is - an indispensable part of the cause, or an indispensable condition, of sound.

340   Now and then, observation will give us such an instance. On a cloudy night, no dew is formed. If the clouds just overhead .clear away and leave a patch of open sky, dew will begin to be deposited immediately, and we conclude that a clear sky is a condition of dew. (Cp. the real case on p. 139.)

341   In these instances the groups of phenomena required by the method are *successive*. They may also be *simultaneous*. E. g. to try the effect of a certain manure on a wheat crop, you would not try it one year, and compare the result with the year before, for the weather might be different. You would take two fields exactly alike and try the manure in one of them and not the other.

342   Applications of the Method of Difference to politics or sociology are rough and uncertain. Suppose you want to make out the effects of a strict or lax administration of the Poor Law. It is

very hard either to find two unions agreeing exactly in everything which can effect the condition of the poor except Poor Law administration ; or, if a change of administration is introduced, to make sure that nothing else has changed at the same time. Here the 'Deductive Method' comes in (§ 385, cp. § 370).

The Method of Difference is *not* affected by the Plur- **343** ality of Causes [see § 359 (3)].

> N.B.—In the Method of *Agreement* the instances *differ*, **344** in the Method of *Difference* the instances *agree;* except in the presence of one antecedent and one consequent. But as the one antecedent and consequent in which the instances agree or differ are the most important of all, being proved to be cause and effect, *their* agreement or difference gives the name to the methods.

III. Double Method of Agreement. 345.

This Method adds to the positive instances required by the Method of Agreement a set of **Negative Instances,**[1] intended to overcome the difficulties caused by the Plurality of Causes.

Instance of the Double Method. A fever has broken **346.** out in a town ; what is the cause ? The patients vary in age, general health, circumstances, etc., but they are all supplied with milk from the same dairy. You suspect (by the Method of Agreement) that some taint in the milk has caused the fever. Suppose the dairy-man pleads the 'plurality of causes'; viz., the possibility that some of the patients have got the fever by direct infection, others from bad drains, others from poor living, none from the milk. How would you answer him ? You would see whether those who did *not* drink the milk from his dairy were also free from the fever. If you could say, 'Here are a number of people living under much the same circumstances as the fever

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[1] A *Negative instance* is one in which a given phenomenon does *not* occur, and which confirms or overthrows an Induction. E.g. in § 339, the case of the bell *not* ringing in the absence of air : in § 321 the occurrence of swans which were *not* white.

patients, some exposed to direct infection, some to bad drains, some to semi-starvation, but none of them drink the milk from your dairy and none of them have fever,' then the case against the milk would be much strengthened; because you could point to instances in which the other *possible* causes of the fever had not produced it.

347   N.B.—You would not use this method if you could use Difference. But you can *neither*, if anyone drinks the milk and gets the fever, be sure that the milk is the only new antecedent, *nor* find two people exactly alike in everything likely to produce fever except that one has drunk the milk and the other has not.

348   The Double Method of Agreement, or Method of Positive and Negative Agreement, is sometimes wrongly called 'the Method of Agreement and Difference.' But as we have seen it is used just where the Method of Difference cannot be.

349   Its *canon* is : 'If two or more instances in which a given phenomenon occurs have only one antecedent in common, while two or more *similar* instances in which it does not occur have *not* that antecedent, the antecedent present in the first set and absent in the second set is probably the cause of the phenomenon.' (In the instance above, the phenomenon is the fever, and the antecedent is the milk from the suspected farm.)

350   **IV. Method of Concomitant Variations.**

  Canon.   If two phenomena always vary together, they are probably cause and effect, or at least causally connected.

  N.B.—This method is certain, *if other phenomena remain the same* : a result which generally speaking can only be secured by *experiment.*   Even when other things do not remain the same, a probable result may be reached if the variations correspond closely.

351   *Instances—*

  The more friction there is in the way of any moving

body, the sooner it stops, ∴ friction is the cause of cessation of motion.

The more highly the brain is organised, the more intelligent is the animal to which it belongs, ∴ brain organisation and intelligence are causally connected.

The first of these instances is *experimental;* you can construct **352** a number of surfaces rougher and rougher, and presenting more and more friction to a moving body, and you can calculate the exact rate at which friction increases and speed diminishes while isolating them both.

In the second instance we have *observation*, not experiment; the other phenomena do not remain the same, because the animals which we compare vary in all sorts of ways besides intelligence and brain organisation.

Concomitant Variations is sometimes of use in politics and **353** sociology where Difference [§ 342] cannot be used. Suppose, e.g., that statistics show a close correspondence between a diminution in convictions for drunkenness and an increase of money in savings-banks—whether in one town in successive years, or in different towns at the same time ;—even if other things do not remain the same, we should be justified in concluding that both improvements, if not actually cause and effect, depended on some common cause, improvement in wages or education.

Another application of Concomitant Variations, when we can **354** only observe, not experiment, is to **Periodic Changes** ; i. e. variations in natural phenomena occurring at regular intervals and apparently obeying some law. Suppose two geysers, acting at intervals, one of an hour, the other of a quarter of an hour, and the former about four times the size of the latter : we should infer some connection between them.

V. Residues.   355

Canon. Subtract from a set of consequents that part which is known to be the effect of certain antecedents : the remaining consequent will be the effect of some remaining antecedent.

This method differs from the others : it is a method of observation, not of experiment, but you know a good deal about the phenomenon observed beforehand, and

can *calculate* what effects are due to what causes. When you find that one of the effects cannot be accounted for, it sets you hunting for an unknown cause.

356   *Instances—*

(1) A ball is going on: half the windows are open: two fires are burning: all the doors are shut: but the room is several degrees hotter than it ought to be. You search for the cause of this extra effect, and find a chimney on fire next door.

(2) It was observed that the planet Uranus was not exactly where it ought to have been if the attraction of the sun and the other planets were the only causes at work. It was guessed that the attraction of another unknown planet was the cause of the difference, and a new planet, Neptune, was discovered.

357   N.B.—The remaining consequents, in cases of the Method of Residues, are called '**Residual Pheno-mena.**' E.g. in the last instance, the difference between the actual and the calculated position of Uranus.

358   To apply all the five methods to a matter of ordinary life:— Suppose you want to ascertain the effect of strong tobacco on your health. You suspect that a slight headache after dinner is caused by smoking strong tobacco in the morning. If you could spend two days exactly alike in every way that could affect your health, except that on one day you smoked and had the headache, and on the other you did not smoke and did not have the headache, you would settle the question by the Method of Difference. But it is almost impossible that two days should be so much alike as that.

If, on the first day, when you smoked and had the headache, you could think of nothing but the smoking which could have caused the headache, this would be the Method of Residues. But to apply this method, you would have to know a great deal more about the causes acting on your health and their effects than anyone but a doctor would be likely to know.

If the headache got worse every day in proportion to the number of pipes you smoked in the morning, other things which

might cause the headache remaining as they were, you would be pretty sure of a conclusion, by Concomitant Variations.

Perhaps the Double Method of Agreement would be surest. You spend Monday, Tuesday and Wednesday in different ways, except that you smoke and have a headache : this is the Method of Agreement. But you persuade yourself that the headache has nothing to do with the smoking, but was caused by over-reading (say) on Monday, over-exertion on Tuesday, and sitting in after lunch on Wednesday (Plurality of Causes).

On Thursday, Friday and Saturday you don't smoke and don't have a headache. But in other respects you live much the same as in the first half of the week ; you probably work too hard one day, over-exert yourself another, and sit in after lunch a third. As these things have not given you a headache in the last half of the week, the probability is very strong that it *was* smoking and nothing else in the first half of the week.

NOTE.

There are certain formulæ, illustrating the Inductive Methods, which may make them easier for some readers. Antecedents are represented by capitals, consequents by small letters ; the particular cause and effect whose connection we are trying to discover by A (cause), a (effect). In the trivial instance given, § 358, A = smoking strong tobacco; a = headache : B, C, etc., are different circumstances affecting our health ; b, c, etc., their effects.

Method of Agreement.

      A B C followed by a b c.
      A D E   „   „ a d e.
      A F G   „   „ a f g.

Method of Difference.

      A B C followed by a b c.
        B C   „   „ b c.

Double Method of Agreement.

A B C	a b c	
A D E	a d e	First set of instances.
A F G	a f g	

B H	b h	
D L	d l	Second set of instances.
F N	f n	

N.B.—The second set is *similar* to the first : this is shown by the recurrence of B, D, F ; b, d, f ; but not exactly similar : this is shown by changing the other letters. The recurrence of B, D, F, *not* followed by a, shows that none of them can be the cause of a, and, so far, gets over the difficulty of the Plurality of Causes.

Method of Concomitant Variations.

A′ B C	a′ b c.
A″ B C	a″ b c.
A‴ B C	a‴ b c.

Method of Residues.

A/B C   a/b c.

The formula shows the difference between this method and the rest. We have only one instance, and we separate a, the part of the effect a b c not accounted for, from b c, the part known to be the effect of B C, by *calculation*, and so discover the cause, A.

CHAPTER IV.

CHARACTERISTICS AND USES OF THE METHODS.

Compare the Method of Agreement and the Method **359** of Difference.

(1) *The Method of Agreement is the method of observation, that of Difference is the method of experiment.*

When you can only *observe*, you can seldom get two such instances as those required by the Method of Difference, differing only in one circumstance. When you can *experiment* you can add or take away *one* new circumstance: then you have the Method of Difference.

(2) *Agreement is the Method of Discovery; Difference is the method of proof.*

For Agreement suggests experiments which may be tried by Difference. Eating a certain herb is often followed by death: you administer it to a dog, and the dog dies.

(3) The Method of Difference is not liable to be vitiated by the plurality of causes: if you introduce *one* more antecedent and a new consequent follows, the new antecedent must be *one* cause (or part of one cause) of the new consequent, though there may be other causes.

How are Residues and Concomitant Variations alike? **360**

(1) They often require exact *measurement*—knowledge of quantities as well as qualities.

For this reason they are often called **Quantitative**

Methods; Agreement and Difference, in which it is sufficient to know *that* a thing happens, without knowing *how much* of it happens, being called **Qualitative Methods.**

(2) Hence Residues and Concomitant Variations are useful in the *more advanced* stages of science, after the use of the other methods.

361　　What are the characteristics of Concomitant Variations?

(1) There are certain great phenomena called **'permanent causes,'** which you cannot entirely get rid of, e. g. the attraction of the earth, friction, the tides, etc., etc.　As we cannot *eliminate* them so as to employ Difference, we must *vary* them so as to employ Concomitant Variations.

(2) You must not infer from this Method that a phenomenon which varies with another is the entire cause of the other, unless they vary *in such proportions* as to prove this.　We *can* prove in this way that the fall of a heavy body is entirely due to the attraction of the earth, or the retardation of motion to friction.　But though solids and liquids diminish in bulk as heat is withdrawn, they do not diminish at such a rate as to suggest that there is a temperature at which they would vanish altogether.

(3) We must not assume that a variation will continue beyond observed limits.　Water, to which you communicate heat, up to a certain point only gets hotter; when its temperature reaches $212°$ it boils.　It is calculated that gases diminish in bulk, when heat is withdrawn, at such a rate that they would vanish altogether at a certain very low temperature ('absolute zero').　But, before reaching that point they liquefy.

362　　What are the characteristics of the Method of Residues?

(1) It is used where you know a good deal already about the phenomena, and can tell not only *what* effect, but *how much* of an effect is due to a given cause.

(2) In these cases you can generally find out how much of an effect is due to certain causes only by *deduction*: e.g. in astronomy you calculate, by the law of gravitation and the laws of motion, the position of a given planet. Hence most instances of Residues are from deductive sciences like Astronomy and Physics. Thus—

(3) It is useful in case of homogeneous effects. [§ 402.]

Distinguish 'Difference' from 'Residues.' **363**

In Difference you have two separate cases, differing in the presence of an antecedent and consequent: in Residues you have only one case, and distinguish the cause of which you are in search, and its effect, from the other causes and effects only in *thought.*

Distinguish 'Difference' from 'Concomitant Varia- **364** tions.'

In Difference you have the cause or the effect which you are seeking present in one case, absent in the other: in Concomitant Variations the cause and effect are always *present* but they *vary.*

Distinguish Difference from the Double Method. **365**

In Difference you have two *instances* alike in every circumstance but one. In the Double Method you have two *sets of instances* as much alike as possible but not exactly alike: if you could have them exactly alike in every way except one, you would have Difference, and would not want the Double Method.

Never say 'the two sets of instances in the Double Method of Agreement *must not* be exactly alike' etc.: the point is that you *cannot* get them exactly alike, you would if you could.

366   *Degrees of certainty in the Methods.*

Agreement only proves *probable* causation: because of the Plurality of Causes.

Difference proves causation with *certainty.*

The Double Method only proves *probable* causation, because the two sets of instances are only *similar.*

Concomitant Variations proves *causation* with certainty when you can experiment and measure exactly. When you can only observe, and when other phenomena do not remain the same, it only proves *probable causation* or *causal connection.*

Residues, if the conditions can be fulfilled, proves causation with certainty.

367   N.B.—Where we know the *effect* and want to discover the *cause,* we use Agreement, the Double Method, Residues and Concomitant Variations (in its looser form). Where we know the *cause* and want to discover the *effect,* we can use Difference and Concomitant Variations (in its stricter form).

368   *Uses of the Methods in different sciences.*

Difference, being the method of experiment, can be used most in chemistry and physics, where experiment is easiest: *Agreement,* requiring only observation, is used in zoology, geology, meteorology, and other sciences of observation, also in politics and sociology; assisted by the *Double Method: Residues,* involving deduction, in physics and astronomy : *Concomitant Variations,* in the stricter sense [§ 352], in chemistry and physics, where we can measure and weigh exactly; in the looser sense, in politics and sociology.

N.B.—*An inductive science may become wholly or partially deductive* through the discovery of a general law : e.g.

astronomy since the discovery of the law of gravitation ; chemistry, to some extent, since the discovery of the law of atomic proportion.

The inductive methods are not, like the syllogism, rigid for- **370** mulæ which can be applied to any subject indiscriminately. In- ferences by them are generally assisted by deduction from what is known already. E.g We connect the disagreeableness of the east wind with its blowing overland [§ 337], not merely because this is the sole invariable antecedent, but because it is likely to produce such an effect : we infer a connection between sobriety and saving [§ 353], not only from their varying together but from our knowledge of human nature.

CHAPTER V.

HYPOTHESIS AND ANALOGY ;
DEDUCTIVE METHOD.

371 There are three processes which are not true induction because they do not prove causation, but which are often useful as *suggesting* conclusions to be *proved* by true induction: (1) induction by simple enumeration, (2) hypothesis, (3) analogy.

For induction by simple enumeration, see § 320.

372 I. An **hypothesis** is ' an *imagined* cause intended to discover the real cause': or, 'a guess at the explanation of known facts, which may lead to a real explanation.' E. g. the hypotheses that the sun's heat is maintained by contraction due to gravitation; or by the presence of radium in the sun.

373 A **vera causa** = a cause, of which the existence is *known*, but the action or amount *supposed* (for the sake of an hypothesis). E.g. gravitation, in the instance above; the existence of radium in the sun is not at present known (Jan., 1904).

374 The conditions of a **good hypothesis.**

(1) It must be **adequate** to explain the effect which it attempts to explain. Voltaire suggested (in fun) that the fossil sea shells found on mountain-tops were Eastern shells accidentally dropped by mediaeval pilgrims from the Holy Land!—obviously an *inadequate* hypothesis.

(2) It must be capable of proof or disproof by further **375** enquiry. When Galileo discovered that the moon was full of hollows, someone, who wished to keep up the Aristotelian idea that it was 'a perfect sphere,' suggested that the hollows were really filled up by transparent crystal!

(3) A hypothesis must not be incompatible with any **376** known facts. The hypothesis that the sun's heat is due only to combustion is disproved by the fact that an amount of combustion sufficient to account for it would lower the sun's temperature to an extent which we could not fail to observe if such a process were really going on.

The mediaeval theory, that the planets were carried round the earth in solid but invisible spheres of crystal, was disproved by the passage of comets right across the path of these supposed solid spheres.

A **working hypothesis** is one that fulfils these **377** conditions, and is in process of verification.

An '**experimentum crucis**,' **crucial experi-** **378** **ment** or **crucial instance** is one which decides between two rival hypotheses (crux = a guide post: it shows which of two roads to take). E.g. Was the rise of the mercury in the barometer due to 'nature abhorring a vacuum' or to the pressure of the atmosphere? If the latter, the pressure would be diminished on going up a mountain and the mercury would fall. Pascal tried the experiment, and found that it did.

II. **Analogy** (*a*) in the Aristotelian and popular **379** sense = a resemblance of *relations*. E.g.—

Governors are to peoples as ships' captains to passengers: passengers must not interfere with captains, ∴ peoples must not interfere with governors. (Plato.)

Governors are to peoples as cooks to eaters of dinners: the guest is a better judge of the dinner than the

cook, ∴ peoples are better judges of administration than governors. (Aristotle.)

Such arguments only have any value when they *suggest* true causes : they cannot *prove* causes. The first instance above is a good analogy in times of revolution : the second suggests a fairly sound argument for democracy under ordinary conditions.

380 A **False Analogy** is one where there is no real resemblance of relations : e.g. 'Ancient books are worthless, because only rubbish floats on the stream of time.'

381 **Analogy** (*b*) in the scientific sense = a resemblance of things in certain qualities, from which we infer a resemblance in certain other qualities : A is like B in qualities C D E, ∴ it is *probably* like it in F.

Mars resembles the earth in many ways : both have an atmosphere, sea and land, and (probably) snow at the poles : ∴ they *may* resemble each other in being inhabited.

382 What are the conditions of a good Analogy ?

(1) The two things must be pretty well known to us : agreement in a few qualities, when innumerable qualities are unknown—e.g. an analogy between one comet and another—would prove little.

383 (2) The qualities in which the two things are known to *agree* must be numerous, in proportion to those in which they are known to *disagree*. The moon and the earth agree in a good many things : but they are known to disagree in many more : e.g. the absence of air and water in the moon : hence we cannot argue from the earth to the moon by analogy.

384 **How does Analogy differ from Induction ?**

In both we argue 'A is like B in the quality or qualities C, ∴ it is like B in the quality D.' But in induction

we know or have good reason to think that C is the *cause* of D. In analogy there is only a possibility that the cause of D is among the qualities denoted by C.

'Animal life is impossible in a vacuum : the moon resembles a vacuum in the absence of air, ∴. Animal life is impossible in the moon.' This is an induction : because the presence of air is a condition of animal life.

'Mars resembles the earth in several particulars, and there is a chance that among these is the (unknown) cause of animal life on the earth, ∴. Animal life may exist in Mars.' This is an analogy.

III. **The Deductive Method.** 385

Really the type of most reasoning, ordinary and scientific : more so than either Syllogism or Induction by themselves. Cp. § 370.

It has **three stages** :—

    (1) **Induction** or **Hypothesis.**
    (2) **Deduction** (=**Ratiocination**).
    (3) **Verification.**

The first stage, though called Induction, *need not be a* **386** *strict Induction.* It may be a guess (hypothesis), or an analogy, or an induction by simple enumeration. The defects in the first stage are made up for in the second and third.

In plain language this methods amounts to— **387**

    (1) Seeing what we know already about a thing, or making a guess about it ;

    (2) Calculating what will follow when we put together what we know, or what will happen if our guess is right ;

    (3) Trying whether it *does* happen.

Instances.—There are in many places (e. g. near Settle, in Yorkshire) wells which rise and fall. To explain the cause (1) you *guess* that it is due to chambers and

channels in the rock through which the water passes : (2) you *calculate* by the laws of hydraulics what their size and shape must be : (3) you construct a model of what you suppose them to be and run water through them into a tank like the well. If the water ebbs and flows, as it does in the real well, you have probably discovered the cause of the ebb and flow.

389   (1) Newton, on seeing the fall of an apple, guessed that the same force which made heavy bodies fall to the ground, attracted the moon, sun, &c., to the earth, and to one another. He also guessed (on certain grounds) that this force, as between any two bodies, varied inversely as the square of their distance from each other.

(2) Newton then calculated by a long train of mathematical reasoning, making separate calculations for the moon, sun, planets, etc., what their movements should be if this hypothesis was correct.

(3) He then compared his results with the actual movements of the heavenly bodies : beginning with those of the moon. At first the result did not answer to the facts. Not till many years afterwards, when a more accurate calculation of the moon's diameter had been obtained, did he discover that his theory exactly fitted the facts.

CHAPTER VI.

LAWS AND THEIR EXPLANATION.

CONJUNCTION OF CAUSES, ETC.

A **Law** (or '**law of nature**' **in the wider sense**) **390** is the invariable coexistence or sequence of two phenomena, e. g. 'all magnets attract iron.'

Such laws are of three kinds—

(1) **Empirical laws,** founded on Induction by **391** simple enumeration, *or* on scientific induction, but *not yet explained.* See § 323.

(2) **Derivative laws,** sometimes called **scientific 392 laws.** We know in these cases not only that *a* is the cause of *b,* but *why a* is the cause of *b,* and we are certain that wherever *a* is found (unless counteracted, § 399) *b* will be found.

(3) **Laws of Nature in the strict sense** = very **393** general laws, not yet *explained*; but verified on so wide a scale that it is very unlikely that exceptions to them exist. E.g. the law of gravitation, or the law of the persistence of force.

Explanation of Laws or Facts. 394

A law is said to be *explained* when it is shown to follow from one or more other laws.

A fact is said to be *explained* when it is shown to be an instance of a law: e.g. when a London flood is shown to be caused by the law of spring-tides.

395 **What are the ways in which a law is said to be explained ?**

(1) When one law is resolved into several other laws : e. g. when the law that a cannon ball describes a parabola is resolved into the effects of—(a) the first law of motion; (b) the resistance of the air; (c) the law of the earth's attraction.

(2) When an **intermediate link** is discovered between a cause and an effect. ' Hot water cracks thick glass' may be resolved into two more general laws; 'heat causes bodies to expand :' 'unequal expansion fractures brittle bodies.' The inside of a thick tumbler expands faster than the outside if you pour hot water into it.

(3) When two or more laws are found to be instances of one more general law : e. g. all the movements of the heavenly bodies to be the effect of the law of gravitation.

396 Such instances show how '*Science converts empirical laws into derivative laws,*' i.e. by discovering causes. Clocks and watches have often been observed to go too slow in summer, and too fast in winter. So far we have an empirical law. The expansion of the pendulum or balance-wheel in hot weather and its contraction in cold suggested itself as an explanation: and the rates of expansion in different substances were found to explain the facts exactly.

397 Explain '**theory**' and '**fact.**'

'*Theory*' is used sometimes of a hypothesis as opposed to a known law : sometimes of a general law (e. g. theory of gravitation, theory of the tides) as opposed to particular facts. In this latter sense, 'theory' is to be distinguished from 'hypothesis.'

393 In the same way *fact* = (1) what we believe to be true, as opposed to what is false : e. g. 'the law of gravi-

tation is a *fact*': (2) a particular phenomenon opposed to a general law : e. g. ' the theory of gravitation was suggested by the *fact* of an apple falling.'

Are there exceptions to laws of nature ? (or) Can **399** laws of nature be counteracted ? [§ 390].

If we say ' yes,' we do *not* mean that the same cause may fail to produce the same effect : but that two causes may *neutralise* each other. E. g. a stone is acted on at the same time by gravitation, tending to cause it to fall to the earth, and by the muscular action of the hand, preventing it from doing so. Each cause has its full effect, but one neutralises or counteracts the other.

A **tendency** is a cause considered *as producing an* **400** *effect unless* counteracted by another cause.

When two or more causes act together to produce an **401** effect, we speak of **Conjunction of Causes** and **Intermixture of Effects.** But there are two ways in which this may take place.

Conjunction of Causes.
Intermixture of Effects.

| Composition of Causes. Homogeneous Effects. | Combination of Causes. Heterogeneous or Heteropathic Effects. |
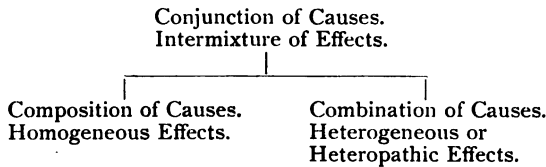
When two causes are acting together, and their com- **402** bined effects are exactly the same as the sum of their separate effects would have been, we have *homogeneous effects* produced by a *composition of causes.* E. g. when a stone is pushed by two sticks at once, it moves to the same place as if it had been pushed first by one and then by the other. If you communicate to water which is already at 150° a certain additional amount of heat, you only raise its temperature to 200°.

K

403   When two causes acting together produce an effect different from the sum of their separate effects, we have *heterogeneous* or *heteropathic effects produced by a combination of causes.* E. g. if oxygen and hydrogen combine they produce water, a substance whose effects are quite different from the separate effects of oxygen and hydrogen. If you communicate to water already at 200° the same amount of heat as in the previous instance [§ 402], its temperature does not rise to 250°, it rises to 212° and the water boils.

404   How can induction be put in the Syllogistic form ?

      (1) Magnets A B C attract iron.
          Magnets A B C are (i. e. represent) all magnets,
     .·. All magnets attract iron.

This is an irregular syllogism in the 3rd fig.; the predicate of the minor premiss is quantified, and there is a universal conclusion.

405   (2) Magnets A B C attract iron.
          All magnets are (represented by) A B C,
     .·. All magnets attract iron.

This is more correct in form, but how do we know that the minor premiss is true ?

406   (3) What is true of magnets A B C is true of all
              magnets.
          Attracting iron is true of magnets A B C,
     .·. Attracting iron is true of all magnets.

407   If asked to prove our major premiss, we can do so, in a case where it is true, by saying: 'What is true of A B C *as effect of cause,* is true of all cases like A B C.'

This is what is meant by saying that **the law of the Uniformity of Nature is the ultimate major premiss of the inductive syllogism.**

N.B.—A 'Perfect Induction' [§ 315 ff.] can be reduced **408** without difficulty to a single syllogism of the form (2). E. g.

> Sunday, Monday—Saturday are derived from names of heathen deities.
>
> All the days of the week are Sunday, Monday —Saturday,
>
> ∴. All the days of the week are derived from names of heathen deities.

CHAPTER VII.

METHOD, CLASSIFICATION, ETC.

409 Method is the arrangement of a subject in such a way that it may be easily intelligible.

410 Analysis is the method which begins with a whole and divides it into parts : and is the *method of discovery.*

411 Synthesis is the method which begins with the parts and puts them together into a whole : and is usually—perhaps too often—the *method of instruction.*

E. g. the scholar who deciphers an inscription in an unknown language, gradually making out the meaning of the separate letters and words, proceeds by *analysis* : the boy who learns grammar, beginning with the noun and the verb, and finding out how they are put together in written composition, proceeds by *synthesis.*

412 *Deductive reasoning is synthetic* : for we begin with simple general principles and deduce complicated results from them ; e. g. in mathematics.

Inductive reasoning is analytic : for in it we take the facts as they stand, and break them up or analyse them into cause and effect by the inductive methods.

413 A priori reasoning = deductive reasoning from generals to particulars.

A posteriori reasoning = inductive reasoning from particulars to generals.

The reason for the names is that Aristotle spoke of general truths as ' prior in natural order ' to particular truths, which, as he thought, were 'later in natural order.' The use of the names does not commit us to his view.

Classification is an arrangement of things ac- **414** cording to their resemblances and differences.

Popular Classification proceeds by the most obvious **415** marks or characteristics of things. It must keep the rules of Logical Division [§ 72], and must be ' appropriate to the matter in hand ' : e.g. a lawyer divides people into minors and adults, etc.; a politician into Conservatives and Liberals, etc.

Scientific Classification (as in zoology, botany, etc.) **416** tries to form classes which will have the greatest possible number of properties in common; and .˙. chooses as a basis of division those differentiae on which the greatest number of properties depend [§§ 50, 51]. E.g. the scientific classification of flowering plants by the character of the seed vessels and arrangement of parts of the flower enables you to make many more general assertions about each class, than the Linnæan classification by the number of stamens and pistils.

Classification in this sense is different from, and much more difficult and important than, Logical Division.

A **terminology** means a set of names for the **417** *qualities* of things in a scientific classification : e.g. for colours, degrees of elasticity, etc.

A **nomenclature** means a set of names for *classes* **418** of things in a scientific classification: e.g. names of elementary bodies in chemistry.

An **axiom** = a self-evident truth, on which other **419** truths depend. E.g. in geometry, 'two straight lines cannot enclose a space '; in logic, the Dictum de Omni et Nullo [§ 181].

420 Abstraction means neglecting accidental qualities in classification. E.g. in forming the class 'triangle' in geometry, we neglect the size and colour of particular triangles.

431 Generalisation may mean the same as 'abstraction' or the same as 'induction': more properly it means 'appealing to a wider experience.' The discovery of black swans showed that the empirical law 'all swans are white' did not hold: but it could not be relied on even before then, because 'generalisation' showed that species of animals and birds often varied in colour [§ 332].

422 Generalisation is used in a different sense for 'giving a wider meaning to a name.' E.g. 'coal' originally meant only charcoal, and was extended to mineral coal. **Specialisation** means 'narrowing the meaning of a name': 'physician' meant originally 'a student of nature,' and was narrowed to the sense of 'doctor.'

EXERCISES IN INDUCTION.

(1) What inductive methods are employed in the following examples?

(*a*) 'The number of cases of small-pox in Essex has been found to bear some relation to the distance of a town or village from the hospital-ship in the direction of the prevailing wind.'

Concomitant Variations : assisted by knowledge of the way in which infection has been found to be conveyed. Valid, if there are more cases as you get nearer to the hospital-ship ; and if there is no other probable explanation.

(*b*) 'The higher the intellectual development of any creature the greater is its capacity for happiness; we may therefore infer that intellectual development is the cause of happiness.'

Concomitant Variations : but the conclusion is incorrectly stated, for we can only prove that intellectual development is *causally connected* with *the capacity for* happiness, which may also be a capacity for unhappiness.

(*c*) 'Since iron rusts both in air and water, the cause of the rust must be the oxygen, which is the only element common to air and water.'

Method of Agreement : needs however further confirmation by experiment, owing to 'plurality of causes.'

(*d*) 'All great generals have been remarkable for the excellence of their commissariat; generals who have failed have not been successful in this respect : therefore attention to commissariat is an indispensable function of a successful general.'

Bad application of Double Method. Attention to commissariat is not the *only* quality in which successful generals agree. Even if it were, plurality of causes would make it impossible to draw a conclusion *by induction only :* there are many conditions of success *which are not present in the second set of instances ;* e.g. skill, foresight, power over men.—It would be easy to prove *by deduction* that attention to commissariat is under ordinary circumstances a condition of success.

(*e*) 'Bodies which fall slowly in air fall rapidly in a vacuum ; therefore the air must exercise some retarding influence upon them.'

Method of Difference. Correct, if the air is the only thing present when bodies fall slowly and absent when they fall rapidly.

(2) What kind of arguments are these?

(*a*) 'A farmer found that his orchard had been robbed. He borrowed for two nights a dog from a neighbouring cottager, and found each morning that his orchard had been robbed again ; he then procured a dog from a distance and found that no further depredations took place. He inferred that the cottager had been concerned in the theft.'

Deductive Method. By Method of Agreement you conclude that presence of neighbour's dog is *probably* part of the cause of the robbery (first stage). You argue that if so, the premisses will be kept safe by any other dog (second stage). You verify this calculation by experiment (third stage). (See §§ 385 ff.)

(*b*) 'Russian and Polish aliens must displace English labour in London, for they do not become chargeable to the rates, as would otherwise be the case.'

The second stage of the 'Deductive Method,' applied in order to discover one cause of want of employment in London. Observation, or a rough application of 'Residues,' suggests alien immigration. You then argue that the aliens must live somehow, that they do not come on the rates, and that therefore they must be doing work which the London unemployed could and would do. The value of the argument depends on the 'verification,' and is of course disputed. When we examine the actual occupations of the aliens (tailoring, furriery, cigar-making, etc.), the question arises whether the aliens have not, in some cases at least, special aptitudes for supplying a demand which without them could only be met by importation.

(3) What inductive methods might be employed to ascertain the following ?—

(*a*) The connection between sun-spots and magnetic storms.

Concomitant Variations. Whenever sun-spots are largest and most numerous, magnetic storms are most violent.

(*b*) The cause of a fire in a theatre.

Residues. It was not an incendiary, for the manager and the theatre are very popular. It was not the ordinary heating apparatus, for that is perfectly safe. Therefore it must have been the plumber with the brazier!

(*c*) The difference in the amount of effort required to cover five miles with a bicycle on a wet or on a dry road.

Difference. Try on two days; wind, condition of bicyclist and bicycle, stoniness of road, etc., being the same.

(*d*) The extent to which the speed of a steamer is impeded by a head wind.

Residues; speed in a calm being known; other circumstances allowed for; and effect of head wind calculated.

(*e*) A plague of wasps in a particular year.

Agreement. You would look for some circumstance common to previous years in which there had been a plague of wasps, e.g. a hot spring, however much the seasons had differed in other respects. If the spring had been cold in previous years when there was no unusual number of wasps, your conclusion would be confirmed by the Double Method.

(4) Analyse the following arguments :—

(*a*) ' I am sure to succeed this time, for I have never failed yet.'

Induction by simple enumeration : gives no ground for a conclusion *in itself.*

(*b*) 'Dogs are capable of memory, affection, and gratitude; they have probably therefore some sort of feeling of right and wrong.'

Analogy of the second or scientific kind [§ 381]. Dogs resemble men in qualities a b c, .·. in quality d. A good enough analogy to set us observing and trying experiments.

(5) What Inductive Methods do the following arguments employ ? Are they correct or incorrect and why ?

(*a*) 'The number of cases of insanity has increased of late years, and so has the number of letters sent by post; therefore letter-writing must be a cause of insanity.'

(*b*) ' In France, Switzerland and the United States (which are all Republics) there is a widespread interest in public affairs. But in Russia, Turkey and China (none of which are Republics) there is no such widespread interest. Consequently a republican government is indispensable to a general interest in public affairs.'

(*c*) 'A town in the South of England introduced a new water-supply; there followed very shortly in that town an out-break of fever. Therefore the fever must have originated in the water supplied by the new waterworks.'

(*a*) Incorrect application of Concomitant Variations. No attempt is made to show either that other things remain the same, or that letter-writing and insanity increase in the same ratio.

(*b*) Incorrect application of the Double Method of Agreement. The instance of Great Britain disproves the conclusion at once. The first set of instances resemble each other in many other things besides republican government, and the second set is not similar enough to the first.

(*c*) Rough application of the Method of Difference. No statement that the new waterworks were the *only* change.

(6) Illustrate scientific methods as applied to the following :—

(*a*) The question whether the planets are inhabited.

The only available method is Analogy, as in §§ 381 ff. :—or Analogy of a slightly different kind, approaching the Method of Agreement. If, e.g., it should prove that the so-called 'canals' on the surface of the planet Mars present a degree of regularity only known to exist in the works of human beings, we might argue tentatively from this effect to its probable cause (as we argue from the exact resemblance between photographs of the moon's surface and photographs of volcanic regions taken from a balloon, that volcanic action has been at work on the moon). Some day we *may* discover enough about the physical causes or conditions of life, and the physical constituents of the planets, to argue deductively.

(*b*) The prevalence of goitre in Alpine districts.

As long as endemic goitre (sporadic goitre may occur anywhere) had attracted notice chiefly in the valleys of the European Alps, a 'sole invariable antecedent' was sought in the (supposed) closeness of the air in these valleys, or the poverty of the mountain villages. Wider experience showed that it was endemic also on tablelands, and, in places, among fairly well-to-do people. Another and more invariable antecedent is now found in the limestone formations to which, in widely differing parts of the world, it is usually confined. But as there are limestone districts in which it does not occur, we only have the Method of Agreement, not the Double Method; and it would seem that the character of the soil is a condition, and not the entire cause, of endemic goitre.

(*c*) The effect of a fog on the transmission of sound.

See Tyndall on Sound, Ed. 4. Observation, too narrowly applied, had led to a belief that fogs obstructed sound. Tyndall's observations off the South Foreland showed that this was not true. On one particularly clear and bright day, fog-horns and guns, which had been audible in a haze from a distance of twelve to thirteen miles, were inaudible three miles off. An hypothesis to account for this was suggested by an observation previously made by Humboldt. He had noticed that the Falls of the Orinoco sounded far louder by night than by day, though the tropical night was noisier than the day; and, as the ground between him and the waterfall was partly rock and partly grass, he had suggested that the interruption of the sound by day was due to the non-homogeneous state of the atmosphere, caused by columns of rarefied air rising over the heated rocks. Tyndall was struck by the idea that the heat of the day must cause a similar

irregular and invisible evaporation from the surface of the sea ; and deduced the inference that a cloud which had just come over the sun would, by diminishing the evaporation, render the sounds audible again : which it did. Another deduction had been practically verified earlier in the day. If such 'acoustic clouds' really obstructed the sounds, they must also cause an echo, which would be audible to anyone landing under the Foreland between the sea and the guns and fog-horns. Tyndall had done so, in order to ascertain that their inaudibility was not due to some accidental derangement, and had heard echoes, nearly as loud as the original sound, from the open sea.

He then confirmed his conclusion by a series of careful experiments (Difference and Concomitant Variations) in which he artificially produced non-homogeneous atmospheres in a laboratory, and tested their effect on the transmission of sounds.

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