ARISTOTLE'S

POSTERIOR ANALYTICS

TRANSLATED

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INTRODUCTORY NOTE.

THE text used is that of the 'Selecta ex Organo Aristoteleo Capitula,' published by the Clarendon Press, and, for portions of the work not included in those selections, the Tauchnitz edition of the Organon (1893). Where the numberings of the chapters differ, the system adopted in the Clarendon Press selections has been followed.

I am much indebted, as regards the short analyses placed at the head of each chapter, to St. Hilaire's 'Logique d'Aristote' (Paris, 1838), and, for the translation, to Dr. Zell's 'Zweite Analytica' (Stuttgart, 1840).

Two chapters of the Prior Analytics (Bk. II. cc. 23, 24) have been added in an Appendix, as illustrating Aristotle's doctrine of Induction and Example.

E. S. B.

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ARISTOTLE'S

POSTERIOR ANALYTICS

BOOK I.

CHAP. I.

Previous knowledge is required for all scientific studies or methods of instruction. Examples from Mathematics, Dialectic and Rhetoric. Previous knowledge as variously expressed in theses concerning either the existence of a thing or the meaning of the word denoting it. Learning consists in the conversion of universal into particular knowledge.

ALL communications of knowledge from teacher to pupil by way of reasoning pre-suppose some pre-existing knowledge. The truth of this statement may be seen from a complete enumeration of instances:—it is thus that the mathematical sciences are attained and every art also. The same is the case with dialectical arguments whether proceeding by means of the syllogism or of induction, for the former kind makes such assumptions as people who understand the meaning admit, the latter uses the recognized clearness of the particular as an indication of the universal, so that both convey their information by means of things already known. So too orators produce conviction in a like

manner, using either Example, which is equivalent to induction, or Enthymeme, which corresponds to syllogism.

Pre-existing knowledge of two kinds is required: one must either assume beforehand that something exists, or one must understand what the word means, while sometimes both sorts of knowledge are required. As an example of the first case we may take the necessity for previously knowing the proposition 'everything must be either affirmed or denied.' Of the second case an instance would be the knowledge of the meaning conveyed by the word 'triangle'; of the combination of both kinds, the knowledge both of what 'Unit' means, and of the fact that 'Unit' exists. The distinction is necessary, since the grounds of certainty differ in the two cases.

Some facts become known as a result of previously acquired knowledge, while others are learned at the moment of perceiving the object. This latter happens in the case of all things comprised under a universal, with which one is already acquainted. It is known to the pupil, before perceiving any particular triangle, that the interior angles of every triangle are equal to two right angles; but it is only at the moment of sense-perception that he learns that this figure inscribed in the semi-circle is a triangle.

In some cases knowledge is only acquired in this latter way, and the particular is not learned by means of a middle term: that is to say, in the cases where we touch the concrete particular, that is in the case of things which are not predicable of any subject. We ought to admit that, even before arriving at particulars, and so obtaining a syllogism, we do, from one point of view perhaps, possess knowledge, although from

another we do not. For how, it may be asked, when he did not know whether the thing existed at all or not, could he have known absolutely that it contains two right angles? The answer is that he knows it from a particular point of view, in that he knows the universal, but he does not know it absolutely. On any other view we shall have the dilemma of the Meno—a man will either learn nothing at all or only what he knows before. This difficulty must not be solved as some try to do. The question is asked, 'Do you or do you not know every dyad to be even?' On receiving an affirmative reply they bring forward some dyad of the existence of which the other was ignorant, and so could not have known it to be even. The solution suggested is to say that one does not know every dyad to be even, but only that which one knows to be a dyad. On the other hand one knows that of which one possesses or has received a demonstration, and no demonstration concerns merely (e.g.) every triangle, or number, one may happen to know, but every possible triangle or number. No demonstrative proposition is taken as referring to 'any number you may know of,' or 'any straight line you may know of,' but to the entire subject. Nothing, however, I should suppose, precludes our knowing already what we learn from one point of view and not knowing it from another. The absurdity would consist not in having some sort of knowledge of what one learns, but in having knowledge of it in a certain respect—I mean in the very same respect and manner in which one learns it.

CHAP. II.

Scientific knowledge of a thing consists in knowing its cause demonstratively. The principles required for Demonstration. Meaning of 'Thesis,' 'Hypothesis,' 'Axiom,' 'Definition.'

WE suppose ourselves to know anything absolutely and not accidentally after the manner of the sophists, when we consider ourselves to know that the ground from which the thing arises *is* the ground of it, and that the fact cannot be otherwise. Science must clearly consist in this, for those who suppose themselves to have scientific knowledge of anything without really having it imagine that they are in the position described above, while those who do possess such knowledge are actually in that position in relation to the object.

Hence it follows that everything which admits of absolute knowledge is necessary. We will discuss later the question as to whether there is any other manner of knowing a thing, but at any rate we hold that that 'knowledge comes through demonstration.' By 'demonstration' I mean a scientific syllogism, and by 'scientific' a syllogism the mere possession of which makes us know.

If then the definition of knowledge be such as we have stated, the premises of demonstrative knowledge must needs be true, primary, immediate, better known than, anterior to, and the cause of, the conclusion, for under these conditions the principles will also be appropriate to the conclusion. One may, indeed, have a syllogism without these conditions, but not demonstration, for it will not produce scientific knowledge. The premises must be true, because it is impossible to know

that which is not, e.g. that the diagonal of a square is commensurate with the side. The conclusion must proceed from primary premises that are indemonstrable premises, for one cannot know things of which one can give no demonstration, since to know demonstrable things in any real sense is just to have a demonstration of them. The premises must be Causal, Better known and Anterior; Causal, because we only know a thing when we have learned its cause, Anterior because anteriority is implied by causation, previously known not only in our second sense, viz. that their meaning is understood, but that one knows that they exist.

Now the expressions 'anterior' and 'better known' have each a double meaning; things which are naturally anterior are not the same as things anterior to us, nor yet are things naturally better known better known to us. I mean by things anterior, or better known, 'to us,' such as are nearer our sense-perception, while things which are absolutely anterior or better known are such as are more removed from it. Those things are the furthest removed from it which are most Universal, nearest to it stands the Particular, and these two are diametrically opposed.

The phrase 'the conclusion must result from primary principles' means that it must come from elements appropriate to itself, (for I attach the same meaning to primary principle [*πρῶτον*] and to element [*ἀρχή*]). Now the element of demonstration is an immediate proposition; 'immediate' meaning a proposition with no other proposition anterior to it. A premise is either of the two parts of a predication, wherein one predicate is asserted of one subject. A dialectical premise is one which offers an alternative between the two parts of the

predication, a demonstrative premise is one which lays down definitely that one of them is true.

Predication is either part of a Contradiction. Contradiction is an opposition of propositions which excludes any intermediate proposition. That part of a Contradiction which affirms one thing of another is Affirmation, that which denies one thing of another is Negation.

I apply the name Thesis to an immediate syllogistic principle which cannot be proved, and the previous possession of which is a necessary condition for learning something, but not all. That which is an indispensable antecedent to the acquisition of any knowledge I call an Axiom; for there are some principles of this kind, and 'axiom' is the name generally applied to them.

A Thesis which embodies one or other part of a predication (that is that the subject does, or does not, exist) is a Hypothesis; one which makes no such assertion a Definition. Definition is really a kind of Thesis; e.g. the arithmetician 'lays it down' that Unity is indivisibility in respect to quantity, but this is not a Hypothesis, for the nature of unity and the fact of its existence are not one and the same question.

Since then belief and knowledge with regard to any subject result from the possession of a demonstrative syllogism, and since a syllogism is demonstrative when the principles from which it is drawn are true, we must not merely have a previous knowledge of some or all of these primary principles, but have a higher knowledge of them than of the conclusion.

The Cause always possesses the quality which it impresses on a subject in a higher degree than that subject; thus, that for which we love anything is dear in a higher degree than the actual object of our love. Hence if our knowledge and belief is due to its primary prin-

ciples, we have a higher knowledge of these latter and believe more firmly in them, because the thing itself is a consequence of them. Now it is not possible to believe less in what one knows than in what one neither knows nor has attained to by some higher faculty than knowledge. But this will happen unless he whose belief is produced by demonstration has a previous knowledge of the primary principles, for it is more needful to believe in these principles, either all or some, than in the conclusion to which they lead.

Now in order to attain to that knowledge which comes by demonstration one must not only be better acquainted with and believe more firmly in the elementary principles than in the conclusion, but nothing must be better known nor more firmly believed in than the opposites of those principles from which a false conclusion contrary to the science itself can be educed; that is to say if he who possesses absolute knowledge is to be quite immovable in his opinions.

CHAP. III.

Certain objections met. (1) *That first principles are hypothetical;* (2) *That their consequences establish one another by a circular proof.*

Now some persons, because of the necessity of knowledge of the primary principles, infer that knowledge does not exist, while others suppose that it does exist and that everything whatever is capable of demonstration. Neither of these views is either true or necessary. Those who assume that knowledge is not possible at all, think that it would involve an infinite regress, since one cannot know the later terms of a series by

means of the earlier when such a series has no primary terms. In this they are right, for it is impossible to complete the infinite. But if there be a limit to the regress, and primaries do exist, they say that these must be unknowable, supposing that they admit of no demonstration, which is the only way of knowing they allow to exist. But if it be impossible to learn these primary principles, one cannot know their results either absolutely or in any proper sense, but only hypothetically, viz. on the assumption that such principles do exist.

The other party agrees with them in holding that knowledge can only be attained by demonstration, but considers that there is nothing to prevent a demonstration of everything being given, maintaining that demonstration may proceed in a circle, all things being proved reciprocally.

We, on the other hand, hold that not every form of knowledge is demonstrative, but that the knowledge of ultimate principles is indemonstrable. The necessity of this fact is obvious, for if one must needs know the antecedent principles and those on which the demonstration rests, and if in this process we at last reach ultimates, these ultimates must necessarily be indemonstrable. Our view then is not only that knowledge exists, but that there is something prior to science by means of which we acquire knowledge of these ultimates. On the other hand it is clear that absolute demonstration cannot proceed in a circle if it be admitted that the demonstration must be drawn from anterior and better known principles than itself; for it is impossible for the same things to be both anterior and posterior in relation to the same objects, except from a different point of view, e.g. some things may be anterior relatively to us and others abso-

lutely anterior, a distinction which inductive proof illustrates. If this be so the definition of absolute knowledge might be considered defective, since it really has a double sense; or that second kind of demonstration drawn from principles better known in relation to us is ambiguous.

Those who hold that demonstration proceeds in a circle not only meet with the difficulty already mentioned, but really say that 'this is if this is,'—an easy method of proving anything whatsoever. This appears plainly when three terms are assumed (for it is immaterial whether one says that the proof passes through many or few terms before returning to the starting point, as also whether it be through a few or two only). For when:

	If A is, B must be
and	If B is, C must be
Then	If A is, C will be
And when	If A is, B must be
and	If B is, A must be (for that

is how the circular proof proceeds). Let A be placed in the position C held before. Then to say that 'If B is, A must be,' is equivalent to saying that C must be, and this proves that 'If A is, C must be'; and C is here identical with A.

Thus those who hold that the demonstration proceeds in a circle simply declare that if A is, A must be—an easy method of proving anything.

Nor is even this proof possible except in the case of reciprocals such as Properties. It has been already shewn (Prior An. II. 5) that it is never necessary that a conclusion should follow when only one thing is assumed (by 'one thing' I mean one term or one proposition); such can only happen when there are at least two antecedent propositions capable of producing a syllogism.

If then A be a consequence of B and of C, and these latter consequences of each other, and also of A, it is possible to prove reciprocally all the questions that can be raised, in the first figure, as has been shewn in the treatise on the Syllogism (Prior An. II. 5). But it has also been shewn that in the other figures no circular demonstration can be effected, or none concerning the premises in question.

Circular demonstration is never admissible in the case of terms not reciprocal. Hence, as few such terms occur in demonstrations, it is clearly useless and untrue to maintain that demonstration consists in proving each term of a series by means of the others, and that consequently everything is demonstrable.

CHAP. IV.

Demonstration deals with necessary truths. The definition of 'distributively true,' 'essential,' 'universal.'

Now since the object of absolute knowledge can never undergo change, the objects of demonstrative knowledge must be necessary. Knowledge becomes demonstrative when we possess a demonstration of it, and hence demonstration is a conclusion drawn from necessary premises. We must now then state from what premises and conclusions demonstrations may be drawn; and first let us define what we mean by 'Distributively true,' 'Essential' and 'Universal.'

By 'Distributively true,' I mean a quality which is not merely present in some instances and absent in others, or present at some times and absent at others; e.g. if the quality 'Animal' be distributively predicable of man, if it be true to say 'this is a man,' it must also

be true to say 'this is an animal'; and if he be the one now, then he must be the other now; so too if 'Point' be true of every line. An empirical proof of this is the fact that when the question is raised whether one thing is true of another distributively, our objections take the form of asserting that it is not true of some particular instance or at some particular time.

I. 'Essential' qualities are all those which enter into the essence of a thing, (as 'line' does into that of 'triangle,' and 'point' into that of 'line'; for 'line' and 'point' belong to the essence of 'triangle' and line respectively), and are mentioned in their definition.

II. Essential qualities are, further, attributes of subjects in the definition of which the subject is mentioned, thus 'Straight' or 'Curved' are essential attributes of 'Line'; 'Odd' or 'Even' of 'Number'; as also 'Prime' and 'Compound,' 'Equilateral' (as 3) and 'Scalene' (as 6); in all these cases the things form part of the definition of the real nature of the attributes mentioned, these things being in the first instance 'Line,' in the second 'Number.' So too in other instances I call attributes which inhere in either of these ways 'essential,' while attributes which do not belong to the subject in either of these ways I call 'accidental'; e.g. 'Musical' or 'White' as applied to 'Animal.'

III. Thirdly, essential is that which is not predicated of anything other than itself as attribute of subject; thus if I say, 'the walking thing,' some other independent thing is 'walking' or is 'white.' On the other hand substances and everything which denotes a particular object are not what they are in virtue of being anything else but what they are. Things then which are not predicable of any subject I call 'essential,' those which are so predicable 'accidental' [in the sense of dependent].

IV. In a fourth sense the attribute which exists in a subject as a result of itself is essential, while that which is not self-caused is accidental. E.g. Suppose lightning to appear while a person is walking. This is accidental, for the lightning is not caused by his walking, but, as we say, 'it was a coincidence.' If, however, the attribute be self-caused it is essential: e.g. if someone is wounded and dies, his death is an essential consequence of the wound, since it has been caused by it:—the wound and death are not an accidental coincidence. In the case then of the objects of absolute knowledge, that which is called 'essential' in the sense of inhering in the attributes or of having the latter inhering in it is self-caused and necessary; for it must inhere either unconditionally or as one of a pair of contraries, e.g. as either straight or curved inhere in line, odd or even in number. Contrariety consists in either the privation or the contradiction of a quality in the case of homogeneous subjects: e.g. in the case of numbers 'even' is that which is not 'odd,' in so far as one of these qualities is necessarily present in a subject. Hence, if one of these qualities must be either affirmed or denied, essential attributes are necessary. This then may suffice for the definition of Distributive and Essential.

By 'Universal' I mean that which is true of every case of the subject and of the subject essentially and as such. It is clear then that all universal attributes inhere in things necessarily. Now 'essentially' and 'as such' are identical expressions: e.g. Point and Straight are essential attributes of line, in that they are attributes of it as such. Or again the possession of two right angles is an attribute of triangle as such, for the angles of a triangle are essentially equal to two right angles.

The condition of universality is satisfied only when it is proved to be predicable of any member that may be taken at random of the class in question, but of no higher class; e.g. the possession of two right angles is not a universal attribute of figure, for though one may demonstrate of a particular figure that it has two right angles, it cannot be done of any and every figure, nor does the demonstrator make use of any and every figure, for a square is a figure, but its angles are not equal to two right angles. Any and every isosceles triangle has its angles equal to two right angles, but it is not a primary, 'triangle' standing yet higher. Thus any primary taken at random which is shewn to have its angles equal to two right angles, or to possess any other quality, is the primary subject of the universal predicate, and it is to that demonstration primarily and essentially applies; to everything else it applies only in a sense. Nor is this quality of having its angles equal to two right angles a universal attribute of isosceles triangle, but is of a wider application.

CHAP. V.

Demonstration must disregard all accidental circumstances, and aim at the discovery of the essential and universal.

We must not fail to notice that mistakes frequently arise from the primary universal not being really demonstrated in the way in which it is thought to be demonstrated. We fall into this mistake firstly when no universal can be found above the particular or particulars: secondly, when such a universal is found applicable to specifically different subjects, but yet has no name; thirdly, when the universal to be demonstrated stands to the true universal in the relation of part to whole.

In this last case the demonstration is indeed appli-

cable to all the particular parts, but will not contain a primary universal. I consider the demonstration to be primary and essential when it is a demonstration of a primary universal. If then it were to be proved that perpendiculars to the same line are parallel, it might be thought that this was the primary subject of the demonstration because it is true in the case of all right angles so formed. This, however, is not the whole truth. The lines are parallel not because each of the angles at their base is a right angle, and consequently equal to the other, but because such angles are in all cases equal to two right angles.

So, too, if there were no other kind of triangle than the isosceles it might be supposed that the quality of possessing angles equal to two right angles was true of the subject as isosceles. Again, the law that proportionals, whether numbers, lines, solids, or periods of time, may be permuted, would be a case, as it used to be proved, viz., of each case separately, though it may really be proved of all together by means of a single demonstration; but since no single designation included magnitudes, times and solids, and since these differ specifically, they were treated of separately. The law is now, however, proved universally. It does not apply to numbers or lines as such, but only because it belongs to the universal conception as such in which all are supposed to be. Hence even if it be proved of equilateral, scalene and isosceles triangles separately, whether by means of the same or by different proofs that every one has its angles equal to two right angles, one will not know except accidentally, that triangle possesses this quality nor will one know it of the universal triangle, even though there is no other sort of triangle than those mentioned. One does not in fact

know it of triangle as such, nor yet of every individual triangle, except distributively, nor does one know it of every triangle ideally, even if there is no triangle of which one does not know it.

When, we may ask, is our knowledge not universal and when is it absolute? It is clear that our knowledge of the law would be universal if triangularity and equilateral triangularity were identical in conception. If, however, the two concepts be not identical but diverse, and if the quality in question belong to triangle as such, then a knowledge of the law as relating merely to a particular form of triangle is not universal. Now does this quality belong to triangle as such, or to isosceles triangle as such? Further, what is its essential primary subject? Also, when does the demonstration of this establish anything universal? Clearly when, after the elimination of accidental qualities, the quality to be demonstrated is found to belong to the subject and to no higher subject. For example, the quality of having its angles equal to two right angles will be found to belong to bronze isosceles triangle, but will still be present when the qualities 'bronze' and 'isosceles' are eliminated; so too, it may be said they will cease to be present when Form or Limit are eliminated. But they are not the first conditions of such disappearance. What then will first produce this result? If it is triangle, the quality of having two right angles belongs to the particular kinds of triangles as a result of its belonging essentially to triangle, and the demonstration in regard to triangle is a universal demonstration.

CHAP. VI.

For necessary conclusions necessary premises are required.

IF then demonstrative knowledge be derived from necessary principles (and that which one knows is never contingent), and if the essential attributes of a subject be necessary (and essential attributes either inhere in the definition of the subject, or, in cases where one of a pair of opposites must necessarily be true, have the subjects inhering in their definition), then it is clear that the demonstrative syllogism must proceed from necessary premises Every attribute is predicable either in the way mentioned or accidentally, but accidental attributes are not necessary. We should then either express ourselves as above or lay it down as an elementary principle that demonstration is something necessary, and that if a thing has been demonstrated it can never be other than it is; and consequently that the demonstrative syllogism must proceed from necessary premises. It is indeed possible to syllogize from true premises without demonstrating anything, but not so if the premises be also necessary, for this very necessity is the characteristic of demonstration.

An empirical confirmation of the view that demonstration results from necessary premises is that when we bring forward objections against persons who imagine themselves to be producing a demonstration, we bring our objections in the form 'There is no necessity.' Whether we hold that the things in question are really contingent or only considered to be so for the sake of

a particular argument. It is clear from this that it is folly to suppose oneself to have made a good choice of scientific principles so long as the premise be generally accepted and also true, after the manner of the sophists who assume that 'Knowing is identical with possessing knowledge.' It is not in fact that which is generally accepted or rejected which constitutes a principle, but the primary properties of the genus with which the demonstration deals; nor is everything which is true also appropriate to the conclusion to be demonstrated.

It is also clear from the following considerations that the syllogism can proceed from necessary premises only. If one who, in a case where demonstration is possible, is not acquainted with the cause, can have no real knowledge of the demonstration, then one who knows that A is necessarily predicable of C, whilst B, the middle term by means of which the demonstration has been effected, is not necessary, must be ignorant of the cause of the thing, for in this case the conclusion is not rendered necessary by the middle term; in fact the middle, since it is not necessary, may not exist at all, but the conclusion is necessary.

Moreover if one who now knows (accidentally) the cause of a necessary conclusion remain unchanged while the thing itself remains unchanged, and if, though he has not forgotten it, yet he has no real knowledge of it, then he can never have had any real knowledge of it before. When the middle term is not anything necessary, it may pass away. In such a case, if the man remain unchanged while the thing remains unchanged, he may hold fast the cause of the thing, but he has no real knowledge of the thing itself, nor has he ever had such knowledge. But if the thing denoted by the middle term has not passed away, but yet is capable of doing

so, that which results from it is only the possible, not the necessary; and when one's inference is derived only from the possible one cannot be said to have knowledge in the true sense of the word. When the conclusion is necessary there is nothing to prevent the middle term, by means of which the conclusion was proved from being necessary, for it is possible to infer the necessary from the not necessary, just as one may infer the true from the untrue.

But when the middle term is necessary the conclusion also is necessary, just as true premises always produce a true conclusion. Thus, suppose A to be necessarily predicable of B, and B of C; A then must be necessarily predicable of C. But when the conclusion is not necessary, it is impossible that the middle should be necessary.

Suppose that, Some C is A, and again that All B is A, and that All C is B. But then All C will be A, which is contrary to our original hypothesis.

Since then that which one knows demonstratively must be necessary, it is clear that one ought to obtain the demonstration by means of a necessary middle term. Otherwise one will neither know the cause of the thing demonstrated nor the necessity of its being what it is, but one will either think one knows it without doing so (that is if one suppose to be necessary that which is not necessary), or one will think one knows it in a different way if one knows the fact of the conclusion with the help of middle terms, and when one knows its cause without the help of middle terms. Now there is no demonstrative science of accidents (attributes) which are not essential according to our definition of 'essential.' It is not in this connection possible to prove that the conclusion is necessarily true, for the accidental *may* not be true; (it is of accidents of this kind that I am speaking).

A difficulty might perhaps be raised as to why accidental premises are asked for for the purposes of a conclusion, if the conclusion drawn from them be not necessary; for it might be maintained that it would make no difference if any sort of premise were brought forward and then the conclusion were subjoined. Premises should however be laid down not because the conclusion is necessarily true because of them, but because the person who admits the premises must necessarily admit the conclusion, and his admission will be correct if the premises are true.

Now since only the essential attributes of any genus and those belonging to it as such are necessary, it is clear that scientific demonstrations both deal with and are drawn from essential attributes. As accidental attributes are not necessary one does not require to know the cause of the conclusion, not even if this be an eternal attribute without being essential, as in the case of syllogisms based on universal concomitance. In this latter connection the essential will be known, but not the fact that it is essential, nor yet why it is so. (By 'knowledge of why it is essential' I mean 'knowing its cause.') In order then to possess knowledge of this sort the middle term must result from the nature of the minor, and the major from the nature of the middle.

CHAP. VII.

Premises must be homogeneous with the conclusion. No transference of premises from one genus to another is valid unless the one is subaltern to the other.

It is not possible to arrive at a demonstration by using for one's proof a different genus from that of the subject

in question; e.g. one cannot demonstrate a geometrical problem by means of arithmetic. There are three elements in demonstrations:—(1) the conclusion which is demonstrated, i.e., an essential attribute of some genus; (2) axioms or self-evident principles from which the proof proceeds; (3) the genus in question whose properties, i.e. essential attributes, are set forth by the demonstrations. Now the axioms which form the grounds of the demonstration may be identical for different genera; but in cases where the genera differ, as do arithmetic and geometry, it is not possible, e.g. to adapt an arithmetical demonstration to attributes of spatial magnitudes, unless such magnitudes happen to be numbers. That such transference is possible in certain connections I will explain later (cf. Chap. IX.).

Arithmetical demonstration is restricted to the genus with which it is properly concerned, and so with other sciences. Hence if a demonstration is to be transferred from one science to another the subjects must be the same either absolutely or in some respect. Otherwise such a transference is clearly impossible, for the extremes and the middle terms must necessarily belong to the same genus, for if not they would not be essentially but only accidentally predicable of the subject.

Hence one cannot shew by means of geometry that opposites are dealt with by a single science nor yet that two cubes when multiplied together produce another cube. Nor can one prove what belongs to one science by means of another except when one is subordinate to the other, as optics are to geometry and harmonics to arithmetic.

Neither is geometry concerned with the question of an attribute of line which does not inhere in it as such, and does not result from the special principles of

geometry, as for instance the question whether the straight line is the most beautiful kind of line, or whether the straight line is the opposite of a circumference, for these qualities of beauty and opposition do not belong to line as a result of its particular genus, but because it has some qualities in common with other subjects.

CHAP. VIII.

The conclusion of a demonstration must be of everlasting application. Perishable things are, strictly speaking, indemonstrable. This applies also to definitions, which are a partial demonstration.

It is clear that if the premises from which the syllogism proceeds are universal, the conclusion of such a demonstration and of demonstration in general must be eternal. There is then no knowledge properly speaking of perishable things, but only accidentally, because the knowledge of perishable things is not universal but under restrictions of time and manner. When this is the case, the minor premise at least must be other than universal and must be perishable:—perishable because then the conclusion will contain a similar element, other than universal because then the predication will apply to some and not others of the subjects in question; so that no universal conclusion can be drawn but only one referring to this or that definite time. The same holds good with regard to definitions, seeing that definition is either the starting point of a demonstration, or itself a demonstration which differs from definition only in the way in which it is expressed or, lastly, in form a conclusion of a demonstration.

Demonstrations and sciences concerning things which occur only frequently (e.g. lunar eclipses) are clearly of everlasting application in so far as they are demonstrations, while in so far as they are not of everlasting application they are particular. As in the case of eclipses so is it with other subjects of the kind.

CHAP. IX.

All demonstration is derived from special principles, themselves indemonstrable, the knowledge of which, in each genus, is the supreme knowledge on which the whole deduction depends.

SINCE it is clear that nothing can be demonstrated except from its own elementary principles, that is to say when the thing demonstrated is an essential attribute of the subject, it does not suffice for the possession of knowledge that a thing shall have been demonstrated from true, indemonstrable and ultimate premises. Otherwise demonstrations would be admissible resembling that of Bryson demonstrating the squaring of the circle. Now such arguments demonstrate by means of a common principle which will apply to another science as well, so that the same arguments are of service in other sciences distinct in kind. Thus we have no essential but only an accidental knowledge of the thing, for otherwise the demonstration would not also be applicable to another kind of subjects.

We have more than an accidental knowledge of anything when we see it in the light of its essential nature, after starting from the elementary principles of the things as such. Thus we know the law that a triangle has two right angles when we know of what figure this

is an essential attribute and know it after starting from the principles peculiar to Triangle. Hence if the attribute is essentially an attribute of the subject, the middle term of the demonstration must necessarily be included in the same genus, or, if not, one of the genera must be subordinate to the other, as when proportions in harmonics are proved by means of arithmetical premises. Such relations are proved in the same way as in arithmetic, but there is a difference between the two cases, for the question of the Fact falls under the one science (since the subjects of the two sciences differ generically) but the Cause is established by the superior science, to which the properties in question are essential. It is plain even from the case of the subordinate sciences that no absolute demonstration of a thing can be attained save by starting from its own elementary principles. In this case, however, the elementary principles of the sciences in question are not mutually exclusive.

If this be admitted it is also clear that it is impossible to demonstrate the special elementary principles of each science, for the principles of such a demonstration would be the elementary principles of everything, and the science formed by them would be the universal master science; seeing that one who learns a thing through the recognition of higher causes has a better knowledge of it, and the principles through which he learns the thing are anterior when they are causes not themselves produced by any higher cause. If then his knowledge be of this higher kind it must have attained to the highest possible degree, and if this subjective knowledge of his constitute a science, that science must be higher than any other, and in fact the highest science.

The demonstration of one thing is not applicable to

another genus except in the case already mentioned, as illustrated by the application of geometrical demonstrations to mechanical or optical, or of arithmetical demonstrations to harmonic theorems.

Now it is hard to decide if we really know a thing or not, for it is hard to decide whether our knowledge is derived from the elementary principles of the subject or not, and it is in this that knowledge consists. We imagine that, if we possess a syllogism drawn from true and primary premises, we really possess knowledge. This, however, is not the case, for the conclusions should belong to the same genus as the primary principles.

CHAP. X.

Such indemonstrable principles may be either peculiar to each science or common to several sciences, though common only by analogy. All demonstration involves three things:—the object demonstrated, common axioms or principles, and the special modifications or properties of the subject genus. The distinction between Hypothesis and Petition.

I MEAN by the elementary principles in each genus those whose existence it is not possible to prove. Now the meaning of the primary principles and that of their consequences are assumed; the existence of the elementary principles must also be assumed, that of everything else proved. For instance the meaning of Unit, or Straight, or Triangle must be assumed, that Unit and Magnitude exist must also be assumed, everything else must be proved.

Of the principles employed in demonstrative science

some are peculiar to each science, others are common to all, i.e. common in the sense of analogous, since their use is confined to each genus as comprehended by a particular science. Principles peculiar to one science are such as the proposition 'Line, or Straight, is of such and such a nature;' common principles are such as, 'If one take equals from equals the remainders are equal.' Each of these principles is taken as applicable to all cases belonging to the particular genus; for its results will be the same whether it be treated universally or only particularly, e.g. in geometry to spatial magnitudes or in arithmetic to numbers.

Those principles too are peculiar whose existence is assumed not demonstrated, namely those whose essential attributes are investigated by the science; as arithmetic investigates units, geometry points and lines, for these sciences assume that the thing in question exists, and that it is identical with some particular object. They likewise assume the meaning of the essential attributes of the thing, as arithmetic assumes the meaning of Odd, Even, Square or Cube, and geometry that of Incommensurable, and Inclined or at an Angle, while the existence of these qualities is shewn by means of the common principles and the conclusions already demonstrated. The same thing applies to astronomy.

In short in every demonstrative science there are three elements: (1) the things whose existence it assumes, namely the subject or genus, the essential attributes of which are investigated by the science; (2) what are called 'Common Axioms' which the demonstration uses as its primary principles; and (3) Properties, the meaning of which is assumed.

However nothing prevents some sciences from over-

looking one or other of these elements; e.g. a science may not expressly assume the existence of the subject genus if this be self-evident (for the existence of Number is more obvious than that of Cold or Heat), or it may not assume the meaning of the properties if it is obvious, just as in the case of their common principles the sciences do not assume the meaning of 'taking equals from equals,' because this is known. None the less however there are naturally these three elements in a science:—the subject of proof, the things proved and the grounds of proof.

That which must needs exist and must necessarily be supposed to exist is neither Hypothesis nor Petition but Axiom. Demonstration is not concerned with the outward expression of an idea but with its inner significance, for that is the case with syllogism in general, and one may always raise objections to the external expression but not always to the inner significance.

Everything which, being capable of proof, is assumed without being proved, if admitted by the learner is a Hypothesis, which hypothesis is not an absolute hypothesis but only one with reference to the person who accepts it.

If however something be assumed with regard to which the learner has no opinion or a contrary one it is a Petition. This then is the difference between hypothesis and petition; petition being that which is somewhat opposed to the learners opinion, or, in a wider sense, whatever, though capable of demonstration, is assumed and employed without any proof.

Definitions are not hypotheses, since it is not asserted that their subjects do or do not exist. Hypotheses are formulated as propositions, Definitions require only to be understood, and no Hypothesis consists in that alone,

unless it be maintained that mere Hearing is a Hypothesis. Hypotheses are the premises from the existence of which the conclusion is inferred.

The hypotheses of the geometrician are not, as some assert, false, saying that, though one ought not to make use of false propositions, yet the geometrician calls a line a foot long which is not a foot long, or declares that he has drawn a straight line, though the line is really not straight. The geometrician in reality draws no conclusion from the fact of the particular line that he draws actually possessing the quality which he names, but from the existence of the things which that line represents.

Moreover all postulates and hypotheses are universal or particular, definitions are neither.

CHAP. XI.

[*The possibility of Demonstratiou presupposes the validity of universal predicates, but does not require Platonic ideas*]. *The 'Common Axioms' are expressly formulated in exceptional cases. They connect the sciences with one another, and with Dialectic and Metaphysics, thus giving unity to all forms of true Thought.*

[It does not follow, if demonstration is to exist, that there must be Ideas or a Unity outside the many individual things, but it does follow that some unity must be truly predicable of the many. If no such unity existed we should have no universal; and without a universal there could be no middle term and consequently no demonstration. Since demonstration does exist there must be some self-identical unity, a real and no mere nominal unity, predicable of many individual

things.] No demonstration lays down that it is impossible both to affirm and to deny a quality of a thing at the same time, unless it is necessary to present the conclusion in a corresponding form by the help of that axiom. In that event the conclusion is proved by our assuming that the major is predicable of the middle term, and that to deny the major of the middle is untrue. It makes no difference if the thing denoted by the middle be assumed to exist or to be non-existent, and the same applies to the thing denoted by the minor. If it be granted that Man is such and such; i.e. if, though Not-man be also such and such, it be simply granted that man is animal and not not-animal; then Callias [being man] will be animal and not not-animal, even though not-Callias be also man. The reason of this is that the major is not only predicated of the middle but of something else outside it, because it has a wider application, so that it makes no difference to the conclusion whether the middle be an affirmative or a negative expression.

Demonstration by means of reduction to absurdity assumes the truth of the law 'everything may be either affirmed or denied of a subject,' and this not always in a universal sense but simply to the extent required, namely so as to be applicable to the particular genus in question. I mean by 'applying to the genus,' that genus with which one's demonstration is concerned, as has been remarked above. (Chap. X.).

All sciences overlap as far as their common principles are concerned. (By these I mean the principles used by them as the grounds of demonstration, not the subjects of the demonstration nor yet the thing demonstrated). Now dialectic is common to all the sciences, and if one were to try and give a universal proof of the common

principles of science, such as 'Everything can be either affirmed or denied,' or 'if equals be taken from equals,' or some maxim of that kind [the resulting science would similarly be common to all sciences]. But dialectic does not deal with any definite objects of this sort nor with any single genus. Otherwise it would not have used the interrogative form, for this cannot be employed for purposes of demonstration; since the same thing cannot be proved from opposite propositions. This has been proved in the treatise on the syllogism. (Prior An. II. 15).

CHAP. XII.

Corresponding to the special principles of a science are special questions which must not be transferred from one genus to another, so that no discussion of a science with persons ignorant of it can lead to valid results. Two kinds of opposites to a science exist:— questions or demonstrations entirely outside its range and those which involve a breach of some of its laws.

If a syllogistic question be the same as one of the members of an alternative, and if there be premises in each science from which the syllogism belonging specially to each science may be deduced, there must be some scientific question from which the special syllogism corresponding to each science is derived.

It is plain then that not every question can be a geometrical or a medical question, and similarly with all other special sciences, but only those questions can be geometrical proceeding from which some of the matters connected with geometry are proved, or something proved on the same principles as geometry; e.g. optical theorems. The same is the case with other sciences.

Now with regard to these questions, in the case of geometry they must be explained in accordance with the principles and conclusions of geometry, but no account need be given of the principles themselves by the geometrician as such, and this applies to other sciences also.

One should not then ask every possible question of a person acquainted with a particular science, nor need he answer every question asked of him, but only a question concerning the definite subject of the particular science. If one enter into a discussion with a geometrician as such, it is clear that the proof he gives will be a sound one if drawn according to these principles, otherwise unsound. It is also clear that in such circumstances one cannot confute a geometrician except accidentally, so that we must not discuss geometry before persons ignorant of that science, for any unsound arguments put forward will remain unnoticed. The same is the case with other sciences.

Since then there are geometrical questions, it may be asked whether there are also ungeometrical, and what kind of ignorance in connection with each science causes certain questions to bear the same relation to that science as ungeometrical bear to geometrical questions. Further is a syllogism resting on ignorance a syllogism formed from premises which contradict the science it belongs to, or rather a fallacy which nevertheless does belong to the science in question, e.g. geometry? Or, again, is a question belonging to another pursuit, such as a musical question, ungeometrical as regards geometry? Again, is the supposition that parallel lines can meet in one sense geometrical and from another point of view ungeometrical? 'Ungeometrical' is in fact an ambiguous expression, as is 'unrhythmical.'

One thing may be ungeometrical or unrhythmical from not possessing the quality in question at all, another from having it defectively. So too the form of ignorance resulting from bad or defective principles is contrary to Science. In mathematical sciences the fallacy is more easily perceived than in other sciences, because in them the middle term is always expressed twice, something being predicated distributively of the middle term, and the latter in turn predicated distributively of another subject. The predicate is not however used distributively. In mathematics one may, as it were, see by an immediate act of thought the relations of the middle term, while in words they remain unnoticed. E.g. as regards the question, 'Is every circle a figure?' If one describe a circle on paper it clearly is so. If the conclusion be drawn 'then the epic cycle is a figure,' this is clearly untrue.

No objection should be raised to a science on the ground that its premises are inductive, for just as nothing can be a premise which does not apply to several instances (otherwise it would not be universally predicable, and Syllogism is drawn from universals), so an objection must have a universal application. Premises and the objections to them correspond to one another, and any objection one urges against a premise should be capable of serving either as a demonstrative or as a dialectical premise.

The laws of the syllogism are violated when the common attribute of both major and minor terms is treated as their predicate. An instance is the syllogism of Caeneus that 'fire increases in geometrical proportion'; 'for,' as he says, 'fire increases rapidly and so does geometrical proportion.' No syllogism can, however, be formed thus. The truth is: if the proportion

which increases most quickly in respect to quantity be the geometrical, and if fire be that which increases most quickly in respect to motion . . . .

Thus it is sometimes impossible to draw a conclusion from two premises of this kind, at other times it is possible, though the possibility may not be observed. If it were impossible to draw any true conclusion from false premises, it would be easy to bring the syllogism to a conclusion, for it would necessarily be convertible. For instance let A exist by hypothesis, and when A exists let something else (B for instance) exist also, which one knows in this instance does exist. By conversion then it may be shewn from B that A exists. Conversion is more frequent in pure mathematics because these admit of no accidental qualities (and in this differ from dialectical arguments) but only of definitions.

Mathematical science is advanced not by the use of a number of middle terms, but by the subsumption of one term under another (as A under B, B under C, C under D, and so to infinity). The process may also take two directions, A being predicable both of C and E. Suppose A represents any number definite or indefinite.

B any odd number of definite magnitude.

C any odd number whatsoever.

(Then A will be seen to be predicable of C).

Again :— Let D be an even definite number.

E any even number whatsoever.

Then A is predicable of E.

CHAP. XIII.

There are two classes of demonstration, one giving the Fact, the other the Cause of the fact; such demonstrations being effected either by the same or separate sciences. If the former, the propositions may be immediate and convertible, when we have the demonstration of the cause, or mediate and inconvertible, when we have only the demonstration of the fact. If different sciences are employed, and one is subordinate to the other, the superior gives the Cause, the inferior the Fact.

A DIFFERENCE exists between knowing that a fact is and knowing its cause. This may be considered firstly in connection with the same science and from two points of view, viz. (1) in the case where the syllogism is not deduced from ultimate propositions (for here the primary cause is not expressed, while knowledge of the cause goes back to the primary cause). (2) The second aspect of the distinction is seen when the propositions from which the conclusion is drawn are ultimate and reciprocal, but the middle employed is not the cause but the better known effect. Nothing in fact prevents in the case of reciprocating terms, that term which is not the cause being better known to us, so that our demonstration will be through this as a middle.

E.g. Planets are proved to be near the earth from the fact that they do not twinkle, as follows. Let

C designate Planets.
B Not twinkling.
A Being near.

Here B may rightly be predicated of C, for planets do not twinkle. Also A is true of B, for that which does not twinkle is near,—a truth to be arrived at by induction or observation. A then must be true of C, so that we have now demonstrated that the planets are near.

This syllogism then does not deal with the cause of the phenomenon but with the fact; for the planets are not really near because they do not twinkle, but do not twinkle because they are near. It is also possible to prove the first fact by means of the second, and the demonstration will then be of the cause. Thus:—

Let C be the Planets.
B Being near.
A Not twinkling.

Here B is true of C, and A ('not twinkling') of B. Therefore A is true of C. Thus the syllogism is a syllogism of the cause, for it comprehends the primary cause. Another instance is the method by which the moon is proved to be spherical by a reference to its regular increases. It proceeds thus:—If that which increases in this particular way be spherical, and if the moon do so increase, it is clear that the moon is spherical. As thus expressed the syllogism demonstrates only the fact, but when the middle term is transposed it is a demonstration of the cause. The moon is not spherical in consequence of its increases, but undergoes these particular increases because it is spherical. Let C be the Moon; B spherical form; A the method of increase. In cases, however, where the middle terms are not interchangeable, and

where the effect is better known than the cause, the fact may be proved but not the cause. This is also the case when the middle term is wider than the other two terms. Here too the demonstration is of the fact, not of the cause, for the primary cause is not stated. E.g. To the question 'why does not a wall breathe'? suppose the answer to be given 'because it is not an animal.' Now if this negative quality be the cause of its not breathing, the corresponding affirmative 'is an animal' ought to be the cause of this phenomenon, just as granting that a negation of a quality be the cause why something does not exist, the affirmation of it is the cause why it does exist. E.g. If a want of balance between heat and cold be the cause of the absence of health, a due balance between them must be the cause of its presence. So conversely, if the affirmation be the cause of the presence of a quality the negation is the cause of its absence. But in the first instance quoted this does not hold good. Not every animal in fact does breathe. The syllogism which demonstrates a cause of this kind belongs to the second figure. E.g. Let A be Animal; B Breathing; C Wall. Now A is true of all B (for everything which breathes is an animal), but of no C. Hence B is true of no C, and therefore no wall breathes. Such statements of cause resemble hyperbolical expressions, for one is guilty of a kind of hyperbole if one depart from the proximate cause and take the more remote as one's middle term. Of such a nature is the inference of Anacharsis that the Scythians have no flute-players because they have no vines.

Such are the differences between the syllogism of the fact and that of the cause, as regards the same science and the position of the middle terms; but from another point of view the fact sometimes differs from

the cause in that each is examined by a different science. This is the case when the sciences are of such a nature that one is subordinate to the other, as optics to geometry, mechanics to the measurement of solids, harmonics to arithmetic and records of observation to astronomy. Some of these subordinate sciences have almost similar names; e.g. mathematical and nautical astronomy, mathematical and acoustic harmonics. In these cases the fact depends on the observational sciences, the cause on the mathematical sciences; for the mathematician can demonstrate the causes though he often does not know the fact, just as those who are aware of a universal law, through want of observation, are often ignorant of some of the particular facts. These superior sciences will be such as differ in essence from the subordinate sciences, and deal merely with abstract forms. Thus mathematics are concerned with forms, and do not deal with any concrete subject; and even if the propositions of geometry happen to be true of a concrete subject they are true of it not as concrete. Now there is a science which bears the same relation to optics as optics to geometry; e.g. knowledge about the rainbow. The fact that there is such a thing falls within the province of the natural philosopher, the cause within that of the optician, either as such or in so far as he is a mathematician.

Many sciences which are not subordinate one to another, yet sometimes have similar interrelations: e.g. medicine and geometry. Thus the fact that circular wounds heal more slowly must be learned by the surgeon, the cause of it by the geometrician.

CHAP. XIV.

The first figure of the syllogism is the most scientific, being the most suitable for the attainment of the cause. Further it alone can examine into the simple fact which must be both affirmative and universal. The other two figures reinforce their demonstrations by an appeal to the first figure, the latter never makes use of them.

Of the figures of the syllogism the most proper for scientific demonstration is the first, for mathematical sciences, such as arithmetic, geometry and optics, and generally speaking all sciences which investigate the cause of things, effect their demonstration by its means. The demonstration of the cause is in fact carried out either exclusively or generally and in most cases by means of this figure, so that in this respect also it appears to be the most proper for science, seeing that the examination of the cause is the most important element in knowing. Further, the knowledge of what a thing is can only be attained by means of this figure, for in the second figure no affirmative conclusion is produced, and the knowledge of what a thing is involves affirmation. In the third figure there are indeed affirmative conclusions, but not universal ones, and the knowledge of what a thing is is of the character of a universal; thus, 'two-footed' is true of man universally and without restriction. Moreover the first figure has no need of the assistance of the two other figures, while these latter are strengthened and extended by means of the

first until they arrive at ultimate principles. It is clear then that the first figure is the most important instrument of scientific knowledge.

CHAP. XV.

Yet demonstration is possible in the other figures, and if of a negative character is as valid in the second figure as in the first.

JUST as the quality A may inhere in B without the intervention of a middle term, so it may not inhere without such intervention. By these expressions I mean that there is no middle term connecting A and B. In that case inherence and non-inherence will no longer depend on the presence of a third term. When then either A or B, or both, are true of the whole of a third term, it is impossible that A should not be true of B immediately. We may suppose all C to be A. Then if all C is not B (for it is possible that all of a subject should be A, but none of it B) the conclusion will follow that B is not A. For if all A is C, and no B is C, then no B is A.

The same proof will be adopted if both terms are distributively predicable of a third. That B need not be predicable of a subject of which A is distributively predicable, and conversely that A need not be predicable of a third term of which B is distributively predicable may be seen clearly from a consideration of those series of terms wherein no term of the one series can be interchanged with one in the other series. Thus if none of the terms in the series A, C, D are predicable of any in the series B, E, F; if further A is distributively predicable of G, a term belonging to the same series, then it is clear that no G will be B, for otherwise these distinct

series would have interchangeable terms. So too if B is distributively predicable of some other subject. If, however, neither A nor B is distributively predicable of any third term, and if A is not predicable of B, A must be not predicable of B immediately. This is so because if any middle term were present, one of the two terms named would have to be distributively predicable of a third term, since the syllogism must be either in the first or the second figure. Now if it be in the first, B will be distributively predicable of a third term, for in this case the premise must be affirmative; if it be in the second A or B may be distributively predicable of a third term, for when either premise is of a negative character a conclusion may be attained, though this is impossible when both premises are negative.

It is plain therefore that one term may be proved to be deniable of another immediately, and we have now shewn when and how this may happen.

CHAP. XVI.

Concerning ignorance and error; FIRSTLY *in the case where two terms are predicated of one another immediately.*

THAT ignorance which results not from the simple absence of knowledge but from a faulty arrangement of terms is a logical deception which, in cases where one thing is predicable or not predicable of one another immediately, takes two forms, (1) an immediate supposition that one thing is or is not predicable of another, (2) a supposition to this effect arrived at through a syllogism. Now in the case of the simple or immediate supposition the mistake is simple, in the case of that which is produced by the syllogism it may assume

several forms. Suppose it to be proved immediately that no B is A; then if one conclude, with the help of a middle term C, that B is A, one's reasoning will have led one astray. Here it is possible for both premises to be false or else for only one. Thus if no C be A, and no B be C, and if each of these premises be transposed, both will be false. It is in fact possible for C to be so placed with regard to A and B that it is neither included in A nor is universally predicable of B. Now B cannot be true of another term distributively, since the hypothesis was that A was not immediately predicable of C, and there is no necessity why A should be universally predicable of all C, so that here both premises are false. Further one of the premises may be true, not however either of the two, but only A C; for the premise C B will be always false, because C is predicable of no part of B. The premise A C may however be true, as when both C and B are shewn to be immediately predicable of A. For when the same thing is predicated primarily of more than one term, no one of these latter will be predicable of another. Nor does it affect the case if A be shewn to be predicable of C not immediately (but by means of a term taken from a higher class). Only in the case of premises such as these and only in this manner can mistakes arise in connection with predicating one term of another, for no syllogism in another figure can prove universal predication.

Mistakes connected with the proof that one term is not predicable of another may however occur in either the first or the second figure.

We will first mention in how many ways this may happen in the first figure, and what the position of the premises must then be.

For instance suppose A to be immediately predicable

of B and C. Then if one take as premises 'No C is A,' and 'all B is C,' the premises will be false. A mistake will also follow if only one of the premises, either of the two, be false. It is possible for the premise AC to be true, BC false, AC being true because A is not distributively predicable of C, BC false because it is impossible for C to be B when no A is C, for then the premise AC would no longer be true. When however both premises are true the conclusion also will be true. Further the premise BC may be true while the other is false; for instance in the case where both C and A are B; since one of these terms must be included in the other. Hence if one assert that no C is A, the premise will be false. It is clear then that the conclusion will be false if one or both of the premises be false.

In the second figure it is not possible for both the premises to be entirely false; for when all B is A no third term can be found which will be predicable of the whole of one and not predicable of any part of the other term. If one want a syllogism at all one ought to select the premises in such a way that the middle term will be affirmed of one of the other two terms and denied of the second. If then, when thus stated, the premises are false, it is clear that the contrary of them will be true. This however is impossible[1], though nothing prevents each of the premises from being partially false when the conclusion is false, as in the case where some of A and also of B are C, while it is asserted that all A is C and no B is C. Here the two premises are false, not however entirely but only partially false. The same thing will happen when the position of the negative premise

[1] Because if the conclusion be false, both the premises cannot be true.

is changed[1]. It is also possible in the second figure, for one premise, either of the two, to be false. Suppose that what all A is, B will be also. If then it be asserted that all A is C, and no B is C, the premise AC will be true, BC false. Again that which is predicable of no B will be predicable of no A, for if a thing be true of A it will be true also of B, but the hypothesis was that it was not true of A. If then it be asserted that all A is C, and no B is C, the latter premise will be true, the former false. Similarly if the negative premise be reversed, that which is predicable of no A will be predicable of no B. If then it be asserted that no A is C and all B is C, the former premise will be true, the latter false. Again, to assert that what is predicable of all B is predicable of no A is false, for a term which is predicable of all B must be predicable of some A. If then it be asserted that all B is C and no A is C, the former premise will be true, the latter false. It is clear then that whether both the premises are false or only one of them, an atomic or elementary error will attach to the resulting conclusion.

CHAP. XVII.

SECONDLY *concerning logical errors arising when two terms are connected by a common middle term.*

IN cases where one term is predicated or denied of another not immediately but by means of a middle term, when the conclusion is attained by the help of the proper middle term wrongly expressed, both premises

[1] I.e., if the negative premise be treated as the major instead of the minor.

cannot be false, but only the premise containing the major term. By the 'proper middle term' I mean that by which the syllogism which contradicts the opposite conclusion may be attained. Suppose that it be shewn by means of the middle C that B is A. Here, since if a conclusion is to be attained at all the premise CB must be affirmative, it is clear that this same premise will always be true, that is it can never he converted into a negative; but the premise AC will be false, for when this is converted the opposite conclusion will prove true. The same is the case if the middle be taken from another series of terms. Let D be such a term. Now if D inhere in all of A and be distributely predicable of B the premise BD must remain unchanged, while the other, major, premise must be converted to a negative form. Hence the former premise will be always true, the latter, or major, false. Generally speaking this sort of fallacious argument will be the same as that already mentioned where the proper middle term is employed.

But if the conclusion be not attained by means of the proper middle term, when the middle term used is included in A but is not predicable of any of B, both the premises must be false. Here the premises must be converted into their contrary if any conclusion is to be drawn from them. If their form remain unaltered they must both be false. E.g. If all D be A, but no B be D.

If these premises be converted into their contrary a conclusion will follow and both premises will be false.

But when the middle term (e.g. D) is not included in A the premise AD will be true, BD false. For AD is true because D is not included in A, DB is false because otherwise the conclusion also would be true, and the hypothesis was that the conclusion is false.

When a fallacious argument occurs in the second figure it is not possible for both the premises to be false in their entirety. When B is included in A no term can be predicable of the whole of the one and of none of the other, as has been remarked above (Chap. XVI). On the other hand one of the premises, either of the two, may be false. For instance, supposing that both A and B are C, if it be asserted that C is A, but C is not B, the premise CA will be true, the other premise false. Again if it were asserted that B is C, but A is not C, the premise CB will be true, the other premise false. We have now shewn when and from what premises the fallacy is produced if the fallacious syllogism be negative. If it be affirmative it is impossible, when the proper middle term is used, for both premises to be false, since, as was said before, if a conclusion is to be attained the premise CB must remain unaltered. Consequently the premise CA will always be false, for that is the one which is converted into a negative. The like is the case if the middle be taken from a different series of terms, as was remarked in connection with the negative fallacy. Here the premise DB must remain unaltered, while AD must be converted, and the fallacy is the same as the preceding. When however the proper middle is not used, if D be included in A the major premise containing those terms will be true, the other will be false. It is in fact possible that A should be predicable of several terms, no one of which is included under another. But if D be not included in A the premise containing them must clearly be false, for it is expressed affirmatively. The premise BD on the contrary may be either true or false; for it is quite possible for no D to be A while all B is D:—thus 'no science is animal,' but 'all music is science.' So too no D may be A, and no B may be D.

It is plain then that, when the middle term is not included in A, both or either of the premises may be false. It is now therefore possible to see in how many ways and from what causes syllogistic fallacies may arise, both in the case of immediate assertions and of those attained mediately through demonstration.

CHAP. XVIII.

Ignorance is the result of a defect in sense. Universals can only be attained by the help of Induction. Induction however depends on Sensation, the objects of which are particulars, of which no science is possible. Consequently Induction is necessary for the conversion of Sensation into Scientific knowledge.

It is also clear that if some branch of our perceptive faculties prove deficient the corresponding branch of science, which cannot be attained without those faculties, must fail also; that is to say if it be agreed that we must acquire knowledge either through induction or demonstration. Now although demonstration proceeds from universals and induction from particulars, it is impossible to attain to the knowledge of universals except by means of induction. Even the matter of the abstract sciences may be established through induction, since some qualities belong peculiarly to each class of thing and make them what they are, even though these qualities are not really separable from the things themselves. Induction without the power of perception is impossible, for perception is concerned with particulars, which cannot be grasped at all by means of science. The reason of this is that we cannot attain to universals without induction, nor use induction without sense perception.

CHAP. XIX.

Syllogisms being either affirmative or negative, are the attributes of a subject and the subjects of an attribute limited or unlimited in number? Further, can an infinity of middle terms exist between two given extremes?

EVERY syllogism proceeds by means of three terms. The aim of one, the affirmative, class is to shew that C is A, because B is A and C is B; the negative syllogism has as one of its premises the proposition stating that one term is true of another, as its second that one term is not true of another.

It is clear then that these premises constitute the principles of demonstration and are what are called its hypotheses. When the premises have been expressed in this form the conclusion must follow; e.g. C is proved to be A by means of B, or again B is proved to be A by means of some other middle term, and similarly C is proved to be B.

It is plain therefore that if inferences depend on opinion and are merely dialectical the only thing the logician need keep in view is that the premises of his syllogism should be as generally recognized as possible. Hence if a middle term between A and B really exist, but is thought not to be so, an inference drawn according to the received opinion will be a dialectical inference; but in order to draw universally true inferences one should look to that which really is, not that which is thought to be. Of the former character is a term predicated of other terms essentially not accidentally. By

'accidentally' I mean after the manner in which we sometimes say 'that white thing is a man,' which is not the same as when we say 'the man is white.' In the latter case the man is not white because he is something else, but simply because he is man; in the former proposition whiteness is predicated as an accidental attribute of the man.

Now some things are of such a nature that they may be predicated essentially. Suppose a term C, which is such that it is not predicable of any other term, while B is immediately predicable of it. Further let E be predicable of F, and F of B. Now must this process terminate or can it proceed indefinitely? Again, if nothing be predicable of A essentially, but A be immediately predicable of H and of no prior term, must this process also terminate or can it also continue indefinitely?

This case differs from the one last mentioned, inasmuch as that amounts to asking whether it is possible, when one begins with a term which cannot be predicated of anything else while another term may be predicated of it, to advance upwards along an illimitable series? The other signifies, 'can one, when starting with a term which is predicated of another term while no other is predicated of it, proceed downwards along an infinite series'? Also, can the intervening terms be infinite when the major and minor are definite? Thus, if C be A, and the middle term between them be B, while other terms exist between B and A, and still more between these others, can these middle terms be continued to infinity, or is that impossible? This enquiry is identical with the question whether demonstrations are illimitable, whether everything is capable of demonstration or whether the process must terminate in both

directions. The same questions may, I consider, be asked concerning negative syllogisms and premises. Suppose that no B is, at least immediately, A, will there be then any intervening term, of which A is also, not predicable, prior to B? Suppose such an intervening term to be G, which is predicable of all B, and suppose another term prior to this, as H, which is predicable of all G. In these cases there is either an infinite series of terms of which A is denied antecedently, or there is a limit at which the series terminates. This does not, however, apply to reciprocally predicable terms, for here all the terms bear the same relation to one another, whether only the attributes are limitless, or both attribute and subjects, except where the reciprocation is effected in a different manner, so that the attribute is now predicated as essential and again as accidental.

CHAP. XX.

Middle terms cannot be limitless; otherwise the subject and attribute could never be brought into the relation demanded by the syllogism. Attribution also is limited both in the direction of the general and of the particular.

THAT the intervening terms of a predication cannot be infinite if predications terminate both in an upward and a downward direction is obvious. [I mean by 'upward' that which is more in the direction of universal, by 'downward' that which is nearer to the particular]. For if, when A is predicated of F, the intervening terms (here designated as B) could be infinite, it is clear that if one proceeded from A in the direction of the particular one could continue to predicate one term of another to

infinity, [the terms intervening between A and F are here regarded as infinite]; and similarly, if one proceeded from F in the direction of the more general, one would traverse an infinite number of terms before arriving at A. If, however, there can be no such infinite progress or regress, the terms intervening between A and F cannot be infinite.

It is of no avail to maintain that some of the intervening terms, say A, B, C, follow one another so closely as to admit of no further intervening term, while others of the series are not so closely connected. For whichever of the B's I care to select must have a certain relation to A or to F, and the intervening terms must be finite or infinite. To enquire from what starting point one begins the process to infinity, and whether this process is mediate or immediate is not to the purpose, for everything which follows any given point must be looked on as limitless.

CHAP. XXI.

If the series terminate in the case of affirmative demonstration, it will do so in negative demonstration. It will be found that demonstration may be carried out in various figures, but that the methods are limited in number so that the demonstrations are limited also. In every figure a primary or ultimate is reached of which the attribute is predicable, though the ultimate is not predicable of the attribute.

THE process will also clearly terminate in the case of negative demonstration, if it be admitted that an upward and a downward limit are reached in affirmative demonstration. Suppose it to be impossible to proceed to

infinity when starting from the last term and advancing upwards, (by the 'last term' I mean that which is not predicable of any other term, though some other term, e. g. F, may be predicable of it), and impossible also to proceed from the first term to the last, (by the 'first term' I mean that which is predicable of another term though no other is predicable of it). If this supposition be correct then the process of negative demonstration will also terminate. Negation is proved in three ways: (1) According to the first figure: all C is B, but no B is A. Then from the premise C B and from any minor premise whatsoever one must proceed to ultimate knowledge, for such a premise as this is affirmative. As to the major premise it is clear that when the major term is not predicable of another term (such as D) prior to the middle, this term must be distributively predicable of B. Again, if the major term be not predicable of another term prior to D, that other term must be distributively predicable of D. Hence, since the process of demonstration terminates in the direction of the universal it will do so likewise in that of the particular, and there will be some primary term of which the major (A) is not predicable immediately. (2) In the second figure: if all A be B, and no C be B, then no C is A. If a demonstration of this be required it may clearly be proved either by the method just mentioned, or by our present method or by the third method. The method adopted in the first figure has already been explained, so I will now explain the second. The system of proof is as follows. Suppose that all B is D and no C is D, while something must be predicable of B. If it be proved that C is not D, some other term which is not predicable of C must be predicable of D. Hence, since predication, as it advances continually to the next highest

term, must terminate at some point, negation will similarly terminate. (3) The third method is as follows. If all B be A, but no B be C, C will not be predicable of everything of which A is predicable. This, again, may be proved by the two methods already mentioned, or according to our present method. We have shewn that the process must terminate if the two former methods be adopted. If we use the third figure we will thus state the premises. All E is B, but some E is C. Here the major premise, some E is not C, may be proved in the same way as before. Since our hypothesis was that the process terminates in the direction of the particular, it is now clear that negative demonstration (in this case the negation of C) will also terminate. It is plain, too, that the process will terminate in every case, even if the proof adopt not one method alone, but all three, according to the first, the second, or the third figure. All these three methods are definite, and that which is brought to a definite end in a definite manner must itself be definite. Granting then that the process of affirmative demonstration terminates, that of negative demonstration must do so likewise.

CHAP XXII.

In the case of essential attributes, the attributions may easily be seen to be limited in number, so that the demonstrations of them are limited also. The mind cannot traverse an infinity, and as Substance, for instance, is definable, its attributes must be limited. In other words demonstration is applicable only to Essentials (καθ' αὑτά) which cannot be unlimited, for that would render definition impossible. As it is possible, the attributes are limited. Hence demonstration possesses certain principles which are not themselves capable of any demonstration.

THAT affirmative demonstration terminates at a certain point may be proved dialectically as follows. It clearly terminates in the case of predications concerning the essence of a thing, for if the essential attributes can be defined and are knowable, and if one cannot reach to the end of the infinite, predications of essential attributes must needs have some limit. To give a general turn to the statement we may express ourselves thus. It is equally possible to say with truth that 'this white thing is walking' and 'that great thing is a stick,' or again 'the stick is great' and 'the man is walking,' but there is a difference between the two pairs of expressions. In saying 'the white thing is a stick,' I mean 'that which has the accidental quality of whiteness is a stick,' not that 'the white thing' is the subject of which 'stick' is the predicate. It is in fact a stick not because it is white nor from being essentially white, so that 'this white thing' is only accidentally a stick. But when I say 'the stick is white,' I do not mean that another thing distinct from stick is white, and that stick is an

accidental quality of it; (as e.g. when I say 'the musician is white;' for in that case I mean that the man, who has the accidental quality of being a musician, is white) but the stick is the subject which is white without being, as a result of that, anything else than the genus or a species of 'stick.' Thus if we are to provide separate designations for the two methods, the latter form of expression may be called the 'predication of attributes,' the former either not predication at all or accidental, not absolute, predication. In the first case 'white' is the attribute,' 'stick' that of which the attribute is predicated.

We may now lay down the rule that the attribute is always predicated of its subject absolutely, not accidentally, for that is how demonstrations are able to effect proof. Hence when one thing is predicated as an attribute of another it concerns Substance, Quality, Quantity, Relation, Action, Passion, Place or Time. Moreover that which denotes a substance denotes either the Genus or the Species of the thing of which the attributes are predicated, but that which does not denote a substance, but is predicated of another subject without being either the Genus or the Species of that subject, is an accident: e.g. White as predicated of Man; for 'man' neither belongs to the genus 'white,' nor is he a species of it. He should rather be called 'animal,' for man is a species of animal.

Everything which does not denote substance must be affirmed of some subject as an attribute, and nothing can be (e.g.) white, in the sense that it is simply white, without being at the same time something else besides. We may at once dismiss Ideas; they are mere empty names, and if they do exist cannot concern our argument, for demonstrations deal only with subjects such as we have already mentioned.

Further if one thing be not an attribute of another nor yet the latter an attribute of the former, and if no attribute of an attribute can exist, the two terms in question cannot be reciprocally predicable as attributes. One of them may be correctly predicable of the other, but each cannot really be predicable of the other, for one would have to be predicated as a substance, as if it were a genus or differentia of the attribute. It has however been proved that these attributions cannot be continued to infinity, either in the direction of the universal or of the particular. Take the proposition 'Man is a biped, this again an animal, while animal belongs to some other genus.' Nor can the process be infinite when 'animal' is predicated of 'man,' 'man' of 'Callias,' and 'Callias' of an individual definite man who is Callias. It is indeed possible to define every substance of this sort, but one cannot even in thought complete the infinite. Hence one cannot arrive at the infinite, either in the direction of the universal or of the particular, for one cannot define that substance of which infinites are predicated.

Two terms, of which one is an accident, cannot be reciprocally predicable as genera are; otherwise each would be a species of itself. Neither can qualities or any other of the categories be so predicated, unless the predication be accidental, for all these categories are accidents and are predicated of substances.

It may also be shewn that this process of predication is not limitless in the direction of the universal, for that which is predicated of any subject must denote Quality, Quantity, or some such attribute of substance.

All these attributes are however limited, not less than the classes contained in the categories, namely Quality, Quantity, Relation, Action, Passion, Place or Time;

and our hypothesis is that one thing should be predicated of one, and things should not be predicated of each other unless they denote substances, for all the categories, except substance, are accidents, some essential, others accidents in a different sense.

All these then are predicated of some substance. Accidents however are not subjects, for we hold none of those things to be subjects which are not called what they are called in virtue of their being already something else; one accident being predicated of one subject, another of another. Hence nothing indefinite will be predicated of any subject either in the direction of the universal or of the particular, for the terms of which accidents are predicated are those which constitute the substance of a thing, and such terms cannot be limitless. As we advance towards the universal we find that these substances and their accidents are neither of them limitless. There must then be some term of which an attribute is predicated as a primary attribute, while of this latter something further is predicated. The process must in time terminate, and there must be something which is not predicated of anything more primary, and of which nothing more primary is predicated.

This then is one method of demonstrating that the process of predication has limits. Another is as follows. The existence of antecedent predicates renders propositions demonstrable. One cannot grasp demonstrable things in any better way than by knowing them, nor can knowledge of them be obtained without demonstration. But if one thing can only be learned by means of others, and we are unacquainted with these latter, and do not know them by the help of any higher perception than knowledge, we shall have no real knowledge of

these subjects which can only be learned mediately. If then it be possible to obtain absolute knowledge of anything by means of demonstration, not merely knowledge restricted by particular conditions or hypotheses, the intervening predications of attributes must necessarily terminate. Otherwise, if there were always some term higher than that actually employed, everything would be demonstrable.

Since however one cannot pass beyond the limitless, one cannot know by means of demonstration that which cannot be demonstrated. If then we have no higher perception of the demonstrable than knowledge, the result must be that we cannot know anything absolutely by means of demonstration, but only conditionally.

This proof may win a dialectic assent to our assertion, but the following argument, based on the real nature of things, will prove more shortly that predications of attributes in demonstrative sciences, such as we are now considering, cannot be limitless in either direction.

Demonstration deals with all the essential attributes of things; and Essential has two meanings, viz.: (1) Attributes forming part of the definition of the subject; (2) Things of the definition of which the subject forms part. For instance odd is essential to number, for odd is an attribute of number, while number itself forms part of the definition of odd. Again, multitude or discrete forms part of the definition of number. Neither of these processes can be unlimited. (1) The process by which e.g. odd is predicated of number, cannot be so, for if it were, there would be some other attribute included in odd, of which odd itself would be predicable as an attribute. If this were so number will be predicable as primary subject of all the attributes thus becoming predicable of it. (2) If, however, unlimited

attributes cannot be predicated of a single term, predications in demonstration must reach a limit in the direction of the universal. Every attribute must be predicated of a primary subject, as in this example of number, while conversely number is an attribute of these others, so that both will be convertible and will not overlap. Neither are the attributes which form part of the definition unlimited, for in that case definition would be impossible. Hence if all the attributes are regarded as essential, and if that which is essential cannot be unlimited, a limit to predication must be reached in the direction of the universal, and consequently in that of the particular. If this be so, that which falls between the two limits of predication must always be limited, and this at once shews that demonstrations must necessarily have ultimate principles, and that not everything can be asserted, and that not everything is, as some have held, capable of demonstration. If ultimate principles do exist not everything can be demonstrable, nor can the process of demonstration continue to infinity. A necessary consequence of either of these conclusions would be that there can be no immediate and inseparable propositions, but that everything must be mediate and separable, for that which is demonstrated is demonstrated by the interposition of one term between two others, not by the addition of one from outside. Hence, if Deduction could go on to infinity, infinite means might exist between two terms. This, however, is impossible if attributes are limited in both directions; and that they are so has already been proved dialectically, and has now been demonstrated in accordance with the real nature of things.

CHAP. XXIII.

Several terms may have only one thing in common, but one middle term uniting attribute and subject is necessary for demonstration; for immediate propositions are indemonstrable and serve as the basis for demonstrating other propositions. Such elementary principles need not be everywhere identical; for 'Unit' in different sciences is only analogously the same.

AFTER this proof it is clear that if the same quality belong to two terms: e.g. A to C and D, when neither of these terms is predicable of the other, either universally or in some other way, A will not always be predicable of them in consequence of possessing a common quality. For instance it is a common quality of isosceles and scalene triangles to have their angles equal to two right angles, for it belongs to them because they are a particular kind of figure and not in any other connection. But this is not always the case. Suppose a common quality B which is the cause of A belonging to C and D. It is clear then that B belongs to D in consequence of some other common quality, and that other quality in consequence of a third. This process would involve the intervention of an infinite number of terms between two other terms, which is impossible. If then one term be common to two others it is not necessary that it should be common to several additional terms, since there are also ultimate propositions. It is, however, necessary for the terms which have something in common with one another to be in the same genus and derived from the same series, if there is to be any community of essential attributes, for demonstration cannot

pass from one genus to another. It is also clear that when A is predicable of B, if there be any common middle term A may be shewn to be so predicable. The elements of demonstration are all things which are of the nature of middle terms, and correspond in number to the quantity of middle terms existing. Although immediate propositions, either all of them or only those which are universal, are the real elements of demonstration, yet if there be no such elements there can be no demonstration; but the stage is that of seeking the primary principles of demonstration (viz. Induction). Similarly, suppose A to be not predicable of B; if there be either a middle or a more comprehensive term of which neither is predicable, the fact that A is not predicable of B may be demonstrated; if not, that is impossible. The primary principles and elements are equal in number to the terms of a demonstration, for the premises formed by these terms are the principles of demonstration. Also, just as some of these principles are themselves indemonstrable, such as that 'this is that' or 'this is predicable of that,' or the corresponding negatives, so some of these immediate principles pronounce that a thing is, others that it is not. When a proof of anything is required a middle term must be found which is predicated of the minor B as a primary attribute. Let such a middle be C, and let A be similarly predicated of C. If the process be continued in this way, no premise is added from outside in the course of the proof, and no attribute is predicated of the subject A. Thus the middle terms are continually compressed, until they form a single proposition not divisible by any further middle term. Unity is attained when the proposition is immediate and simply forms one immediate premise. Just as in other subjects the primary

element is simple, though not identical in all cases, being in Weight a Mina, in Music a Semitone, and elsewhere something different, so in Syllogism the Unit is Immediate Premise, in Demonstration and Science it is Reason. Now in affirmative demonstration the middle term never falls outside the attributes of the predicate, and the same is sometimes the case in negative syllogisms, as in the case where A is not predicable of B because of C; namely, when all B is C and no C is A. But if it be required to prove that no C is A, one must take a mean between A and C, and the process will go on for ever. But if one have to prove that D is not predicable of E because C is predicable of all D but of none or of not all of E, the middle term will never fall outside of E, and E is the term of which D was not to be predicable.

In the third figure the middle term will never fall outside that term which is denied of another or of which another is denied.

CHAP. XXIV.

It may be supposed that particular demonstration is superior to universal: Because (1) *It gives knowledge of the things in themselves.* (2) *The universal is a nonentity, and has no existence outside the particulars. But knowledge of the universal is really more extensive than knowledge of the particular. The universal has not a separate existence, but resembles other abstractions like Quality or Relation. It alone gives the Cause; it cannot end in an unknowable infinity; it gives knowledge of more things than of the one under consideration. It contains the particular potentially, and ends in Understanding, not, like the particular, in Sensation.*

SINCE one sort of demonstration is universal and another particular, one affirmative and the other negative, the question is raised as to which is superior. A similar doubt attaches to the method of direct demonstration and of that which proceeds by reduction to the impossible. First then let us consider the universal and particular demonstration, and when we have explained that point we may consider direct and indirect demonstration. Some may perhaps regard the particular method as superior in virtue of the following considerations. If that demonstration which gives us more scientific knowledge be superior (for to produce that is the function of demonstration), if further we have more scientific knowledge of each thing when we know it essentially than when we know it through something else (e.g. we know better about the musician Coriscus, when we know the fact that Coriscus is musical than when we know that 'man' is musical, and so in other

instances); if, thirdly, universal demonstration prove that something else, not merely the thing in question, is what it is (e.g. prove that the angles of an isosceles triangle are equal to two right angles, not because it is isosceles but because it is a triangle), while particular demonstration shews that the thing itself and not something else possesses the quality in question; if, in short, essential demonstration be of a superior kind and particular demonstration be more essential than universal, then particular demonstration would seem to be the superior. Further, they would argue, no universal can exist outside the particulars, while universal demonstration produces the impression that there is some independent universal in connection with the thing demonstrated, and that a natural quality of this kind exists in real objects (e.g. that there is a universal triangle outside particular triangles, and a universal figure outside particular figures, and a universal number outside particular numbers); and demonstration which is concerned with the existing is superior to that which is concerned with the non-existing, and that which leads to no errors to that which does. Now universal demonstration is of the latter kind, since the method adopted is cumulative, as e.g. in the demonstration of analogy, that 'what is not in line, number, solid or plane is the universal of analogy.' Since then universal demonstration is of this character, and since it is less concerned with existence than is particular demonstration, and since it may produce wrong opinions, it would seem to be inferior to particular demonstration. But is not this last argument favourable rather to universal than to particular demonstration? If the quality of having its angles equal to two right angles belong to a figure, not because it is isosceles but because it is

triangle, he who only knows that it is isosceles knows less than he who knows it to be a triangle. Strictly speaking when this quality is proved to inhere in isosceles triangle, but not as a result of that figure being a triangle, the proof is not a demonstration at all. If however the proof be effected in the manner mentioned, one who knows everything in the light of its particular essential qualities has superior knowledge of it. If triangle has a wider denotation than isosceles triangle, and if the word 'triangle' is not equivocal and the same idea underlies all triangles, and if further the quality of having its angles equal to two right angles belongs to every triangle, then an isosceles triangle does not possess this quality because it is isosceles but because it is a triangle.

Consequently one who knows the universal has a higher knowledge of the thing's essential qualities than one who knows the particular. Thus universal demonstration is superior to particular. Further, if the universal be one and unambiguous, the universal will exist in no less a degree than the particulars, but actually in a greater degree, in that the universal possesses only imperishable qualities while the particulars are more liable to perish. Moreover there is no necessity for supposing that the universal is anything outside the particulars because it expresses a unity, any more than that those categories have independent existence which signify, not substances, but qualities, relations or actions. If, in fact, it be supposed that the universal has a separate existence, it is not the demonstration which is to be blamed, but the listener who misunderstands it.

Moreover if demonstration be a syllogism proving the cause and reason of a thing, the universal contains the cause to a higher degree, for that which is an essential

attribute of a thing is its own cause. Now the universal is primary and is therefore the cause of the attribute. Hence universal demonstration is superior for it gives a better proof of the cause and reason.

Further we pursue our search for the cause of a thing until, and think that we have learned it when, we see nothing else which can be regarded as the cause, whether it be in the region of becoming or being. This last must be the end and goal of our enquiry. Take the question, 'for what reason did he come?' 'To receive the money, and this in order to pay his debt, and that again in order not to act unjustly.' If we proceed in this way, when we find that a thing has happened on no other account and for no other reason than the fact we have attained to, we say that 'he came' or 'it is, or becomes owing to this ultimate cause,' and that we have then learned most completely why he came. But if the same happens with regard to all causes and all reasons, and if our knowledge is most complete when we know the ultimate cause, then in other cases also we have most complete knowledge of a thing when its existence is not merely the result of the existence of something else. When therefore we know that the external angles of a figure are equal to four right angles because it is isosceles, there remains the question 'why have isosceles figures this quality?' The reason of this is that they are triangles, and the reason why triangles possess this quality is that they are rectlinear figures. If this latter fact be not caused by something else, we have then the most complete knowledge of it, and have then attained to the universal. Hence universal demonstration is superior.

Further, the more a demonstration partakes of the nature of the particular, the larger is the indefinite

element which it contains. In so far as things are indefinite they are unknowable, in so far as they are definite they are knowable. Hence things are more knowable the greater the universal element they contain, less knowable the greater the particular element. Demonstration is applicable in a higher degree to things which are more capable of demonstration, and corresponds in definiteness to the definiteness of its objects. Consequently that demonstration which is the more universal is superior, since it is demonstration in a higher sense. Moreover, that demonstration which brings one knowledge of other things as well as of the single object of study is preferable to that which gives information about the latter alone; and one who has a universal demonstration knows the particular as well, while one who knows the particular does not know the universal. Hence universal demonstration is superior from this point of view also.

We may also consider the following point. To prove more universally is to use for the proof a middle term which is nearer to the elementary law; now that which is nearest to this law is the ultimate, and so the ultimate must be identical with the elementary principle. If then the demonstration which is derived from the elementary principle be more exact than that which is not, that which is more nearly derived from it must be more exact than that which is more remote. Now the former has the larger universal element. Hence from this point of view the universal is superior. E.g. If one had to prove that A is predicable of D; the middle terms are B and C, B being the more universal. Then the demonstration based on B is more universal.

Some, however, of the arguments here used are merely dialectical, and the best proof that the universal

demonstration is the superior may be derived from the fact that when we possess the major premise we in a manner know the minor also and possess it potentially. E.g. If we know that every triangle has its angles equal to two right angles, we know in a manner, or potentially, that an isosceles figure has this property, even if we do not know that an isosceles figure is a triangle. On the other hand one who possesses this minor premise, does not in any way know the universal, either potentially or actually. The universal too belongs to pure thought, while the particular is finally referable to acts of sensation. This may suffice to shew that universal demonstration is superior to particular.

CHAP. XXV.

Affirmative demonstration is superior to negative. It requires fewer propositions, is more persuasive and comprehensible, and also more immediate, for the negative is only proved through the medium of the affirmative.

THAT affirmative demonstration is superior to negative is plain from the following considerations. We may suppose that, other circumstances being similar, the demonstration which proceeds from fewer postulates, hypotheses, or premises is superior. If these fewer postulates are as well known as the more numerous, knowledge will be attained more quickly by their means: a desirable result. Now the reason for the assertion that the demonstration proceeding from fewer premises, so long as they are universal, is superior, is as follows. If the middle terms be equally well known, then the

antecedent terms will likewise be better known. Firstly then let it be supposed that, by means of the middle terms B, C and D, the demonstration is arrived at that E is A, and then the same demonstration by means of the middle terms F and G. Here the fact that D is A is similar to the fact that E is A, but the fact that D is A is antecedent to and better known than the fact that E is A, for the latter is demonstrated by means of the former, and that by which a thing is demonstrated is more convincing than the thing demonstrated. Hence, other circumstances being similar, the demonstration proceeding by means of fewer propositions is superior. In both cases alike the proof is attained by means of three terms and two premises, but affirmative demonstration assumes that a certain thing exists, negative demonstration first that it does and then that it does not exist, so that the latter is inferior to the former. Further, since it has been proved that, when both premises are negative, no conclusion can be arrived at, a negative syllogism must have one negative and one affirmative premise. We should now add the following condition. When the demonstration is extended in application the number of affirmative premises must be increased, while the negative premises in each syllogism can never be more than one. Suppose that no B is A, but all C is B. If the premises are to be further enlarged a middle term must be interposed between each of these pairs. Let the middle between A and B be D, and that between BC be E. Now it is clear that the term E is affirmative, and D must be affirmative when joined to B, negative when joined to A, for all B must be D, and no D must be A. Thus one premise, DA, is negative.

The same method applies to other syllogisms. In

affirmative syllogisms the middle term is always used affirmatively when joined with one of the other two terms, but in negative syllogisms the middle term must be negative in one premise. Thus one premise is negative but the others are affirmative. Also if that by which a thing is proved be more comprehensible and convincing than the thing itself, and the negative demonstration be proved by affirmative premises, but not vice versâ, the affirmative demonstration would seem to be prior to, and more comprehensible and convincing than the negative.

Moreover, since the first principle of syllogism is the universal immediate premise, and since in the affirmative syllogism the universal premise is affirmative, in the negative it is negative; since also the affirmative premise is prior to and more comprehensible than the negative (for the negation only becomes known by means of the affirmation, and affirmation is prior to negation, just as 'being' is prior to 'not-being'); then the primary principle of the affirmative syllogism is superior to that of the negative, and that syllogism which uses superior principles must itself be superior. Moreover, the affirmative syllogism is more primary, because without it no negative syllogism can be formed.

CHAP. XXVI.

Negative demonstration is superior to demonstration by reduction to the impossible, for, though both are proved by means of Not-being, in the case of the negative demonstration this Not-being is anterior to the demonstration, in the case of the other it follows. This advantage of priority makes the Negative superior.

SINCE the affirmative argument is superior to the negative it is clearly superior to the reduction to the impossible. The difference between them should be noticed. Thus, let no B be A, and all B be C. It follows necessarily that no C can be A. When terms are thus placed the negative demonstration shewing that C is not A is direct. The reduction to the impossible on the other hand proceeds as follows. If one have to prove that B is not A one must assume that it is A, and also that C is B; whence it follows that C is A. This is already known and acknowledged to be impossible. Hence the conclusion follows that B cannot be A. If then C be acknowledged to be A, B cannot be A.

The terms then are arranged in a similar way in both methods, but a difference arises according to which of the two negative premises is the better known, whether that shewing that B is not A, or that C is not A. When the conclusion that C is not A is better known we have a demonstration by reduction to the impossible, when the other negative proposition in the syllogism itself (B is not A) is better known, the demonstration is direct. Now the proposition B is A is naturally prior to the proposition C is A, for that from which the conclusion is drawn is prior to the conclusion itself. But the proposition C is not A is the conclusion, the proposition B

is not A is a premise from which the conclusion is drawn; and the refutation of any statement does not consist merely in the conclusion but in the premises from which it is drawn. Now that from which a conclusion is drawn is a syllogism so constituted that one premise bears to the other the relation of whole to part or part to whole. The premises CA and BA, however, have not this relation to one another. If then the demonstration from prior and better known premises be superior, and if further both methods of demonstration rest on the assumption that something does not exist, if thirdly one of these methods be derived from a more, another from a less primary source, then negative demonstration is, from this fact alone, superior to reduction to the impossible. Hence, if affirmative be superior to negative demonstration, it is plainly superior to reduction to the impossible.

CHAP. XXVII.

The highest science is that which gives both the fact and the cause. The science which gives the cause only is superior to that which gives the fact only. One science may also be superior to another because it has immaterial objects or simpler principles.

A SCIENCE is more exact than and prior to another when it gives the fact and the cause at the same time, and when there are not separate sciences for each. Further a science which has no material object is more exact than and prior to one which has (as in the case of arithmetic as contrasted with harmonics). Lastly a science with simpler principles is superior to one which requires a greater number. What I mean by this may

be illustrated by the following example. Point is a substance in position, Unit a substance without position. Hence 'point' is possessed of additional qualities or principles.

CHAP. XXVIII.

A science is one when it applies to a single genus, and when all the principles used belong to that science. Otherwise demonstration would be impossible (cf. Bk. I, c. 7).

Those sciences are one and the same which belong to the same genus, namely those which have the same primary principles and common parts or essential qualities. One science differs from another when their elementary principles are not drawn from the same source, and when the principles of one science are not derived from those of the other. A proof of this may be seen when one reaches the indemonstrable propositions of a science. These, if the sciences be one, must belong to the same genus as the things which are demonstrated. Another proof of this is that the things demonstrated are homogeneous to those indemonstrable propositions by which they are proved.

CHAP. XXIX.

Several demonstrations of the same conclusion may be given, and their middle terms may be taken from different series as well as from the same series. Such middle terms must however be reciprocally predicable.

It is possible to give several demonstrations of the same things, not only by taking a middle term from the

same series of terms, and that too a middle term which is not logically proximate (as for instance by taking as middles between A and B not only the proximate term C, but also D and E) but by taking one from a different series of terms. As an instance of this last let A represent Changing, B Rejoicing, D Moving, and again H represent Being calm. Now D may be correctly predicated of B, and also A of D, for one who rejoices experiences movement, and that which moves undergoes a change. Again A may also be predicated of H, and H of B, for everyone who rejoices feels a calm, and one who feels a calm undergoes a change. Hence the syllogism is established by different middle terms not derived from the same series. It is not however allowable that neither of these middle terms should be predicable of the other, for both are necessarily predicable of a common third term. The other figures of the syllogism may also be examined in order to see in how many ways a syllogism with the same conclusion may be constructed.

CHAP. XXX.

No demonstration can prove fortuitous circumstances, for demonstration deals only with the necessary or sometimes with the probable.

No knowledge of a fortuitous occurrence can be attained by demonstration. The fortuitous does not resemble either the necessary or the probable, but is that which falls outside both of these classes, while demonstration deals with one or other of them, since every syllogism is drawn from necessary or probable premises. If then the premises be necesssary the conclusion is so likewise,

if the premises apply, in most cases only, the conclusion has a similar application. Hence, if the fortuitous be neither probable nor necessary, it cannot be demonstrated.

CHAP. XXXI.

No Science can be attained by means of Sensation, which can never prove a universal, though repeated sensations may in time produce a universal, and this a knowledge of the Cause.

NOR can scientific knowledge be gained by means of sense perception, for even though perception may give information concerning a thing's quality as opposed to its concrete existence, yet an act of perception must indicate the existence of the object in a particular place and at the present time. The universal on the other hand and that which is present in every example of a subject cannot be perceived by the senses, for the universal is not a particular thing visible at the present moment, for then it would not be a universal at all, seeing that we mean by Universal that which is eternal and omnipresent. Since the demonstrations rest on the universal, and universals cannot be perceived by the senses, it is clear that one cannot acquire scientific knowledge by means of sense perception. Even if we could have perceived that a triangle has its angles equal to two right angles, we should certainly have gone on to search for a demonstration of it, and should not, as some assert, have already known the fact by means of perception alone. Perception as an act must deal with the particular alone, while scientific knowledge consists in learning the universal. Thus even if we were on the moon and saw the earth shutting out the light, we

should nevertheless be ignorant of the cause of an eclipse. We should indeed see that the moon was being eclipsed at that particular moment, but we should not know the cause of an eclipse in general, for our perception would not be of the universal. I do not deny that after seeing the same phenomenon occur repeatedly we might search out the universal law, and thus attain to demonstration, seeing that knowledge of the universal results from repeated acts of sense perception. But the value of the universal lies in its shewing the cause of particular phenomena, and consequently the universal is more important than the perception of particular cases or the immediate apprehension of such things as have for cause something other than themselves. Of self-caused primaries we are not now speaking. It is then clearly impossible to acquire scientific knowledge of any demonstrable thing, unless the meaning of 'scientific knowledge acquired through demonstration' be attached to the phrase 'act of sense-perception.'

Certain doubtful questions may be solved by a reference to the failure of the sense perceptions. Thus if we had *seen* certain things we should have made no further enquiry about them, not because we know them simply from seeing them, but because the mere sight of them would have sufficed to give us the universal. E.g. If we saw that the burning-glass was porous and that the light filtered through the apertures, it would be clear why it burns, because we should see the phenomenon occur in every separate glass; but we should yet have to form the abstract idea that this quality is universally true of every possible glass[1].

[1] This translation follows the reading διὰ τί καίει with the Clarendon Press Edition. Poste, Zell and other versions follow the old reading φωτίζει 'transmits light,' and make ὕελος refer to all kinds of glass.

CHAP. XXXII.

The principles of demonstration cannot be the same in all cases, for true conclusions may be drawn from false premises, and even in the case of true syllogisms the principles may differ generically. Further all principles may be divided into Common and Special, corresponding to the grounds and the subjects (ἐξ ὧν καὶ περὶ ὅ) *of demonstration.*

IT is impossible that all syllogisms should have the same elementary principles, and this may be proved by purely dialectical considerations, Some syllogisms are true, others false, and it is also possible to deduce a true conclusion from false premises, though only in one particular class of circumstances. For instance the proposition C is A may be true, but the middle term B is false, since B is not A, nor yet is C B. But if the middle terms to these premises be expressed, the falsity of the premises will become obvious; since a false conclusion presupposes false premises, while true conclusions result from true premises, and false and true premises are different from one another. Nor do false conclusions follow only from premises which are false in the same manner as themselves, for things which are false may be both the contrary to and inconsistent with each other, as may be illustrated by the assertions 'Justice is either injustice or cowardice'; 'Man is either a horse or an ox'; 'Equal is either greater or less.' That all syllogisms have not the same principles may also be proved as follows from conclusions already arrived at. Even true conclusions are not invarably derived from the same elementary principles, for in many cases the principles differ and do not suit every kind of argument: e.g.

the conception of 'unit' cannot be used as a principle when theorizing concerning points, since units, unlike points, have no special position. In order to make the same principles suit various forms of syllogism it is necessary to use them as predicates of the major term, as subjects of the minor or as intermediate between major and minor; or else they must be variously related, some being intermediate between major and minor, others superior to the major or inferior to the minor.

No common principles can exist from which everything may be demonstrated (by 'common principles,' I mean those resembling the proposition,—'it is possible either to affirm or deny everything.') Existing things differ generically; some predicates can only be assigned to the genus quantity, others to that of quality, and these subjects and predicates together with the common principles of science join in producing a demonstration. Moreover the principles are not much less numerous than the conclusions, since the principles constitute premises, and may become formal premises by inserting a term between major and minor or adding a term either superior to the major or inferior to the minor. Further the conclusions are unlimited, the terms limited. Again some principles are necessary, some contingent.

If we consider the matter in this way we see that these limited principles cannot be identical, since the conclusions are unlimited. If an objector were to assert that these are the principles of geometry, those of calculation, those again of medicine, his assertion would simply amount to saying that different sciences have different principles. It is however absurd to say that they are the same principles in all cases just because they are principles and not something else; for by that method all distinct things might be proved identical.

Nor can it be meant that every premise will prove every conclusion, which would be equivalent to claiming that all sciences should have the same principles—a ridiculous assumption, for this is not the case with existing kinds of exact science, nor is it possible in logical analysis. The immediate premises are principles, and distinct from them is the conclusion which is attained by means of the addition of an immediate premise. If it be asserted that it is the primary immediate premises that constitute those principles which are identical in every science, we should answer that there is a unique premise in each branch of science. If then it be agreed that not everything can be proved from any principle whatsoever, and yet that the principles of various sciences are not so unlike one another as to fall into distinct classes, there remains the suggestion that the principles of every science are akin, while the conclusions drawn from them differ. This however is clearly untrue, for it has been proved that the principles of sciences which differ generically are themselves generically different. Principles are in fact of two kinds, being either the sources or the subject of science. The former are common, the latter, such as 'number' or 'magnitude,' are peculiar to each science.

CHAP. XXXIII.

Science depends on the Necessary, Opinion on the Contingent. Opinion may attain to immediate propositions, but as these are not necessary, Opinion is uncertain and can never be applied to the same object as Science.

SCIENTIFIC knowledge and its object differ from Opinion and its object, in that Science is universal and rests on

the necessary, and the necessary is not contingent. Some things are true and do exist, but yet are contingent so that they cannot be the object of science, for that would involve the identification of the contingent with its opposite, the necessary. Neither is the contingent the object of Reason (by which I mean the elementary principle of Knowledge), nor again of indemonstrable knowledge, which consists in the assumption of immediate propositions. Yet Reason, Knowledge and Opinion, together with everything which they make known, are true, so that the object of Opinion is still the true or the false, but yet contingent; that is to say it involves the apprehension of an immediate but not necessary proposition.

This view is in harmony with ordinary experience, which makes us regard Opinion as unreliable, and the nature of the things about which opinion is held is likewise unreliable. Also when one thinks that something cannot but be what it is, one never supposes that one merely opines that thing, but that one knows it. On the other hand when one thinks that the thing is now some one particular thing, but yet that nothing prevents it from taking a different form, then one supposes oneself merely to opine, since opinion refers to objects of this latter kind, whereas knowledge relates to the necessary. Why then, it may be asked, is it impossible[1] to opine and know the same thing, and why is not opinion the same as knowledge, if it be laid down that everything which one knows may also be the subject of opinion, and those who merely opine pass in company through the intervening middle terms until they arrive at ultimate principles? If the former possess scientific knowledge

[1] Reading *πῶς οὖν οὐκ ἔστι* . . . The negative seems necessary as this passage is evidently attributed to an imaginary objector.

why do not the latter also? The object of Opinion may be the Cause of things just as much as the Fact of their existence, and it is the Cause which supplies the middle term.

The difficulty may be explained thus. One who has such a clear perception of the uncontingent objects as also to possess the definitions by means of which the demonstrations of them are arrived at, will know those objects and not merely opine them. If on the other hand he knows them as true, but yet he does not know that the attributes in question belong essentially and specificially to the subject, he will only have opinion not scientific knowledge both of the fact and the cause, that is to say if his opinion rest on immediate propositions. If his opinion do not so rest, he will opine only the fact, not the cause. Opinion and Knowledge have not absolutely the same object, but their objects are similar in the manner in which the objects of Truth and Falsity are similar. The assertion of some that true and false opinions are of the same kind involves many absurdities, such as that a false opinion is not an opinion at all, since all opinions are assumed to be true. But since 'the same' is used in many senses, false and true opinions are in one sense the same, in another different. For instance, a true opinion that the diagonal is commensurable with the side of a square would be absurd, but since the diagonal concerning which the opinions are held remains the same whether the opinion about it be right or wrong, the object of the two kinds of opinions is one and the same, while according to their essential nature and definition those opinions are different. In a similar way knowledge and opinion may be said to have the same object. The knowledge concerning the nature of animal is of such a kind that its object cannot

be other than animal. Opinion concerning the same is such that its object may be other than animal. Thus knowledge concerning man contains a reference to his essential characteristics, opinion contains no such reference. In this case the objects of knowledge and opinion are the same, but regarded from a different point of view.

It is clear from this that one cannot opine and know the same thing at the same time. Otherwise one would suppose simultaneously that a thing was both contingent and necessary, which is impossible. It is possible, as has been said, for knowledge and opinion concerning the same object to exist in different persons, but in the same person they cannot. Otherwise he would have to suppose simultaneously that, e. g. Man is essentially animal (for that is equivalent to saying 'man cannot but be animal') and also 'man is not essentially animal' (for that is the meaning of 'capable of being something else' or 'contingent'). How to distinguish between Inference, Reason, Knowledge, Art, Prudence and Wisdom, are questions belonging partly to Natural Philosophy and partly to Ethics. (Cf. de An. I, 1. Eth. VI, 3, 4).

CHAP. XXXIV.

Sagacity is a rapid perception of the middle term, or cause, resulting from a consideration of the major and minor terms.

SAGACITY is a faculty for hitting upon the middle term in an imperceptible moment of time. For instance, suppose some one, seeing that the moon always has its bright side turned towards the sun, quickly inferred that

this was so because the moon receives its light from the sun; or again, seeing someone conversing with a rich man, inferred that he was doing so in order to borrow money; or again inferred that the reason why two persons were friends of one another was that both were enemies of a third person. On seeing the major and minor of the syllogism the sagacious man is able to perceive all the causes or middle terms. Thus: Let A represent 'having its bright side towards the sun'; B 'lighted from the sun;' C 'the moon.' Now B, 'lighted from the sun,' is true of C, the moon; A, 'having their bright side towards the body from which the light is received' is true of all objects denoted by B. Hence A is true of C because it is true of B.

ARISTOTLE'S

POSTERIOR ANALYTICS

BOOK II.

CHAP. I.

The objects of knowledge are four in number:—a thing's existence, its cause, the question whether it is, and its nature.

THE subjects of enquiry are equal in number to the objects of scientific knowledge. We enquire about four things, the fact of the phenomenon, its cause, whether it exists and what its nature is. Now when we ask whether a thing is this or that, taking two alternatives, e.g. asking whether the sun is eclipsed or not, we ask about the fact. A proof of this is that when we find that it is eclipsed we abandon this line of enquiry. Also if we know from the first that it is eclipsed we do not ask whether it is eclipsed or not. Next, after learning the fact of the phenomenon we seek for the cause of it. For example, when we know that the sun is eclipsed or that the earth does move, we go on to seek for the cause of the eclipse or of the movement.

These questions concerning the fact and cause stand

towards each other in the relation here stated, but in some questions the enquiry proceeds differently: namely whether a thing exists at all or not; e.g. as to whether or not a centaur or a god is. By 'whether it is or not' I mean *is* absolutely, not whether a thing is, e.g., white or not white. When we know that the thing does exist we enquire about its nature, asking, for instance, 'What then is a god, or what is a man?'

CHAP. II.

The first and third of these questions and also the second and fourth may be identified. Hence all scientific enquiry consists in investigating whether there is a middle term, and what the middle term is, for the middle is identical with the cause.

THESE or such as these are the subjects about which we enquire and which we know when we have found what we sought. Now when we ask about the fact, or enquire whether the thing has absolute existence, we enquire whether it has a middle term, but when we have learned the fact and solved the question as to its absolute or partial existence, then we ask what the middle term is. My phrase 'partial existence' would be illustrated by the questions 'Does the moon wax?' or 'Is the moon eclipsed?' In questions of this sort we do really ask whether a thing exists or not. 'Absolute existence' might be illustrated by the questions 'Does a moon, or does night, exist or not?'

Hence it follows that in every enquiry we really ask if a middle term for the subject in question is or else what this middle term is. The reason is that the middle term

contains the cause, and it is the cause that we look for in all cases. For instance we ask first 'Is the moon eclipsed?' Then, 'Is there any cause of the eclipse or not?' Next, on learning that some cause of it is known we enquire what the cause is. Now the cause of a thing's being, (not of its being this or that, but of its being absolutely) or again the cause why a thing has no absolute existence but is an essential or accidental attribute of something else, is nothing but the middle term. When speaking of absolute existence I refer to the existence of the subject, whether it be moon, earth, sun, or triangle; examples of attributes would be eclipse, equality, inequality, interposition or non-interposition of the earth.

In all these cases it is clear that the nature of the thing and its cause are the same. To the question 'What is an eclipse?' the answer is 'An exclusion of light from the moon owing to the interposition of the earth.' 'Why does an eclipse take place, or why is the moon eclipsed?' 'Because the light fails when the earth excludes it.' 'What is harmony?' 'An arithmetical proportion between sharp and flat.' 'Why does sharp harmonize with flat?' 'Because they are in a certain arithmetical proportion.' Thus the question 'Can sharp and flat harmonize?' is equivalent to 'Is there an arithmetical proportion between them?' On learning that there is we proceed to ask, 'What then is the proportion?' That the object of our enquiry is really the middle term is clearly displayed by those cases in which the middle term is perceptible to the senses. We make an enquiry about it only when we have not perceived it. Thus, in the case of eclipse, we ask whether there is such a thing or not. If, however, we were on the moon we should not enquire whether an

eclipse does occur, nor yet why it occurs, for the answers to both these questions would become visible simultaneously. We should in fact have learned the universal as a result of sense perception. Sense perception would shew that the earth was at a particular moment excluding the sun's light; and since it would also be obvious that the moon was then being eclipsed, knowledge of the universal would have been attained immediately. Thus, as we have said, knowing the nature of a thing is the same as knowing its cause. The former of these may either have or not have an independent existence. E.g. 'One thing is larger, or smaller, than another.' 'The three angles of a triangle are equal to two right angles.'

It has now been made clear that every kind of enquiry involves a search after the middle term.

CHAP. III.

Definitions and demonstration are not identical. Denfitions are always general and affirmative, while some syllogisms may be particular or negative. Even universal affirmative syllogisms cannot always be replaced by definitions. The principles of demonstration, which are themselves indemonstrable, may be definitions, but the two processes differ. Definition states a thing's essence, Demonstration presupposes it.

We may now state in what ways the essential nature of a thing may be proved, and also what definition is and what are its objects; and we may first mention the difficulties connected with these subjects. We will begin with a point closely connected with the matters last treated of, namely the question which might be

raised as to whether it is possible to know the same thing and know it in the same way by means of Definition and by means of Demonstration. Ought not this to be held impossible? Definition would seem to express a thing's essential nature, which is invariably universal and affirmative. Some syllogisms however are negative, others not universal; for instance all in the second figure are negative, those in the third are other than universal. Then too definition is not invariably practicable even in the case of the affirmative syllogisms in the first figure; e.g. the proposition 'Every triangle has its angles equal to two right angles,' cannot be arranged as a definition. The reason of this is that knowing a thing demonstratively is equivalent to having a demonstration. Hence if such cases are capable of demonstration they clearly cannot admit of definition as well. Otherwise one would acquire knowledge by means of the definition without possessing any demonstration; for it is quite possible to have a definition without drawing any demonstration from it. An inductive proof will lead to the same conclusion. We never know anything either of the essential or accidental attributes of a thing from merely defining it. Moreover definition is a method of making known substances, while propositions like the above concerning the triangle clearly do not contain the substance of the subject. It is clear then that not everything which is capable of demonstration also admits of being defined; but then the further question arises:—When a thing is definable is it invariably capable of demonstration or not?

One argument against the possibility of this latter suggestion has already been mentioned, namely, that a single subject is, as such, treated of by a single science. Hence if demonstrative knowledge of a thing consists in

having a demonstration of it we are placed in a dilemma, as one who possesses a definition without demonstration will have real knowledge.

Further, the elementary principles of demonstration are definitions, and it has been shewn before that these principles admit of no demonstration. Either then these principles must be demonstrable and also the principles of the principles, and the like process will go on to infinity; or else the primary principles will be indemonstrable definitions.

But if the objects of definition and demonstration be not entirely the same, may they not be partly the same? Or is that impossible, nothing which can be defined being capable of demonstration? Definition expresses the nature of a thing and its substance, but demonstrations all clearly assume the nature of a thing as a hypothesis, as, e.g. mathematical demonstrations assume the nature of Unit or Odd, and so with other demonstrations. Further, every demonstration proves something of a subject: e.g. that it exists or does not exist; but in a definition no one thing is predicated of another: e.g. animal is not predicated of biped nor biped of animal; nor figure of superficies; for superficies is not what figure is nor is figure what superficies is.

By this I mean, e.g. that we have already proved that an isosceles triangle has its angles equal to two right angles if we have proved that every triangle has that quality, for isosceles triangle is a part, triangle in general a whole. But a thing's Nature and its Existence are not thus related to one another, since neither is a part of the other. It is clear then that a demonstration is not invariably attainable in cases which admit of definition, and that definition does not invariably accompany demonstration.

Hence, generally speaking, one cannot have both for any one subject. It is therefore clear that definition and demonstration cannot be identical, nor can one be part of another, for then their objects would have borne a like relation to one another.

This may be regarded as the answer to the present difficulties.

CHAP. IV.

A syllogism could only be expressed as a definition if a middle term convertible with the two other terms were employed. This, however, would involve a Petitio Principii.

CAN a syllogism or a demonstration treating of a thing's Nature be arrived at, or, as our recent argument assumed, is that impossible? Syllogism proves one thing of another by means of a middle term, but a thing's Nature is a property and is predicated as part of its essence. Further, definition must be convertible with the thing defined; for if A be a property of B, and that again of C, each term is a property of the other. Further, if A be an essential attribute of B, and B be essentially universally and distributively predicable of C, A must be essentially predicable of C.

If, however, one do not thus make use of A twice over, it will not of necessity be predicable of C; that is to say when A is an essential attribute of B, but not of everything of which B is predicable. Both A and B then form part of the essence of C. Hence too B is essentially predicable of C; but if both A and B be essential attributes of the subject C, and also of the

formal cause of C, the formal cause will be present in the middle term before the syllogism is formed.

In general then if one have to prove, e. g. What man's essence is; let C be 'man,' and A the essence, whether this be 'biped animal' or something else. If then a syllogism is to be formed, A must be predicated distributively of B, and further a middle term is required, and this will be predicable of the essence A. Thus one will be assuming what one ought to prove, seeing that B will also denote man's essence.

One ought to consider this phenomenon both in the two premises and in the primary and ultimate proposition, as it will appear most plainly in them. In fact, those who prove by means of a convertible proposition what is the essence of Soul, of Man, or of any other existing thing, are guilty of begging the question.

Thus, suppose it were asserted that the soul is a thing which is the cause of its own life, and that this cause is a number which moves itself. Here one would have to assume that the soul is like a number which moves itself, and is actually identical with it. A will not in fact be essentially predicable of C because A is a consequence of B, and B of C, though it may be conventionally so denoted; nor yet, if A exists, is it thereby made essentially and distributively predicable of B.

For instance, the essence 'animal' is predicated of the essence 'man,' and it is true to say that every essential attribute of man is an essential attribute of animal, (just as it is true to say that every man is an animal) but not in the sense that man and animal are identical.

If the terms are not so stated one cannot infer that A constitutes the essential nature and substance of C. If they are so stated there will be a preliminary assumption that B, the thing which ought to be proved, constitutes

the essential nature of C. Thus no demonstration of this latter fact will have been given, but we shall have begged the question.

CHAP. V.

Nor can demonstration be attained by means of Division, which never proves necessary connection, and can never give the cause. Thus definitions founded on division are invalid as lacking the element of necessity.

NOR does the method of Division produce syllogistic conclusions, as has been pointed out in the analysis of the figures of the syllogism (Pr. An. I. 31). There is never any necessity that the thing to be defined should be exactly what it is stated to be because the other terms of the division are so; and the method of division is even less demonstrative than induction. One ought not to ask that the conclusion should be admitted, nor ought it to be held to be true because another admits it, but it must necessarily be true if those particular premises are true, even though our companion refuses to accept it. Thus, in division the question might be asked. 'Is Man an animate or inanimate creature?' Though the other may decide in favour of 'animate,' yet no real conclusion has been arrived at. Suppose the question to follow, 'As every animate creature is terrestrial or aquatic, which is man?' and the other decides for terrestrial. Yet it is not a necessary consequence of these admissions that man is a terrestrial animate creature, but that also is an assumption.

It makes no difference whether the division has many or few parts; for the same charge may be brought

against every instance of it. Even in the case of arguments which might proceed syllogistically, when division is resorted to the method is not syllogistic. There is in fact nothing to shew that these qualities, though they may all be true of man, really express his Nature or essential Form. Also there is nothing to prevent Division from adding to, subtracting from, or entirely passing over the substance of the thing.

It is in this connection that mistakes are generally made; but the difficulty may be solved by taking all the essential attributes of the thing, arranging them in order by means of division, making a postulate of the first attribute and passing over none of the later ones. Here necessity will be secured so long as everything falls within the division, nothing being omitted, and so long as no term is admitted which is capable of a further subdivision. This process, however, involves no regular syllogism, or if division does convey scientific knowledge it conveys it in a different way from syllogism. Nor is there anything strange in this; for Induction does not properly speaking demonstrate, but yet it makes something known. In the present case, however, one who announces a definition after an inspection of a division does not really give us a syllogism. Just as in the case of conclusions without any middle term, if it be asserted that this conclusion must follow from this premise, one is entitled to ask, 'Why so?' so also with definitions which depend on division. E.g. 'What is man?' 'A mortal, footed, biped, featherless animal.' 'Why?' will be asked at every additional attribute. The answer will be that it may, as the speaker supposes, be proved by division that everything is either mortal or immortal. No reasoning of this kind can have any of the characteristics of definition. Hence even if division did

demonstrate something, definition would not thereby become the same as syllogism.

CHAP. VI.

Division supplies no common attribute by means of which the various attributes may be bound together, so as to produce one predication instead of several.

Is it possible to demonstrate the real essence of a subject when one has assumed hypothetically that the essential nature of that subject is one of the properties which constitute its formal cause, and that only those particular qualities, all being peculiar to the subject, are so included? (That is the meaning of the essence of a subject).

Has one not however really used the same term, the notion of formal cause, twice over? for one must effect the proof by means of the middle term which ought itself to be proved. Further, just as in a syllogism there is no assumption as to the nature of inference, for the premises on which the syllogism is based always bear the relation of whole or of part to each other, so the essential form of syllogism ought not to be included in the syllogism, but to remain outside the particular premises.

One should meet an objector who questions whether an inference is syllogistic or not, by saying, 'that at least is the process which we meant by syllogism,' and to one who asserts that we have not the essential form of syllogism, we should answer with a denial, saying that this was what we meant by the essential form of syllogism. Thus some conclusion may be arrived at

without any definition of its essence or of its essential form being given.

Neither can a definition be proved by means of a hypothesis, as illustrated by the following example. Assuming that Evil consists in the quality of 'the manifold,' and, in the case of subjects which have an opposite, the opposite of evil, is the opposite of manifold; it might be inferred that good, as being the opposite of evil will possess the quality which is the opposite of manifold, and the essence of good will be proved to be the same as the essence of indivisible. Here too, however, the proof is effected by assuming the essential form of the subject and then proving it, and this assumption is made for the express purpose of effecting the proof. It may be objected that the same term is not really used both in the definition of evil and in the proof, and that there is difference. This may be admitted; for in demonstrations also it is assumed that one thing is predicable of another; but it is not, as in this case, the thing itself which has to be proved, nor yet that which has the same definition or is convertible with it.

The following difficulty applies both to a proof proceeding by division and to a syllogism based on definition. Why are the predicates of a definition not taken separately, as, in the sentence above 'man is a biped animal,' why should one not say 'an animal' and 'biped'? The assumptions underlying the definition in no way demand that the attributes predicated should form a single expression; they might be stated separately, as one might call man both 'musical' and 'capable of writing,' not a 'musical writer.'

CHAP. VII.

Definition does not prove the essence of things, for, if it proved a thing's essential nature, it would also prove that the thing exists. It does not however merely explain the meaning of words, for then every word we uttered would be a definition. The objects of definition and demonstration are entirely different, and neither gives knowledge of a thing's essence.

How then is definition to prove the Substance or Nature of a subject? It will neither shew, as if demonstrating from admitted premises, that, when certain premises exist, something else must necessarily follow, nor will it shew, as induction shews from the evidence of particular instances, that everything must have a certain quality because nothing is without that quality; for induction does not prove the nature of a thing but only that the thing does or does not exist. What other method of demonstration then remains? It is surely impossible to demonstrate by an appeal to the senses, or by pointing at a thing with the finger.

Further, how is one to prove the essential nature of a thing? It is necessary, in order to learn the nature of Man or of anything else, to know that the subject in question exists; for no one can know the nature of the non-existent, but only what its name or other designation signifies, as when I say e.g. 'Goatstag'; for the nature of a goatstag it is impossible to know. Moreover, though one may prove both the nature of a thing and that it exists, how can it be possible to do so by one and the same method? Definition and demonstration each prove one single thing; but 'what man is,' and 'that man exists' are two different questions.

Further we hold that the existence of anything must needs be proved by demonstration, with the exception of the essence. Existence as such is in no case identical with the essence, for 'that which exists' does not form a separate genus. Hence demonstration will only prove that the thing exists, not what it is. This may be seen in the separate sciences. E.g. the geometrician assumes the meaning of the word Triangle, but proves that Triangle exists. What is it then which definition will prove? Will it be the essence of triangle? In that case one would know by definition the essential nature of triangle without knowing whether triangle exists. This is impossible. It is also clear from the present system of definition that definitions do not prove the existence of a thing. Even if according to the definition, lines drawn from the centre to the circumference of the circle are equal, what proves the existence of lines or circle? Why is the thing defined a circle and nothing else? Why might one not call it bronze just as well as circle? If then definition must prove either the nature of the thing or the meaning of the name, if further the former be impossible, a definition would appear to be a phrase with the same meaning as the subject itself. This is untenable, for in the first place there would be definitions of things which are not substances and of things which do not exist at all, for even non-existing things may be denoted by a name. Further every phrase would in that case be a definition, for it is possible by means of a word to impose any name whatever on a thing, so that all of us would be talking in definitions, and the name Iliad would be a definition. Also no science could demonstrate that a particular name denoted a particular thing. Hence definition and syllogism are clearly not identical, and have not identical

objects. Further definition does not demonstrate or prove anything, nor can one know the essential nature of a thing either by definition or demonstration.

CHAP. VIII.

When a thing is once known its essence and its cause are identified. The essence cannot be demonstrated, but before seeking for the cause one must know that the thing exists. Hence, though demonstration cannot give the essence, without it the essence could never be learned.

We must now consider which of our recent statements are well and which ill expressed; what consequently is the nature of definition, and whether it is possible to produce both a demonstration and a definition of a thing's essential nature, or not. Now since, as we have said (Bk. II., Ch. 2), the knowledge of a thing's nature is the same as knowledge of the cause of its nature, and the reason of this is that a cause exists for everything, this cause must be either the same as the subject itself or something different. If the latter, it must be either demonstrable or indemonstrable. If then it be other than the subject and also demonstrable, the cause must necessarily form the middle term of the demonstration, and the syllogism must be proved in the first figure, since that which is to be proved is a universal affirmative proposition.

Such is the only method of proving a thing's essential nature by means of some other term, for in proofs of this sort the middle term also must be a substance, and one property of a thing is proved by means of another

of its properties. Thus of two essential attributes of the same thing one may be proved, the other cannot (being taken as the cause or middle in the demonstration). That this method is not demonstration has been explained before, but it may be regarded as a dialectical proof of a thing's essence.

We will now repeat our former statements concerning the way in which demonstration is concerned with the essence of subjects. Just as we begin to seek for the cause of a thing only when we are acquainted with the fact of a thing's existence, while sometimes (though the cause cannot be learned before the fact) both fact and cause are learned simultaneously, so the essential form clearly cannot be learned without a previous knowledge that the thing exists. It is impossible to know what a thing is without knowing whether it exists. The latter fact we know sometimes from the accidental qualities of the thing itself, sometimes because we are acquainted with some of its essential attributes. To take an example of the second; we know that thunder exists from the noise in the clouds; that an eclipse exists from the interception of light; that man exists, because we know that an animal of a particular kind exists; that soul exists, because we know something to exist which moves itself. In every case where we know a thing only from its accidental qualities, we are necessarily ignorant of its essential nature, for, properly speaking, we do not know that it exists; and to search for a thing's essential nature without even knowing that the thing exists is to search for a nonentity. But the process is easier when we know something of the subject's essential nature. Thus the better the knowledge we have of the thing's existence the more easily may we learn its essence. The following may stand as a first exam-

ple of those cases where the knowledge of a thing's existence gives us part of its essence. Let Eclipse be A. Moon C. Interposition of the earth B. To seek whether the moon is eclipsed or not is equivalent to enquiring whether B really exists or not, and that is the same as enquiring whether B is the cause of A. If that be the case, we say that B also exists. As a second example, take the question 'with which of these two contradictory majors does the definition of triangle agree:—a triangle has its angles equal to two right angles; no triangle has its angles equal to two right angles'? If the premises are immediate truths we learn the fact and the cause of the quality simultaneously. If no demonstration be possible we know the fact but not the cause. Let C be the moon; A, eclipse; B, the impossibility of there being a shadow at full moon when nothing visible interposes. If then B (inability to cast a shadow when nothing interposes between us and the moon) be true of C, while A (being eclipsed) is true of B, the fact of an eclipse is evident, but the cause is not yet known. Thus we know that there is such a thing as an eclipse but not what its nature is.

When it is clear that A is true of B, to seek for the reason why it is true of B is the same thing as seeking for the nature of B, whether this be an exclusion of light, a turning away of the moon or an extinction of its light. Here then is the cause of the major term, in this case A, that is to say an eclipse is caused by an exclusion of light by the earth. As another example take the question, what is thunder? A quenching of fire in a cloud. Why does it thunder? Because fire is quenched in a cloud. Let cloud be C; Thunder A; Quenching of fire B. Now B is true of C, the cloud, for fire is quenched in the cloud; A, the noise, is true of B. Thus

B is the cause of the major term A. If the middle term here given be included under another middle term the definition will be a prior one. We have then shewn how the nature of a thing is attained to and becomes known, and it follows that there can be no syllogism or demonstration proving a thing's nature, though this may become clear as a result of syllogism and demonstration. Thus we cannot know a thing's nature without demonstration, in cases where the cause is outside the thing; and yet it cannot itself be demonstrated, as we remarked in our previous statement of difficulties.

CHAP. IX.

When the Cause of the thing and the thing itself are identical, no demonstration is possible; for we have then reached ultimate principles, the nature of which must be assumed. When the Cause is outside the thing the Cause may be used as a middle term in the demonstration.

SOME things have, others have not a cause outside themselves. It is clear therefore that of a thing's essential qualities some are ultimate and primary, the existence and nature of which must either be assumed by hypothesis or made clear in some other way than by demonstration. The arithmetician proceeds in this way, assuming both the nature of unity and also that it exists. In the case of things which have a middle term, things the cause of whose substance is something outside themselves, there may be a demonstration, as we have said, this cause being taken as a middle term, although the underlying essence of the thing is not demonstrated.

CHAP. X.

A definition which gives the real nature of a thing also gives its cause, and thus differs only in form from demonstration. There are three classes of definition: (1) An indemonstrable explanation of the essence of a thing; (2) Definitions which resemble a syllogism concerning a thing's essence; (3) A conclusion of an essential demonstration.

SINCE definition is, as we have said, the expression of a thing's essence, it is clear that one kind of definition may give the meaning of the name, or of some other expression having the force of a name:—e.g. the definition of the meaning of 'nature of triangularity as such.' On learning that the thing corresponding to the name exists we enquire why it exists, for it is difficult to grasp the cause of a thing when we do not know previously that the thing exists. The reason of this difficulty has been mentioned before (II, c. 8), namely that we do not know whether a thing exists or not except accidentally.

An expression may have unity in two ways; either from a union of the separate parts (in the manner in which the whole Iliad is a unity), or from predicating an attribute of the subject essentially, not accidentally. Thus one form of definition is that which gives the meaning of a word, as mentioned above. Another explains the reason why a thing is. Hence the former explains signification but proves nothing, while the latter clearly gives a kind of demonstration of the subject's essence, and differs from demonstration only in form. Thus there is a difference between saying, 'Why does it thunder?' and 'What is thunder?' To

the former one would answer, 'because fire is quenched in the clouds'; to the question, 'What is thunder?' 'Thunder is the noise of fire being quenched in the clouds.' Thus the same thought is expressed in two different ways; the former answer containing all the parts of a demonstration, the latter being stated as a definition.

Further there may be a definition of thunder, as 'a noise in the clouds,' which forms only the conclusion of the demonstration of the essence of thunder. Lastly the definition of ultimate terms is an indemonstrable proposition stating the essence of the subject. Consequently definition is either (1) An indemonstrable expression of the thing's essence, or (2) A syllogism expressing its essence, differing only in form from demonstration, or (3) The conclusion of a demonstration which states the subject's essence. What has been said is enough to shew how far a thing's essence is demonstrable, how far the reverse; also what things admit of demonstration and what do not, in what senses 'definition' is used, and in what ways it does or does not prove a thing's essence, and in what cases this can be done; lastly the relations of definition to demonstration have been given, and it has been shewn how far the two may have the same object.

CHAP. XI.

To know a thing is to know its cause; and the Causes, each of which may be used as a middle term in demonstration, are (1) The substantial or Formal cause; (2) The necessary conditions of a thing, or Material cause; (3) That which gave the first impulse to a thing, or Efficient cause; (4) That for the sake of which a thing is done, or Final cause.

Necessity is of two kinds: (1) Obedience to natural impulse; (2) Obedience to external compulsion.

WE suppose ourselves to have scientific knowledge of a thing when we have learned its cause. The causes are four in number. First, the essential conception of things; Second, the conditions from which the phenomena necessarily follow. Third, that which gave the first impulse to the thing. Fourth, that for the sake of which the thing happens. All these causes may serve as middle terms. The material cause cannot be demonstrated by means of one premise only, there must be at least two, and that can only happen when one middle term is added. When this is done a conclusion must necessarily follow. This may be made clear from the following example; 'Why is the angle in a semicircle a right angle? or, under what conditions is it a right angle?'

Let A be right angle, B the half of two right angles, C the angle in a semicircle. Now B is the cause of A, right angle, being predicable of C, the angle in a semicircle; for this latter is equal to A, and C is equal to B, for it also is a half of two right angles. As then B is a half of two right angles A is predicable of C, that is

the angle in a semicircle is a right angle. This cause is however the same as the formal cause, which gives the definition of 'right angle.' Further it has been proved that the formal cause may be used as a middle term.

As another example take the question, 'for what reason were the Athenians engaged in the Persian war?' or, 'What was the cause of the Athenians being attacked?' 'Because they assaulted Sardes together with the Eretrians'; for it was that which gave the first impulse. Now let A represent 'War'; B, 'making the first assault'; C, 'the Athenians.' Here B, making the first assault, is true of C, the Athenians, and A, war, is true of B, for men fight against those who have done the first wrong. Hence A, being attacked, is true of B, those who did the first wrong, and B is true of C, the Athenians, for they were the aggressors. Hence in this case also the middle term is a cause, namely the efficient cause. As an instance of the final cause take the question: 'For what reason is he walking?' 'In order that he may keep well.' 'What is the object of a house?' 'The preservation of furniture.' Thus, the purpose of the former is 'keeping well,' of the latter 'preserving furniture.' [There is no difference between the cause which makes him walk after supper and the final cause of his walking]. Let C represent 'a walk after supper,' B 'food not remaining undigested,' A 'keeping well.' Let it be assumed as an attribute of walking after supper that it prevents food remaining undigested at the entrance to the stomach, and that the absence of this latter produces health. Now food not remaining undigested is considered to be an attribute of C, walking; and A, health, of B. What then is the reason why A, the final cause, is an attribute of C? Clearly it is B (food not remaining undigested), and B

is in a manner the cause of A, for it is through it that A will be explained.

This may also be expressed as follows: 'Why is B an attribute of A?' 'Because being in such a condition as that denoted by B constitutes keeping well.' The matter would be made still more clear if we substituted the notion of final cause for that of efficient cause in this example[1]. The origins of a thing will appear in an inverted order in connection with the efficient cause to that in which they appear in the final cause syllogism, for in the former case the middle term or efficient cause must precede the phenomenon, while in the case of the final cause the minor term C is in point of time earlier, the final cause itself (A) coming last in time.

It is possible for a thing to have a final cause and yet to be necessary; e.g. Why does light pass through a lantern? Because that which consists of the smallest parts necessarily passes through the larger apertures. Thus light is produced because it passes through the lantern in this particular way, and it also has a final cause—namely to prevent us from stumbling.

As then a thing which has a final cause and is necessary can exist, so also such a thing can come into existence. For instance, suppose thunder to arise both because there must necessarily be hissings and roarings when fire is quenched and also, as the Pythagoreans hold, in order to menace those in Tartarus and inspire them with dread. Most instances are of this kind, especially things which are or have been produced by natural

[1] I.e. the efficient cause is demonstrated by means of the final cause. In full the syllogism would be:—A (keeping well, the final cause) accompanies good digestion (B). But C (the efficient cause) produces A; therefore C produces B.

laws, for nature works in some cases with a definite purpose, in others of necessity.

Necessity itself has two aspects, one kind being that which obeys nature or a natural impulse, another that which acts under compulsion and contrary to its own impulse. Thus a stone moves both upwards and downwards 'of necessity,' though not owing to the same kind of necessary. With regard to the results of intellectual processes some things are never produced by accident, but with some end in view (as House or Statue), others from chance (as Health, or Deliverance from danger). The final cause is of the greatest importance in the case of contingent matters, when the origin of the phenomenon is not fortuitous, and the object aimed at, whether natural or artificial, is something good. Nothing however which comes about by chance can have any definite object.

CHAP. XII.

The Cause is the same for past, existing, proceeding and future occurrences, and is always the middle term. It may be simultaneous with or anterior to its effect. In circular demonstrations causes may be inferred from their effects and vice versâ. Probable effects have probable causes.

THE same cause as that which produces existing things applies also to things which are in process, have happened and will happen, for in all these cases the middle term is the cause. Existing things, however, require an existing cause, things in process a like cause, things past a past cause, things future a future cause. For

instance, to the question 'Why *did* an eclipse take place?' the answer is 'because the earth was interposing.' It will take place because the earth will interpose: it does take place because the earth does interpose. Again: What is ice? It may be assumed that it is frozen water. Let C represent Water; A Frozen; B the middle term or cause, namely a total failure of heat. Now B is true of C, and A, frozen, of B. Hence, Ice is being produced when B is in process, has been produced when B has taken place, and will be produced when it does take place. Thus this kind of cause and its effect occur together when they occur at all, they are in process together, do exist, will exist and have existed simultaneously.

In cases, however, where cause and effect are not simultaneous, it may be asked whether, as would appear to be the case, some things are the causes of others which immediately follow them. E.g. Can one thing in process be the cause of another's being in process; is it a future cause which produces a future effect, or a past cause a past effect? Now one may deduce a cause from the effects which have followed it, and in this case the starting point lies in the past. On the other hand one cannot draw an inference from the cause concerning the effect, e.g. that because such a thing has happened some particular effect must have followed. So too with future events. Whether the time intervening between cause and effect be indefinite or definite one cannot say that 'because this has happened, such and such an effect must also have occurred.' In the interval between the cause and the effect it would be incorrect to say that the latter had occurred, though the cause had already appeared. The same argument applies to future events. When one thing has happened another thing is not

necessarily about to happen. The cause or middle term ought to belong to the same genus as the effect, being, in the case of past events, past, of future events, future, of events in process, in process also, of existing events, existing; but past and future cannot be homogeneous in this way. Further, the interval between cause and effect cannot be indefinite nor, until the effect is produced, can it be definite, for during the whole of that interval it would be false to say that the effect exists.

Here we ought to examine the meaning of 'Uniformity of Nature,' owing to which a thing when it has once happened is inclined to happen again. But is it not clear that what is in process is not a continuation of that which is past, that one past event is not a continuation of another, and that everything which is past is an ultimate and indivisible, past events being in fact no more contiguous to one another than are points, both of which are indivisible? The same reasoning shews that the present is not merely a continuation of the past, for an event in process is divisible, a past event indivisible. An event in process really bears the same relation to a past event as a line bears to a point.

Infinite past events go to make up that which is now in process. These subjects must, however, be discussed more clearly in the general treatment of Motion (Cf. Phys. Bk. vi). With regard to the manner in which the middle can be the cause when the result is continuous, this much may suffice. In these cases also the primary term and the middle must both be ultimates. For instance, suppose A to have taken place because C has taken place[1], C however coming later than A. Now

[1] E. g. the foundations of a house may be known to have been laid when the house is seen, though the latter came into existence after the former.

the starting point is C, because it is nearer to the present moment, which forms the starting point in time. Now C has taken place if D has taken place; and when D has taken place A must previously have taken place. The cause of this is C, for when D has taken place it is necessary that C should have taken place, and when C has taken place, it is necessary that A should have done so before. If the middle term be thus expressed it might be asked whether the process must sometime reach an ultimate and terminate, or whether a middle term would always appear and so produce an infinite regress, for as was said a past event is not a continuation of another past event. Yet one must begin with the middle term and with the present moment as a primary point of departure. The same is true of future events: for if it be true to say that the effect D will be, it must be a previous truth that the cause A will be. The cause of this is C, for if D will be, C will be previously, but if C will be A will be previously. Thus in these cases also an infinite subdivision is possible, for future events likewise are not bound together in perfect continuity, and in the case of them also an ultimate starting point must be assumed.

The same thing applies to matters of production. E.g. If a house has been built the stones must have been cut and have existed. What is the reason of this? Because, for a house to be built, a foundation must have been laid. If so, stones must have existed previously. Similarly, if there is to be a house, walls also must exist beforehand. This too is proved by means of the same middle term, namely, that a foundation must be laid before the house can be built.

We see with regards to matters in process that pro-

duction is effected in a circular manner, and we observe that this may happen when the major and minor and also the middle terms are each of them consequences of the other, and it is then that Conversion takes place. Now we proved at the outset (Pr. An. II. 5–7) that causes and effects may be proved circularly, and that is the meaning of the circular process. In the case of matters of production the method may be regarded as follows. When the earth has been moistened vapours must arise. When that happens a cloud is produced. From the cloud comes rain, and as a result of the rain the earth must be moistened. Hence the process has returned to its starting point, and when any one of the terms is present another follows, when that is present a third follows, and when the third is present the first recurs again.

Some events in process are universal, for they exist or come into existence always and in every instance; others are not invariable but Probable. E.g. Not every man can grow a beard, but this is usually so. In such cases the middle term also must be of ordinary application. If A be predicated of B universally, and B of C universally also, then A must be predicated as invariable attribute of C, always present in every instance of it (for so we may paraphrase the expressions 'universal,' 'distributive,' and 'eternal'). Our hypothesis was, however, that the attribute was only ordinarily present in the subject, and therefore the middle term B must be probable also. It follows then that things which exist or come into existence ordinarily but not invariably must also possess certain ultimate starting points or first principles.

CHAP. XIII.

The part of definition is to examine essentially attributes which, individually, may be either co-extensive with their subjects or more comprehensive. The sum of these attributes must however exactly equal the subject. As to the arrangements of attributes, none must be omitted, and that one must be placed first which is the consequence of all the rest. All definitions are universal; truth and clearness must be aimed at, ambiguous and metaphorical language must be avoided.

It has already been stated how a thing's essence is expressed in definition, and in what ways the essence can or cannot be demonstrated or defined. We will now explain how one should discover the essential attributes of a subject. Of the attributes of every subject some are always more comprehensive than that subject, though keeping within the limits of the genus to which the subject itself belongs. As an instance of more comprehensive attributes I might mention those qualities which are universal attributes of the subject in question but are attributes of some other thing as well. Thus a quality may belong to every triad but also to something other than triad. E.g. Existence belongs to triad, but also to other things not numbers at all. 'Odd' is also an attribute of every triad but is more comprehensive, for it also belongs to a pentad. Yet this latter quality remains within the limits of the same genus; a pentad being a number, while nothing outside number can be odd. In defining such terms we should reckon in so many qualities as, when taken collectively, may be

equivalent to the thing defined, though separately they may have a wider comprehension, and we shall then be in possession of the thing's substance.

For instance 'number' is true of every triad, also 'odd' and 'primary' in both senses; that of not being the multiple of another number and not being a compound number. The following then is the definition of triad:—an odd number, primary, and primary in a certain sense. Each of the first two qualities is true of all odd numbers, while the last quality of primariness is true of the dyad also, but no number except the triad possesses all these qualities together. Since we have shewn above that all the attributes which express the essence of any subject are necessary, while it is the universal which is always necessary; since also the attributes established in the case of triad, or similar attributes of any other subject, are part of the essence, it follows that the attributes predicated of it in the definition must necessarily constitute a triad. That they form its substance is clear from the following considerations. If these attributes are not the essence of triad they must form a kind of genus of triad either named or unnamed, which will be consequently more comprehensive than triad, seeing that we assumed that the genus is such as potentially to be more comprehensive. If then the definition be applicable to nothing wider than individual triads it must form the essence of triad. This rests on the assumption that the essence of every subject is the lowest predication of attributes, or one applying only to individuals and to no class higher than that of the subject. Hence the essence of any other subject will consist of the attributes predicated of it in a definition of this kind.

When one is engaged with any complete whole one

ought to cut up the genus into primary indivisible species, e. g. to divide the genus number into triad and dyad, and then endeavour to establish the definitions of these species, considering the cases of straight line, circle, or right angle. Next after establishing the nature or sphere of the genus, for instance whether it concerns quantities or qualities, one should search for its peculiar properties in the light of its common primary principles.

The definition will suffice to shew what are the properties of those species which serve to make up the genus, because definition and unity form the basis of all things, and because accidental qualities are only essentially true of the simple species, and of the others only from their relation to those simple species. Divisions also, if conducted according to the specific differences of the subject, are of service for the establishment of a definition.

In what way division is capable of producing demonstration has already been stated (II, c. 5); namely that it can only serve to deduce the essence of the subject. It might however seem as if it were of no value for obtaining definition, since one might assume all the qualities of the subject at the outset, such assumptions being made without any division.

On the other hand we must remark that the nature of the result varies according to the order in which the attributes in a definition are predicated; e. g. whether one says 'Man is a tame animal with two feet,' or 'a two-footed tame animal'; for if the whole definition be composed of two elements of which the first is 'tame animal,' and if from this, combined with the specific difference 'two-footed,' the concept 'Man' be formed (or whatever else may be the unit which results from

the definition), one must discover the parts of a definition by means of a division.

Moreover division is the only method which can ensure that definition shall omit no essential attribute of the subject. Thus if, after taking the most comprehensive genus, one proceed to some of the subordinate divisions, not everything which belongs to the whole genus will fall within one of those subdivisions. For instance not every animal has either undivided or divided wings, but only every winged animal, and this possession of wings constitutes its difference. On the other hand, in the case of the genus animal, the primary difference of animal must be of such a kind as to be applicable to every kind of animal. In the same way the primary divisions in every genus must be conducted, whether these be genera outside of and co-ordinate with the genus 'animal' already referred to or subordinate to it. For instance, the term Bird ought to be so divided that every separate bird shall be included in the division, and every fish in the division of Fish. If our division be thus conducted we may feel sure that nothing has been omitted, otherwise we must omit some essential quality in our definition without observing our omission.

Though some[1] maintain that it is impossible to know the true Difference of a thing without knowing every other thing also, it is not really necessary for either definition or division to possess universal knowledge. They hold that, if no difference be known between the thing observed and other things, we cannot know that the former is not identical with the latter, and one thing can only be said to differ from another when it has a recognized difference. Now firstly this is untrue. Not

[1] Viz. Speusippus (Diog. Laert., IV, § 5).

every difference renders things diverse, and many differences exist between things specifically the same, namely differences which are neither inherent nor essential.

Secondly, when one has established pairs of opposites in a division, and also the difference between them, in such a way that every individual instance must fall under one or the other class, and further has assumed that the thing which one is seeking is in one of the classes, and is able to recognize it, it is of no importance whether one knows or does not know all the other subjects to which the difference in question also belongs. If one proceed in this manner to a point where no further specific difference is found, one must clearly be in possession of the definition of the subject. That everything must fall under the division if pairs of opposites have been discovered admitting of no further alternative is not an assumption but is necessarily true, if the difference we have selected be really the primary difference of the genus in question.

In order to construct a definition by means of division, three points must be kept in view. We must admit only essential attributes, must arrange them in their right order, and must not omit a single one.

The first of these depends on whether we are able to make an essential predication with the help of the generic notion, as we predicate accidental attributes in the syllogism. The right order of attributes will result from the correct selection of the first attribute. This will be the case if an attribute be found which is the consequence of all the others, although the others are not all consequences of it, for some attributes of the former kind must exist. When such an attribute has been discovered the same method must be pursued with

the less general attributes, for the following term will be primary among the remainder and the third term primary in relation to those next below, since, when the highest term has been set aside, the next term will be primary among those remaining. The same method applies to the subsequent attributes. The enumeration of attributes is complete so long as the primary genus has been taken in the division (so that e.g. every animal must fall under one or other of the divisions of the genus Animal), and also the primary difference belonging to that entire genus; so long also as no further difference appears in the last term of the division, or when the last term combined with the last difference does not differ specifically from the entire genus. It is clear that in such definitions nothing is superfluous, for all the attributes here mentioned form part of the essence of the thing defined, nor is anything wanting, for any such thing would have to be either genus or difference. But here the highest genus has taken the first place in the division together with the difference. Further the subordinate differences all follow in order, and no later term in the series can remain. Otherwise the last term would be specifically divisible, which has been said not to be the case. In searching for a definition we ought to enquire first what common element is possessed by similar individual instances of the subject, and then examine another class of instances homogeneous to the first class and specifically the same among themselves but specifically different from the former instances. When some element has been found which exists equally in all the individuals of the first class, and an element which exists in all those of the second, we ought next to consider whether anything exists alike in both cases. This process must continue

until we attain a single conception, which will form the definition of the subject. If no such single conception be arrived at, but only two or more, we may feel sure that the object of our search is not single but manifold. For instance, if we are enquiring into the nature of Magnanimity we should examine the cases of certain magnanimous persons whom we know of, in order to discover what common quality they all possess in virtue of their magnanimity. Thus supposing Alcibiades, Achilles and Ajax to be all of them magnanimous, what common quality did they all possess? We find that it consisted in impatience of insult. The first made war on his country, the second brooded over his wrath, the third slew himself. We next consider other cases such as those of Lysander and Socrates. If we find that their magnanimity induced them to remain unchanged amidst prosperity and adversity we must take these two aspects of magnanimity and consider what common element exists between disregard of external fortune and impatience of dishonour. If no such element be found, these must constitute two distinct species of magnanimity.

Every definition must have a universal application. The physician does not tell what is beneficial for some particular eye, but either for every eye, or else he divides eyes into different classes. In definition it is easier to assert something of the particular than of the universal; one ought therefore to pass from particulars to universals. Also equivocal expressions are more easily concealed in universals than in individuals. As in demonstrations we must look to the correctness of our syllogistic argument, so in definitions perspicuity is to be studied. This will be attained if it be possible, by means of particular instances quoted, to define that

which belongs to each separate genus. For instance, when defining similarity, we should not define all kinds of similarity at once, but should take the common attribute of sharpness belonging to colours, forms and tones, and then proceed to a universal expression, taking care however to admit no ambiguity of phrase. If we ought not to use metaphors in argument, it is clear that we should not define either in metaphors or metaphorical expressions. Otherwise we shall be obliged to use metaphors in argument also.

CHAP. XIV.

To express questions for demonstration in a fitting manner a subject must be selected to which the quality to be demonstrated primarily belongs.

In order to find questions for solution we must make a selection from various partitions and divisions, taking care that a common generic notion lies at the base of all subordinate divisions, and assuming that all belong to a common genus. E.g. If Animals be the subject of investigation, we must first lay down what attributes are common to every animal. When this is done we should find what are the attributes of the first subdivision after the genus. Thus, if the subject be a bird, we should find the qualities possessed by every bird, and we must continue thus with the attributes of each lower term in the series. We shall then clearly be able to give the reason why the species included in the common genus possess such and such attributes; e.g. the reason why Man or Horse, as species of Animal, possess particular attributes. Let A be animal, B the attributes of every animal, C, D, E, particular species of animal.

Now it is clear why B is an attribute of D, namely because of A, and it will similarly belong to the other species of animal. The same reasoning applies to other instances.

Hitherto we have spoken of cases where custom has sanctioned the application of the common class names to the particular species, but we should not limit ourselves to these. If anything else be seen to be an attribute of several things but to have no common generic name, we should take it for examination and look what are its attributes or of what it is an attribute. Thus, the possession of a ruminating stomach is a common attribute of horned animals, as well as the possession of front teeth in one jaw only. We must then enquire what animals have the attribute of being horned. It will then be clear why the attribute mentioned belongs to these animals. It will belong to them because they have horns.[1] Another method consists in the observation of analogies. No single designation for instance exists for the spine of a fish, the pounce of a cuttle and ordinary bone, and yet all these parts have common qualities, as if their nature were the same in each case.

CHAP. XV.

Questions for demonstration are the same when they use the same middle term. Questions may be generically the same and specifically different.

QUESTIONS for solution are the same, first from having the same middle term (as for instance all questions which can be solved by the common middle term

[1] Cf. Arist. de Part. Anim., III, 2.

'reactionary influence,') and of these some are generically identical while possessing certain specific differences, whether of object or only of method. Take the three questions 'What produces an Echo?' 'Why are objects reflected?' 'What causes a Rainbow?' All these are generically one, for all involve refraction, but they differ specifically. In other cases questions differ in that the middle term of the one is subordinate to that of the other. Thus, 'Why is the current of the Nile stronger at the end of the month?'

'Because the end of the month is more rainy.'

'Why then is the end of the month more rainy?'

'Because the moon is waning.'

These two questions stand to one another in the second of the above relations.

CHAP. XVI.

When the Cause is known the effect also must be known, but in consequence of the Plurality of causes an effect may be known without the exact cause being known.

A DIFFICULTY might be raised in connection with the Cause and its result as to whether, when the effect is present, the cause must also be present; for instance whether, supposing leaves to fall from the tree or the moon to be eclipsed, the cause of the fall, or of the eclipse, is likewise present. It may be assumed that the cause of the former is the possession of broad leaves, that of the eclipse the interposition of the earth, for even if it be not so something else will be the cause of the phenomena. Now if the cause be present the effect must also be present; e.g. if the earth be interposing the moon is being eclipsed, if the tree have broad leaves

it is deciduous. An objection might here be raised that if this were so, the cause and effect would be simultaneous, and each of them might be proved from the other. Thus: let A represent the quality of shedding leaves, B broad-leaved, C vine. Now, if A be true of B (since every broad-leaved tree is deciduous), and also B of C (since every vine has broad leaves), then A is true of C, and every vine is proved to be deciduous. The cause of this is B, which is here the middle term. It may also be demonstrated conversely that the vine has broad leaves from the fact of its being deciduous. Thus, let D be broad-leaved, E deciduous, F vine. Now E is true of F (for every vine is deciduous), and D of E (for every deciduous tree is broad-leaved). Therefore every vine is broad-leaved, and the cause of it is that it is deciduous. On the other hand these qualities cannot be the causes of one another, since the cause is prior to that of which it is the cause. Thus supposing the interposition of the earth to be the cause of an eclipse, then the eclipse cannot be the cause of the interposition of the earth. If then the demonstration of the cause give the reason of a thing, while the demonstration which does not explain the cause gives only the fact, this latter demonstration may suffice to inform us that the earth interposes between sun and moon, but not why it interposes. That the eclipse is not the cause of the interposition of the earth, but this latter of the eclipse, is obvious, for the interposition of the earth is an element in the definition of eclipse, and it is therefore clear that the latter is demonstrable by means of the former, not vice versâ.

Can there be several causes of the same thing?

Since the same thing can be immediately predicated of several subjects, let A be immediately predicable of

B, and also immediately predicable of another subject C, and again B and C of D and E. Here A will be predicable of D and E, and the cause of this will, in the case of D be B, in that of E it will be C. Hence when the cause is present the thing caused must also be present, but when the thing caused is present it is not necessary for every separate cause one may select to be present. Some cause must indeed be present, but not every cause. Again if the subject proposed be a universal one, not only must the cause be something universal but also that of which it is the cause. Thus 'shedding leaves' is a universal attribute of a whole genus, though this may include subordinate species, being applicable either to plants in general or to particular kinds of plants. Hence in these cases the middle term and the effect must be co-extensive and convertible. Take for instance the question 'Why do trees lose their leaves?' If the reason be that the sap is dried up, whenever the tree sheds its leaves this drying up must occur, and if it occur in tree and nothing but tree, that tree must shed its leaves.

CHAP. XVII.

In a demonstration of the cause, no effect can be regarded as the outcome of several causes, for in such a demonstration things are regarded in the light of essentials and not of accidents. Here the middle term is the definition of the major.

Is it possible that it should not be the same cause which produces a like effect in all the subjects included in the minor term, but that another cause should exist, or is that impossible? If the cause has been demonstrated

to be essential and not a mere external sign or accidental cause it is impossible that there should be more than one cause, for the middle term is the cause of the minor. Otherwise it is possible. One may indeed consider the effect and the subject in which it is produced from the point of view of their accidental attributes, but these cases are not to be looked on as scientific problems. If the cause be not made to depend on accidental attributes the middle term will be of like kind with the subjects themselves, but if the latter are one only from an applied use of the common name the middle term can only be employed with like restrictions, while if the subjects be all included under the same genus the middle will be so also. Thus, suppose that one had to state the cause of reciprocal proportion. The cause of this differs in the case of lines and in that of numbers, and yet is in both connections the same in so far as it depends on a certain law of increase. The same argument applies to all such instances. There is however a difference between the cause which makes one colour resemble another and that which makes one figure resemble another, for in these two cases 'resemblance' bears a two-fold meaning. In connection with figures it consists in having an equal number of sides and equal angles, in the case of colours that they convey a similar sensation to the senses or something of the kind. Things which are analogously identical will also have an analogous middle term.

The reason of this is that the cause, the effect and the snbject in which the effect is produced correspond to one another. If one take particular species as subjects the term in which the cause produces the effect will be more comprehensive than any one of the subjects. Thus the quality of having the external angles equal to four right angles is more comprehensive than triangle or

square, but the quality is co-extensive with all angular figures taken together. So too all figures which have their external angles equal to four right angles are included under the same middle term.

As the middle term contains the definition of the major, all scientific knowledge is based on definition. For instance, shedding leaves is a quality both of vines and figs, but is more comprehensive than either of them. Yet it is not more comprehensive than all deciduous species of trees but co-extensive with them. If one take the primary middle term (broad-leaved) it will contain the definition of this quality of shedding leaves. This term will serve as middle term both in questions concerning vines and figs and will shew that all vines and figs possess the quality of having broad leaves. The middle term or cause through which broad-leaved trees are deciduous is that the sap dries up, or something of the kind. In what then does this quality of shedding leaves consist? In having the sap dried up at the junction of stalk and stem.

We will answer enquiries as to the mode in which cause and effect can follow each other by this example. Let A be true of all B, and B be true of all D, but be more comprehensive. Then B will be universally predicable of D. By 'universal,' I here denote a predicate which is not convertible with its subject, while 'primary universal' is a predicate with which the separate individual subjects are not convertible, though the whole subject is convertible and co-extensive with that predicate.

In the above instance B is the cause why A is predicable of the various subjects D; A therefore must be more comprehensive than B; otherwise why should B be the cause rather than A? If A be predicable of all

the subjects E, these latter taken together form a single concept distinct from B. Otherwise how could one say that everything which is E is also A, but that not everything which is A is also E? For why should not the cause be, for instance, that every D is A? Then the various subjects E will form a single concept which must also be considered, and may be denoted by C.

Thus it is possible for several causes to produce the same effect; but not when the subjects in which the effect is produced are specifically the same. For instance, the cause of long life in quadrupeds may be the absence of gall, in birds dryness of constitution, or something else. If however we do not at once attain some ultimate proposition, and if the middle term be found to be not one but many, then the causes also must be many.

CHAP. XVIII.

Particular effects are produced by causes which lie nearer to the particular than to the universal.

WHICH middle term produces effects in individual subjects? Is it the middle term which stands first on reckoning from the universal, or the middle which stands next to the particular? Clearly the middle terms nearest to the subjects in which the effect is produced, since it is those middle terms which are the cause of the major term falling under the universal law; e.g. C is the cause of B being true of D. Now C is the cause why A is predicable of D, B the cause why A predicable of C; that A is predicable of B is due to B alone and to no further cause.

CHAP. XIX.

Concerning the faculty which acquires knowledge of the ultimate principles of demonstration. These principles cannot be innate, but are derived from repeated sense perceptions which produce memory and experience, the germ of unity or generalization in the mind. Thus primary principles are derived from induction, and as they are indemonstrable they cannot be learned by Science, but by Pure Reason (νοῦς) which is the Principle of Science.

We have now shewn what syllogism and demonstration are, and how they are effected; and we have also discussed demonstrative knowledge, for that is the same thing as demonstration. We shall understand the primary principles, both as regards the method of their acquisition and the habit of mind which acquires them, if we first settle certain difficulties connected with the subject. It has already (I. c. 2) been stated that it is possible to acquire scientific knowledge by means of demonstration without first explaining the primary and ultimate principles. A question might however be raised as to whether the knowledge of the ultimate principles is or is not the same as demonstrable knowledge, and whether either of them constitutes a science or not, whether there can be a science only of the one class, while some other faculty cognizes the other; likewise whether faculties for attaining primary principles are produced in us without being innate, or whether they are innate and have remained unnoticed.

It would be absurd to say that we already naturally possess these principles, as then we should have a form

of knowledge more accurate than demonstration, of which however we remained in ignorance.

On the other hand if we acquire these principles without having had them before, how can we learn and understand anything when no previous knowledge existed? That as we said when dealing with demonstration (I. c. 1) would be impossible. It is clear then that we cannot already possess knowledge of this kind, nor can it be produced in us if we are unable to recognize the principles and have no faculty for acquiring them. We must therefore possess some such undeveloped faculty, but not of such a nature as to be superior to the principles themselves in point of accuracy. This faculty indeed is clearly possessed by all animals, for all have an innate critical faculty which is called Sense-perception. When possessed of this some animals become capable of retaining perceptions, others do not. Those which do not retain perception can have no knowledge outside their separate acts of perception, either none at all or none concerning the object which they are incapable of retaining. The other class, in which perceptions are retained, though also perceiving by means of the senses, still preserve a representation of their perceptions in the mind[1]. As these latter multiply a further distinction may be remarked in them. Some beings attain to a concept as a result of the retention of these perceptions, others never do. From perception then, as we hold, memory results, and from repeated recollections of the same phenomenon comes experience, for memories which are numerically many form but a single experience.

[1] Reading *αἰσθανομένοις* with the Clarendon Press Edition. A better reading is *μὴ αἰσθανομένοις*: 'Even at a time when the senses convey no such perceptions.'

Next, from experience, or from the entire universal which is retained in the soul, the single unit apart from the manifold of sense, which is identical in all particular cases, comes the elementary principle of art and science; if the concern be with production, of art, if with reality, of science. The faculties do not exist distinct in the mind, nor do they result from higher states of consciousness, but from sense-perception. Thus, when one side gives way in battle, if a single man rally, another rallies also and then a third, until the original order has been restored. Now the soul's nature is such that a similar process is capable of taking place in it also. We will now state again what has been said with some obscurity just now. When one of the atoms of sense has taken its stand in the soul a first universal idea forms therein, for one may perceive particulars by means of an action of the senses, but perception is concerned with the universal, not with the particular man Callias. Then the remaining particulars halt, and the process continues until indivisible and universal ideas are formed. Thus as a result of the perception of such and such animals the general idea of Animal is formed, and this latter serves to form yet wider conceptions.

It is clear that the most primary knowledge is attained by means of Induction, for it is through induction that sense-perception produces the universal in the mind. Now there are different modes of thought by means of which we attain to truth, and some of them are always infallible, while others, as Opinion and Calculation, admit of error. On the other hand Science and Reason are always true, and there is no further class of faculties, save Reason, which surpasses Science in exactness. Since then the principles of demonstration are better known than the demonstrations themselves, and since

all scientific knowledge implies conclusion, the principles cannot be the objects of Science. Since further, nothing admits of greater truth than Science except Reason, this latter would seem to be the faculty which has the primary principles as its objects. The above argument will serve to shew that demonstration cannot be its own principle, so that science also cannot be its own principle. If then we have no true form of thought (other than science) except Reason, Reason would seem to be the principle of scientific knowledge. Reason is thus the principle of the principles, and bears the same relation to science as the latter does to all other truths.

APPENDIX.

PRIOR ANALYTICS. BOOK II.

CHAP. XXIII.

Induction is one of the two roads to certainty. It infers the major of the middle by means of the minor term, which last must include all the individual instances of the quality denoted by the major. Induction is clearer for us, though syllogism is naturally prior and more knowable.

. . . . . We believe in a thing as a result either of syllogism or of induction. Now induction and the inductive syllogism consist in inferring one term of the middle by means of the other (minor) term. E.g. Suppose B to be the middle term between A and C, induction proves by means of C that A is B, for that is the way we express induction. Thus let A represent 'long-lived,' B 'not having gall,' C 'individual instances of longevity, such as Man, Horse, Mule.' Now all B is A, for every creature without gall is long-lived; also B, not having gall, belongs to every C. If then C be convertible with B, and not more comprehensive than the middle term, A must be B. For we have shewn before that if any two qualities are predicable of the same term, and if the major term be convertible with one of them, then one of the qualities predicated will be true of the convertible term. One ought to look at C as a combination of the

whole number of particular instances, for induction is based on completeness. Now inductive syllogism requires a primary and ultimate premise, for when a middle term exists, the syllogism makes use of that, when it does not, it proceeds by induction. Induction is in a manner opposed to syllogism, as the latter proves the major term of the minor by means of the middle, the former proves the major of the middle by means of the minor. Hence the syllogism which makes the middle term the instrument of proof is naturally prior and more knowable, but for us that which uses induction is clearer.

XXIV.

Example consists in the demonstration that the major is true of the middle term by the help of a fourth term or number of terms resembling the minor. Example bears the relation of part to part, thus differing from syllogism, while it differs from induction in using only a few instances or even one, instead of the entire number of individuals included under the common designation or term.

EXAMPLE is the method used when the major term is proved true of the middle by a means of a term resembling the minor. It must already be known that the middle is true of the minor and the major of the term resembling the minor. For instance, let A be 'a bad thing'; B 'to make war on neighbours'; C 'War of Athenians against Thebans'; D 'War of Thebans against Phocians.' If then we wish to prove that it is a bad thing [for the Athenians] to enter on war with the Thebans, we must make use of the proposition 'It is a

bad thing to make war on neighbours.' This is supported by similar instances; e.g. by the war of the Thebans against the Phocians. Since then fighting against one's neighbours is a bad thing, and fighting against the Thebans is fighting against neighbours, it is clearly a bad thing to fight against the Thebans.

It is plain that B is true both of C and D, for both are cases of making war on neighbours, and it is likewise clear that A is true of D, for the war against the Phocians was not favourable to the Thebans. That A is true of B will be proved by means of the term D.

The same method is applicable if several similar examples be employed to prove the major term of the middle.

It is clear then that the Example has neither the relation of part to whole nor of whole to part, but of part to part; that is to say both terms are included under the same common term, but only one of them is already known. It differs from induction, in that induction proves, by a survey of all the individual instances, that the major is true of the middle, not that it is true of the minor, while example does prove the major true of the minor, and does not make use of all the individual instances, but only of some or one.