

# New Essays on Human Understanding

## Book IV: Knowledge

G. W. Leibniz

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[Brackets] enclose editorial explanations. Small ·dots· enclose material that has been added, but can be read as though it were part of the original text. Occasional •bullets, and also indenting of passages that are not quotations, are meant as aids to grasping the structure of a sentence or a thought. Every four-point ellipsis . . . . indicates the omission of a brief passage that seems to present more difficulty than it is worth.—Longer omissions are [explained] as they occur. Very small bold unbracketed numerals indicate the corresponding section number in Locke's *Essay*; most of these are provided by Leibniz. This version does not follow Leibniz's practice of always avoiding Locke's name in favour of 'this author', 'our gifted author', etc.

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## Chapter vii: The propositions that are called ‘maxims’ or ‘axioms’

**Philaethes:** 1 Propositions of a certain kind are labelled ‘maxims’ and ‘axioms’ and are taken to be principles of science; and because they are self-evident, people are prepared to call them *innate*, though nobody (*as far as I know*) has ever undertaken to show why and on what basis they have the extreme clearness that forces us (as it were) to agree to them. But this is worth looking into, to see whether this great evidentness is something that only these propositions have, and also to examine how far they contribute to our other knowledge. [In this speech by Philaethes, the phrase ‘as far as I know’ was italicized by Leibniz, not by Locke.]

**Theophilus:** Such an inquiry is very useful and even important, but you shouldn’t imagine that it has been entirely neglected. [He cites several examples of such work, including some of Leibniz’s own. Here is one of his anecdotes about this:] Some people objected to Roberval’s assuming the axiom that ‘If equal magnitudes are •added to equals, the wholes are equal’ in order to prove the axiom ‘If equal magnitudes are •subtracted from equals, the remainders are equal’. The objectors judged the two axioms to be similarly evident, and said that Roberval ought to either assume them both or demonstrate them both. This wasn’t my opinion; I believed that to reduce the number of axioms was *always* something gained. And •addition is unquestionably prior to and simpler than •subtraction, because in addition both terms are dealt with in the same way while in subtraction they are not. . . . Anyway, I have for a long time been publicly and privately urging the importance of demonstrating all the secondary axioms that we ordinarily use, by deriving them from axioms that are primary, i.e. immediate and indemonstrable; they

are the ones I have been calling ‘identities’ [e.g. page 172].

**Phil:** 2 Knowledge is self-evident when the agreement or disagreement of ideas is perceived immediately. 3 But other truths are regarded as no less self-evident though they are *not* regarded as axioms. Let us see whether they are provided by the four sorts of agreement that we discussed a little while ago [page 169], namely •identity, •connection, •relation, and •real existence. 4 As regards •identity and •diversity, we have as many evident propositions as we have distinct ideas. For we can deny one of the other, e.g. in saying ‘A man is not a horse’, ‘Red is not blue’. Also, ‘Whatever exists, exists’ is as evident as ‘A man is a man’.

**Theo:** That is true, and I have already pointed out [page 173] that it is just as evident to say with reference to one illustrative example that *A is A* as to say in general that *any thing is what it is*. But I have also pointed out [page 173] that it isn’t always safe, with the subjects of two different ideas, to deny one of the other—like someone thinking that a trilateral (i.e. a three-sided thing) isn’t a triangle, on the grounds that trilateralness isn’t triangularity. [He describes with amusement a case where a fine old mathematician went wrong in doing this ‘not safe’ thing, and didn’t retract it when the then-youthful Leibniz protested to him. Then:] I mention him only to indicate how far wrong one can go in denying one idea of another, if the case is one where the ideas need to be explored in depth and this hasn’t been done.

**Phil:** 5 As for •connection or coexistence: we have very few propositions that are self-evident, though there are some: it appears to be a self-evident proposition that *two bodies can’t be in the same place*.

**Theo:** Many Christians disagree with you, . . . and you oughtn’t to get agreement from Aristotle either, or from those

who follow him in accepting real, literal *condensation*—the reduction of an entire body into a smaller space than it previously occupied . . . . If you take a body to be an impenetrable mass then your statement will be true, since it will be an identity or very close to one; but it won't be conceded by your opponents that that's what a real body is. At the least they will say that God *could* make a body differently, so that they will accept this impenetrability not as absolutely or metaphysically necessary but only as following from the natural order that God has established among things and that experience has vouched for, though they would have to admit that it is also very reasonable.

**Phil: 6** As for the relations of modes, mathematicians have framed many axioms concerning that single relation, *equality*. For example, there is the one you have just discussed: 'If equals are subtracted from equals, the remainder will be equal.' But I find it no less evident that *One and one are equal to two* and that *If you take two from the five fingers of one hand and two from the five fingers of the other hand, the remaining numbers of fingers will be equal*.

**Theo:** That one and one make two isn't strictly speaking a truth, but rather the definition of 'two'; though it partakes of the true and the evident because it is the definition of a possible thing. As for applying Euclid's axiom to the fingers of the hand, I am ready to agree that we can grasp what you say about fingers just as easily as we can see it for As and Bs; but to avoid frequent repetitions of the same thing we indicate it generally, and then we need only make substitutions. Otherwise it would be like dispensing with general rules in favour of calculating with particular numbers, which would mean achieving less than one might. For it is better to resolve this general problem: Find two numbers whose sum is one given number and whose difference is another given

number, than merely to look for two numbers whose sum is 10 and whose difference is 6. If I use a mixture of arithmetic and algebra to solve the second problem the calculation will go like this:

$$\text{Let } a + b = 10 \text{ and let } a - b = 6;$$

then I add the two right sides and the two left sides together, which gives me:

$$a + b + a - b = 10 + 6,$$

and, since +b and -b cancel out, this yields:

$$2a = 16, \text{ or } a = 8.$$

Then by subtracting right side from right side and left from left, and seeing that subtracting a - b is adding -a + b, I derive:

$$a + b - a + b = 10 - 6,$$

that is:

$$2b = 4, \text{ or } b = 2.$$

In this way I shall indeed get the numbers a and b that I am looking for, namely 8 and 2; they answer the problem, since their sum is 10 and their difference is 6. But that doesn't give me the general method for any other numbers that one might want or be able to put in place of 10 and 6, although this method is as easy to find as the numbers 8 and 2, simply by putting x and y in place of 10 and 6. For if we proceed just as before, we shall have:

$$a + b + a - b = x + y; \text{ that is } 2a = x + y; \text{ that is}$$

$$a = \frac{1}{2}(x + y),$$

and we shall also have:

$$a + b - a + b = x - y; \text{ that is } 2b = x - y; \text{ that is } b = \frac{1}{2}(x - y).$$

This calculation yields the theorem or general rule that when seeking two numbers whose sum and difference are given, one has only to take the larger sought number to be half the sum of the given sum and difference, and the smaller sought number to be half the difference of the given sum and difference. You might notice that I could have dispensed

with letters, by treating numbers like letters: instead of putting  $2a = 16$  and  $2b = 4$ , I could have written  $2a = 10 + 6$  and  $2b = 10 - 6$ ; this would have given me  $a = \frac{1}{2}(10 + 6)$  and  $b = \frac{1}{2}(10 - 6)$ . Thus the particular calculation would in itself have contained the general one, through my taking these marks 10 and 6 for general numbers like the letters  $x$  and  $y$ , so as to get a more general truth or method; and by taking these same symbols 10 and 6 *also* for the numbers that they ordinarily signify, I shall have an example that can be grasped by the senses and that can even serve as a check. . . . I have found it very helpful to use numbers in place of letters in extended calculations, for avoiding mistakes and even for carrying out checks . . . . in mid-calculation without waiting for the final result; which is often possible if one selects the numbers shrewdly so that the assumptions turn out true in the particular case. It is also useful in displaying connections and patterns that the mind couldn't sort out so well by letters alone. I have shown this elsewhere, having found that a good symbolism is one of the greatest aids to the human mind.

**Phil:** 7 As for •real existence, which I listed as the fourth kind of agreement to be found among ideas, it can't provide us with any axioms, since we don't have demonstrative knowledge of *any* being other than ourselves, with the sole exception of God.

**Theo:** [In this next speech, 'I am thinking' translates '*Je suis pensant*', which is not standard French. It puts the French for 'I am' alongside the French for 'thinking'; but the idiomatic French way to say that is *Je pense*. Leibniz is *forcing* French to express his view that 'I think' contains as part of its meaning 'I am'. In English no force is needed.] One can always say that the proposition *I exist* is evident in the highest degree, since it can't be proved through any other—indeed, that it is an immediate truth. To say *I think, therefore I am*

isn't really to prove existence from thought, since *to think* and *to be thinking* are one and the same, and to say *I am thinking* is already to say *I am*. Still, there is some reason for you not to include this proposition among the axioms: it is a proposition of fact, founded on immediate experience, not a necessary proposition whose necessity is seen in the immediate agreement of ideas. On the contrary,

only God can see how the two items *I* and *existence* are connected,

that is,

only God can see why I exist.

But if you take the word 'axiom' in a broader sense as covering all immediate or non-provable truths, then the proposition *I am* can be called an 'axiom'. In any case we can be confident that it is a primary truth, and indeed . . . one of the first known statements—first in the natural order of our knowledge, that is, since it may never have occurred to a man to form this proposition explicitly even though it is innate in him.

**Phil:** I had always thought that axioms don't have much influence on the other parts of our knowledge. But you have cured me of that error by actually showing me an important use for identities. Still, let me tell you what I *did* have in mind on this point, since your explanations may serve to set others right as well. 8 It is a famous rule among the Schoolmen that all reasonings are from *things already known and agreed to*. This rule seems to take •these maxims to be truths known to the mind before the rest, and •the other parts of our knowledge as truths that depend on the axioms. 9 I thought I had shown (I.i.) that axioms are *not* the first things known, on the grounds that the child knows that *the stick* (:for punishment:) *that I show him isn't the sugar he has tasted long before he knows any axiom you like*. But

you have distinguished •knowledge of particulars or experience of facts from •the principles of universal and necessary knowledge—and I now agree that with the latter we must avail ourselves of axioms. And you have also distinguished between the accidental and natural orders.

**Theo:** And I also added that in the natural order the statement that *a thing is what it is* is prior to the statement that *a thing is not something else*. ·I stress ‘the *natural order*’ because we aren’t concerned here with the •sequence of our discoveries, which differs from one man to another, but with •the connection and natural order of truths, which is always the same. But your putting what the child sees among the ‘facts’ calls for further consideration. You yourself pointed out not long ago that sense-experience doesn’t provide absolutely certain truths, free from all risk of illusion. If I may make up a story that is metaphysically possible, the sugar could change into a stick in some undetectable way, to punish the child when he had been naughty . . . . But you will say that all the same the pain inflicted by the stick will never turn into the pleasure that the sugar provides. I reply that the child will be as late in explicitly forming *that* proposition as he will in noticing the axiom that

one can’t truthfully say that *what is, at the same time is not*;

even though he is thoroughly aware of the difference between pleasure and pain, as well as of that between perceiving and not perceiving.

**Phil: 10** Yet there are a great many other truths that are as self-evident as these maxims. For instance, that *One and two are equal to three* is as evident a proposition as the axiom that *The whole is equal to all its parts taken together*.

**Theo:** You appear to have forgotten how I called to your attention more than once that ‘One and two is three’ is the

*definition* of the term ‘three’, so that saying that one and two is equal to three is just saying that something is equal to itself. As for the axiom that ‘The whole is equal to all its parts taken together’, Euclid doesn’t use precisely that. Furthermore, this axiom needs to be qualified, for it must be added that the parts should not themselves contain parts in common: 7 and 8 are parts of 12, but they add up to more than 12; the upper half of a man and his trunk add up to more than the man, since they have his chest in common. But Euclid does say that *The whole is greater than its part*, and this is true just as it stands. The statement that *the body is greater than the trunk* differs from Euclid’s axiom only in that the axiom restricts itself to precisely what needs to be said; but by exemplifying it—giving it a body—we turn something that can be •thought into something that can also be •grasped by the senses. You see, the statement that *this whole is greater than that part of it* is actually the proposition that *a whole is greater than its part*, but with its features coloured in or augmented—just as one who says AB says A. So we shouldn’t here be contrasting the axiom with the example, as though they were different truths in respect of how evident they are, but rather regarding the axiom as embodied in the example and as making the example true. It is another matter when the example isn’t itself evident, and is affirmed as a *deduction from* the universal proposition and not merely as an *instance of* it; and this can happen with axioms too.

**Phil:** Locke says: ‘I have a question for the men who insist that all knowledge of anything other than ·contingent· *facts* depends on general, innate, self-evident principles: *What principle do you need to prove that two and two are four?*’ For he holds that the truth of such propositions is known without any proof. What do you say to this?

**Theo:** I say that I was ready and waiting for you! *Two and two are four* is not quite an immediate truth. Assume that ‘four’ signifies ‘three and one’. Then we can demonstrate it, and here is how.

*Definitions.*

- (1) *Two* is one and one.
- (2) *Three* is two and one.
- (3) *Four* is three and one.

*Axiom.*

If equals be substituted for equals, the equality remains.

*Demonstration.*

- 2 and 2 is 2 and 1 and 1 (def. 1)
- 2 and 1 and 1 is 3 and 1 (def. 2)
- 3 and 1 is 4 (def 3.)

Therefore (by the Axiom)

*2 and 2 is 4*—which is what was to be demonstrated.

Instead of saying that *2 and 2 is 2 and 1 and 1*, we could say that *2 and 2 is equal to 2 and 1 and 1*, and similarly with the others. But we can assume that this has already been done throughout, on the strength of another axiom that maintains that a thing is equal to itself. . . .

**Phil:** We don’t *need* to demonstrate such a thoroughly known conclusion, but the demonstration serves to show how truths depend on axioms and definitions. So I can foresee how you will deal with various objections that are brought against the use of axioms. It is objected that there will be a vast multitude of principles. But this comes from including among *principles* the corollaries that follow from the definitions with the help of some axiom: since there are countless definitions or ideas, there will be countless principles in *this* sense of ‘principles’—even if we accept your view that *indemonstrable* principles are axiomatic identities. . . .

**Theo:** Furthermore, in view of the differences in *how* evident they are, I disagree with Locke’s view that all these truths—which he calls ‘principles’ and regards as self-evident because they are so close to the first indemonstrable axioms—are entirely independent of each other and can’t support one another or throw light on one another. For we can always derive them from axioms, or from other truths closer than they are to the axioms, as I showed you with the truth that two and two make four. . . .

**Phil: 11** Locke agrees that maxims have their use, but he believes that it is rather to •silence the obstinate than to •provide foundations for the sciences. ‘Show me’, he says, ‘any science based on these general axioms that couldn’t be shown to stand as firmly without them.’

**Theo:** Geometry is certainly one such science. Euclid uses axioms explicitly in his demonstrations, and both he and Archimedes base their demonstrations concerning the magnitudes of curvilinear figures on this axiom: *If two magnitudes are commensurable, and neither is larger than the other, then they are equal. . . .* And in geometry we can’t do without axiomatic identities such as the principle of contradiction, which is the principle of arguments *ad absurdum*—i.e. arguments of the form:

*P implies Q-and-not-Q. Therefore not-P.*

As for the other axioms that can be demonstrated from these, strictly speaking we can do without them and derive our conclusions immediately from identities and definitions; but if we had always to start again from the beginning, our demonstrations would be so wordy and would involve us in such endless repetition that there would be horrible confusion; whereas by assuming intermediate principles that have already been demonstrated we can readily push ahead. This assumption of already-known truths is particularly useful

with respect to axioms, since they come up so often that geometers are obliged to employ them constantly without citing them. So that it would be a mistake to believe that they are not involved just because they may not always be seen cited in the margin.

**Phil:** But Locke proposes *theology* as an example to the contrary. It is from •revelation that we have received the knowledge of our holy religion, he says, and if we had lacked •that aid maxims could never have given us the knowledge of God that we have. Light comes to us, then, either from things themselves or immediately from God's unfailing truthfulness.

**Theo:** That is like saying that since medicine is based on experience, reason has nothing to contribute to it! Christian theology—the true medicine of souls—is founded on revelation, which corresponds to experience [perhaps meaning 'which doesn't conflict with experience']; but to make it into a completed system we have also to bring in natural theology, which is derived from the axioms of eternal reason. You accept that the certainty of revelation is based on God's truthfulness, but isn't the very principle that *God is truthful* a maxim drawn from natural theology?

**Phil:** Locke wants the method of •acquiring knowledge to be distinguished from that of •teaching it, or rather that of •teaching and •communicating it. When colleges were established and sciences had their professors to teach what others had discovered, they often made use of maxims to imprint these sciences on the minds of their scholars, and to convince them of certain particular truths by means of axioms. So much for •teaching and communicating; but as for •acquiring knowledge: those who first discovered truths did so on the basis of particular truths, with no help from general maxims.

**Theo:** I wish he had offered support for this supposed procedure by giving us some examples of particular truths that were discovered without help from maxims! But if we look carefully into the matter, we won't find this procedure employed in the founding of the sciences. If a discoverer finds only a particular truth, he is only a half-discoverer. If Pythagoras had merely noticed that

a triangle whose sides are 3, 4, 5 has the property that the square on its hypotenuse equals those on its sides (i.e. that  $9 + 16$  makes 25),

would *this* have made him the discoverer of the great truth, Pythagoras's theorem, that holds for all right-angled triangles and has become a maxim among the geometers? It's true that an example hit on by chance will often *prompt* an intelligent man to *look* for the general truth involved; but *finding* it is usually a very different matter. In any case, this way of discovering things isn't the best, nor is it the one most used by those who proceed in an orderly and methodical way—they make use of it only in situations where better methods fall short. . . . Discoverers have been delighted to catch sight of maxims and general truths when they have succeeded in arriving at them, since otherwise their discoveries would have remained quite incomplete. So the only thing we can impute to colleges and professors is having collected and ordered these maxims and other general truths. And would to God it had been done even more, and with greater care and discrimination—the sciences wouldn't be so fragmentary and chaotic. Another point: I grant that the method used to •teach the sciences is often different from the method by which they have been •found, but that isn't the point at issue. Sometimes, as I have already remarked, a chance happening provides the occasion for a discovery. If note had been taken of these occasions and a record of them kept for posterity, these facts would have constituted a useful and

very substantial part of the history of the practical arts, but it wouldn't have been suitable for making them systematic; sometimes discoverers have proceeded by rational means, but very circuitously, towards the truth. I think that those who have made major advances in the sciences would have done us a favour if they had candidly undertaken, in their writings, to sketch their various attempts. But to construct a scientific *system* on that principle would be like wanting to retain in a finished house all the scaffolding that the builders had needed for putting it up. *Sound* methods of teaching a science are all of such a kind that the science could reliably have been found by means of them. And if they aren't the empiric's methods, i.e. if the truths are taught through reasons or by proofs derived from ideas, this will always be by means of axioms, theorems, rules, and other such general propositions. . . .

**Phil:** This is how Locke believes that the need for maxims arose. The Schools made *disputation* the test of men's abilities, and declared as winner the person who held his ground. But maxims had to be established as a means of winning over the obstinate.

**Theo:** No doubt the philosophy schools would have done better to combine theory with practice, as do the schools of medicine, chemistry and mathematics, and to give the prize—especially in moral philosophy—to the one who *did* best rather than to the one who *spoke* best. Still, in metaphysics and some other subjects discourse itself is a product of skill—and sometimes the only one, the one formal proof of a man's mastery. So in some cases it has been right to judge people's skill by their success in discussion. We even know that at the start of the Reformation the Protestants challenged their adversaries to conferences and debates, and that sometimes their success in these debates led the peo-

ple to decide in favour of reform. And we also know how much the art of speaking and of producing and marshalling reasons—what might be called the art of debate—can achieve in councils of state and of war, in law courts, in medical consultations, even in conversations. In these situations we *have to* resort to this procedure and be satisfied with words in place of deeds, simply because what is in question is some future event and we can't wait to learn the truth from what ensues. So the art of debate . . . is very important; but unfortunately it is most disorderly, which is why so often no decision—or a bad decision—is reached. . . . In short, the art of discussion and debate needs to be totally reorganized. . . . The fact is that in these encounters truth is pretty much beside the point, and contradictory theses are maintained at different times from the same rostrum. When Casaubon was shown the hall of the Sorbonne and told 'In this room they have debated for many centuries', he replied 'And what conclusions have they reached?'

**Phil:** In order to prevent the debate running on into an endless train of syllogisms, however, and to provide a means of deciding between two equally skilful combatants, certain general propositions—or 'maxims', most of them self-evident, were introduced. Everyone accepted these, so they were looked on as general measures of truth, and made to do the work of principles . . . beyond which there was no going, and which must be kept to by each side in the debate. And thus these maxims, which came to be called 'principles', couldn't be denied in the course of the dispute and settled the question; and so they were taken—wrongly, in Locke's view—to be the source of all knowledge and the foundations of the sciences.

**Theo:** If only they *had* used them in this way in their debates! Then they would have decided something, and there

would have been nothing to complain about. And what could be better than to reduce the controversy—i.e. the truths in contention—to evident and incontestable truths? Wouldn't this be to establish them demonstratively? And who can doubt that principles that ended debates by establishing the truth would at the same time be sources of knowledge? For as long as one's reasoning is sound, it hardly matters whether it is done quietly in one's study or displayed on a public platform. . . . I'm really astonished to see something so praiseworthy attacked because of who knows what prejudice. Locke's example shows clearly that the cleverest men are liable to prejudice when off their guard. Unfortunately academic debates are conducted quite differently. Instead of •establishing general axioms, everything possible is done to •weaken them by means of vague and poorly thought out distinctions. There are certain philosophical rules—big books crammed with them—that people like to use, but these are quite unreliable and imprecise, and anyway debaters take delight in evading their force by splitting hairs. This is the way not •to settle debates but rather •to make them endless and finally to wear one's opponent down. It is as though he were led into a dark room and subjected to blows from all directions, with no-one being able to judge them. This is an excellent arrangement for respondents who have undertaken to maintain certain theses: Vulcan's shield to make them invulnerable, and Pluto's helmet to make them invisible! They have to be very unskilled or very unlucky to get caught under these conditions! It's true that some rules have exceptions, particularly those that bear on complex situations, as in jurisprudence. . . . But if rules like this, with all their exceptions and sub-exceptions •precisely stated•, were to be brought into academic debates, one would have to debate pen in hand and keep minutes of what is said on each side. . . . [Philaethes produces more of Locke's railing

against 'maxims', saying that 'the Schools' have promoted them as helps to arguments, where things would go better if the disputants merely looked for 'intermediate ideas' to help them establish their conclusions. Theophilus replies that it isn't just the Schools that do this; that all sensible people do it, and there is nothing wrong with it as long as the demand for the underlying reasoning isn't pushed too hard, 'needlessly and inopportunately'.]

**Phil: 12** The use of maxims is also harmful when they are associated with notions that are wrong, loose, or unsteady. For then maxims serve to confirm us in mistakes; and even to prove contradictions. For example, someone who follows Descartes in forming an idea of what he calls 'body' as nothing but *extension* can easily demonstrate that there is no vacuum; i.e. no space that has no body in it, by means of •the maxim that *What is, is*. For he knows his own idea, and knows that it is what it is and not another idea. Since for him 'extension', 'body' and 'space' are three words standing for the same thing, it is for him just as true to say that *space is body* as to say that *body is body*. **13** But someone else for whom 'body' stands for *an extended solid* will be led by a similar argument to conclude that the proposition *Space is not body* on the strength of •the maxim *It is impossible for the same thing to be and not to be at the same time*.

**Theo:** The *misuse* of maxims oughtn't to bring discredit on *all* use of them: every truth has the drawback that if you combine it with falsehoods you can draw false or even contradictory conclusions. In your example there is hardly any need for those •axiomatic identities that you take to be the source of the error and of the contradiction. You would see this if the arguments of those who infer from their definitions that *space is body* or that *space is not body*, were laid out formally. [He offers a technical criticism of the argument

that Locke attributes to the Cartesian. Then:] Your example strikes me as involving a misuse of ideas rather than of maxims.

**Phil: 15** It seems, at least, that whatever use one may make of maxims in verbal propositions, they can't yield us the slightest knowledge of substances that exist outside us.

**Theo:** I am of an entirely different opinion. For example, the maxim that *nature acts by the shortest way* or at least . . . *by the most determinate way* is sufficient by itself to explain almost the whole of optics, including the optics of reflection and refraction, i.e. the whole of what goes on outside us in the actions of light. . . .

**Phil: 19** I should think, at least, that maxims aren't much use when one has clear and distinct ideas; and others contend that even then maxims are utterly useless, claiming that anyone who in such cases can't discern truth and falsehood without such maxims can't do so with their aid either. . . .

**Theo:** When the truths are very simple and evident, and are very near to identities or definitions, one hardly needs to make explicit use of maxims in order to derive these truths from them—i.e. from the identities or definitions—for the mind employs the maxims *implicitly*, and reaches its conclusion all at once without any stops along the way. But mathematicians would find it very difficult to get anywhere if they didn't have axioms and theorems that were already known. For in a long deduction it is good to stop from time to time and, as it were, set up a milestone for oneself in the middle of the road; this will also help to mark out the route to others. If that isn't done, these long roads will be too hard to follow, and may even seem rambling and dark, preventing one from picking out and taking a bearing on anything apart from the place one is in. It is like travelling

by sea without a compass, on a dark night when one can't see the sea-bed or the shore or the stars. [He goes on to say, and illustrate at scholarly length, that this salutary use of 'maxims' as route-markers occurs not only in mathematics but also in jurisprudence. 'One of the chief ways of making jurisprudence more manageable, and of surveying its vast ocean as though in a geographical chart, is by tracing a large number of particular decisions back to more general principles' of the sort Locke would call 'maxims'. Then he speaks of the use of 'maxims' in theoretical medicine as desirable but harder to manage than in jurisprudence:] In so far as medicine is empirical it is harder and more risky to form universal propositions in it. Furthermore, there are usually complications in particular illnesses. Illnesses imitate substances, so to speak, in such a way that an illness resembles a plant or animal that requires an account all of its own. That is, illnesses are •modes or •ways of being that fit what we have said about •bodies or •substantial things, a recurrent fever being as hard to understand thoroughly as is gold or mercury. So it is good—universal precepts notwithstanding—to search among the kinds of illnesses for healing methods and remedies that will deal with several symptoms and conjunctions of causes at once, and above all to collect the cures that are warranted by experience. . . . So I believe that it will be best to combine the two methods, and not to complain of repetitions in such a delicate and important matter as medicine is. What medicine doesn't have but needs are books full of particular cases and catalogues of previously observed facts—which is just what jurisprudence has too much of, in my opinion. I believe that a thousandth part of the books of the jurists would be enough, whereas we wouldn't have too much in medicine if we had a thousand times as many well-documented observations. The point is that jurisprudence, when dealing with matters that

aren't explicitly treated by laws or by customs, is entirely grounded in reasons; for that part of it can always be derived by reason from the law of the land or, if not from that, from natural law. And the laws of each land are finite, and they are determinate or can become so. In medicine, on the other hand, there couldn't be too many observations—those first principles of experience—giving reason more opportunity to decipher things that nature has only half-revealed to us. . . .

### Chapter viii: Trifling propositions

**Philaethes:** . . . . 2 It *seems* that these purely identical maxims are merely trifling. . . . And I wouldn't have been satisfied with saying merely that this 'seems' to be so if your surprising example of the use of identities in demonstrating conversion hadn't made me step with care when it comes to being scornful of anything. [The demonstration of conversion occurs in the long treatment of syllogisms, omitted from this version at page 173.] Still, I'll report to you Locke's reason for saying that they are utterly trifling. It is that they can be seen at first blush to contain nothing instructive except sometimes to show a man the absurdity he is guilty of.

**Theophilus:** Do you count that as nothing? Don't you recognize that to reduce a proposition to absurdity is to demonstrate its contradictory? I quite agree that one won't teach a man anything by telling him that he oughtn't to deny and affirm the same thing at the same time; but one does teach him something when one shows him, by force of inference, that he is doing just that without thinking about it. In my opinion it is hard always to forgo these demonstrations by *reductio ad absurdum*, and to prove everything by direct demonstrations. This is a fact of which geometers, who are very interested in the question, have had plenty of experi-

ence. . . .

**Phil:** 4 I acknowledge that there are legitimate uses of identities, and I can see that this holds even more clearly for propositions—which appear trifling and often are so—in which *a part* of the complex idea is predicated of the object of that idea, as when one says *Lead is a metal*. The only good that does, in the mind of someone who knows what 'lead' and 'metal' stand for, and knows that 'lead' signifies 'a body that is very heavy, fusible and malleable', is that in saying 'metal' one indicates to him several of the simple ideas all at once instead of going through them one by one. 5-7 The same holds when a *part of* a definition is affirmed of the term defined: as in saying *All gold is fusible* (assuming that 'gold' has been defined as 'a body that is yellow, heavy, fusible and malleable'), or *A triangle has three sides*, or *Man is an animal*. . . .—which define the words but don't teach one anything beyond the definitions. But we *are* taught something by being told that man has a notion of God and that he is put to sleep by opium, because neither of these is any part of the definition of 'man'.

**Theo:** In addition to what I have said about completely identical propositions, these semi-identicals will be found also to be useful in their own special way. For example: *A wise man is still a man* lets one know that he isn't infallible, that he is mortal, and so on. Someone in a situation of danger needs a pistol-bullet, he has a mould for making bullets but has no lead to use in it; and a friend says to him 'Remember that the silver you have in your purse is fusible'. This friend won't teach him a quality of the silver, but he will make him think of a use he can make of it, as a source of bullets in this emergency. A good proportion of moral truths and of the finest literary aphorisms are of that nature: quite often they teach one nothing, but they do make one think at the

right time about what one knows already. . . . The jurists' rule that says *He who exercises his rights doesn't do wrong to anybody* appears trifling. Yet it has an excellent use in certain cases, where it makes one have the very thought that is needed. For example, if someone built his house up to the greatest height allowed by the statutes and usages, thus depriving a neighbour of part of his view, if the neighbour ventured to complain he would at once be rebuffed with this rule of law. I would add that propositions of fact such as that opium is a narcotic lead us on further than do truths of reason, which can never make us go beyond what is in our distinct ideas. As for the proposition that every man has a notion of God, if 'notion' signifies *idea* then that is a proposition of reason, because in my view the idea of God is innate in all men. But if 'notion' signifies *an idea that involves actual thinking*, then it is a proposition of fact, belonging to the natural history of mankind. One last point: the proposition *A triangle has three sides* isn't as much of an identity as it seems, for it takes a little attention to see that a polygon must have as many angles as sides; and if the polygon weren't assumed to be closed the sides would outnumber the angles by one.

**Phil: 9** It seems that the general propositions that are made about substances, if they are certain, are mostly just trifling. Anyone who knows the meanings of the words 'substance', 'man', 'animal', 'form', 'soul', 'vegetative', 'sensitive', 'rational' can make many propositions that are undoubtedly true but *useless*—especially about the soul, which people often talk about without knowing what it really is. A man may find countless propositions, reasonings and conclusions of this sort in books of metaphysics, School-divinity and some kinds of natural science without knowing any more about God, spirits or bodies than he knew before he had skimmed

through those books.

**Theo:** It's true that the general run of surveys of metaphysics and of other books of that sort teach nothing but words. . . . But to be fair to the deeper Scholastics, . . . it should be acknowledged that *their* works sometimes contain substantial discussions—for instance of

the continuum,  
the infinite,  
contingency,  
the reality of abstract entities,  
the principle of individuation,  
the origin of forms,  
a vacuum among forms [see explanation on page 142],  
the soul and its powers,  
God's communion with created things,

and so on, and even, in moral philosophy, of  
the nature of the will and  
the principles of justice.

In short, it must be admitted that there is still gold in that dross. But only enlightened people can profit from it; and to burden the young with a great jumble of useless stuff just because it contains good things here and there is to waste the most precious of all things, namely *time*. I would add that we do have *some* general propositions about •substances that are certainly true and also worth knowing: Locke's doctrines include—whether as original to him or partly following others—some great and beautiful truths about •God and about •the soul; and perhaps I have been able to add something to them. As for knowledge of general truths about •bodies: many significant ones have been added to the ones that Aristotle left for us, and it ought to be said that natural science—even the general part of it—is much more real, •much more *thing-oriented*•, than it used to be. As for real

metaphysics, we are on the brink of starting to get it established, and are discovering important general truths, based on reason and confirmed by experience, which hold for substances in general. I hope that I too have contributed a little to what is known of the soul, and of spirits, in general. That is the sort of metaphysics that Aristotle asked for . . .

•It was to relate to •the other theoretical sciences as •the science of happiness does to •the practical arts on which it relies, and as •the architect does to •the builders. That's why Aristotle said that the other sciences depend on metaphysics as the most general science, and should borrow their principles from metaphysics, which is where they are demonstrated. It should also be understood that •metaphysics relates to true •moral philosophy as •theory to •practice. That is because justice and virtue have their proper *extent* only because of the doctrine of substances in general, the knowledge about spirits—and especially about God and the soul. . . . If there were no providence and no after-life, the wise man's practice of virtue would be more restricted, since he would refer everything only to his present satisfaction; and even that satisfaction—which has already been exemplified in •such wise men as• Socrates, the emperor Marcus Aurelius, Epictetus, and other ancients—wouldn't always be as well grounded •as it actually *can* be, in the absence of those broad and beautiful perspectives that are opened up to us by the order and harmony of the universe, extending to an unlimited future. Without those perspectives, the soul's •tranquillity would amount merely to •resignation, [i.e. to quietly *putting up with* whatever the world dishes out]. So it can be said that natural theology—with its two divisions, theoretical and practical—contains both real metaphysics and the most perfect moral philosophy.

**Phil:** Those are cases of knowledge that are certainly very far from being trifling or merely verbal. **12** But it seems that purely verbal propositions are ones in which one abstract term is affirmed of another, for example *Parsimony is frugality*, or *Gratitude is justice*. However attractive these and other propositions may sometimes seem at first sight, if we squeeze out their content we shall find that it amounts to nothing but the meanings of words.

**Theo:** But the principles of *all* demonstrations are expressed by •the meanings of words (i.e. definitions) together with •axiomatic identities; and since these definitions can show *what* the ideas are and at the same time *that* they are possible, it is evident that not everything that depends on them is purely verbal. Take the example *Gratitude is justice* or rather . . . *a part of justice*: that shouldn't be treated as trivial, for it conveys the knowledge that the . . . accusation that can be brought against someone who is ungrateful should receive more attention in the law courts. The Romans entertained this kind of legal action against freedmen, i.e. those who had been released from slavery, and even today it ought to be valid in connection with the revocation of gifts. Finally: I have already remarked elsewhere [page 156] that abstract ideas can also be attributed to one another as genus to species, as when one says that duration is a continuous quantity, or that virtue is a disposition; but universal justice isn't merely a virtue—rather, it is the whole of moral virtue.

## Chapter ix: Our knowledge of our existence

**Philaethes: 1** So far we have considered only the essences of things; and since our mind knows these only by abstraction, separating them from all particular existence except what is in our understanding, they give us no knowledge of real existence at all. And universal propositions of which we can have certain knowledge don't concern existence. Furthermore, whenever something is attributed to an individual belonging to a given genus or species, by a proposition that wouldn't be certain if it made the same attribution to the genus or species as a whole, the proposition only concerns existence, and only declares an accidental relationship in particular existing things—as when it is said that a certain man is learned.

**Theophilus:** Yes, indeed! And that is how the matter is viewed by philosophers, too, when in their often-repeated distinction between •essence and •existence they associate with •existence everything that is accidental or contingent. Very often a *universal* proposition that is known only through experience may, for all we know to the contrary, be accidental too, for our experience is limited. For example, in a country where water never freezes they would arrive at the proposition that *water is always in a fluid state*; but this isn't essential, as is discovered by coming to colder lands. However, we can take 'accidental' in a narrower way, so that there is a kind of middle ground between •the accidental and •the essential: this middle ground is •the natural, meaning something that doesn't necessarily belong to the thing but which nevertheless is inherently appropriate to it if nothing prevents it. Thus someone could maintain that fluidity isn't really essential to water but is at least natural to it. One

*could* maintain this, I repeat, but still it hasn't been demonstrated, and inhabitants of the moon might have grounds for thinking they were just as entitled to say that it is natural for water to be frozen. There are other cases, though, where naturalness is less problematic: for example, a light-ray always travels in a straight line while in the same medium unless it happens to meet a surface that reflects it. . . .

**Phil: 2** I have already remarked, following Locke, that we know our own existence by intuition, that of God by demonstration, and that of other things by sensation; and I recall that you heartily applauded [page 185]. **3** The intuition that lets each of us know that he exists does so in a wholly evident manner that doesn't admit of proof and doesn't *need* proof; with the result that even when I undertake to doubt everything, this very doubt won't allow me to doubt my existence. In short, on this topic we have the highest imaginable degree of certainty.

**Theo:** I wholly agree with all this. And I add that

- the immediate awareness of our existence and of our thoughts provides us with the first *a posteriori* truths, or truths of fact, i.e. the first experiences; and
- identical propositions embody the first *a priori* truths or truths of reason, i.e. the first illuminations.

Neither kind admits of proof, and each can be called 'immediate'—the former because •nothing comes between the understanding and its object, the latter because •nothing comes between the subject and the predicate.

## Chapter x: Our knowledge of the existence of God

**Philaethes:** 1 God, having equipped our soul with the faculties that it is endowed with, hasn't left himself with no witness to his existence; for sense, understanding and reason provide us with clear proofs of his existence.

**Theophilus:** Not only has God endowed the soul with the faculties it needs to know him, but he has also stamped the soul with his trade-mark, so to speak, though faculties are needed if the soul is to be aware of this. But I don't want to revive our earlier discussions of innate ideas and truths, amongst which I count the idea of God and the truth of his existence. Let us instead come to the point.

**Phil:** Well, although the existence of God is the most obvious truth that reason reveals to us, and though its evidentness (if I'm not mistaken) equals mathematical certainty, it still requires *attention*. All that is needed for a start is to reflect on ourselves and on the unquestionable fact that we exist. 2 Accordingly, I take it that everyone knows that he is something that actually exists, and thus that he is a real being. If there is anyone who can doubt his own existence, I declare that I am not talking to him! 3 Next, we know by an intuitive certainty that bare •nothing can't produce •any real being. Whence it follows with mathematical evidentness that something has existed from all eternity; since whatever had a beginning must be produced by something else. 4 Now, any being that draws •its existence from something else also draws •everything it has, including all its faculties, from the same source. So this eternal source of all beings is also the origin of all their powers; and so this eternal being must be omnipotent. 5 Next, a man finds that he has knowledge. So there exists some knowing intelligent being. But things that

have absolutely no knowledge or perception couldn't possibly produce a knowing being, and it is inconsistent with the idea of *senseless matter* that such matter should put sense into itself. So things have their source in a knowing being, and there has been a knowing being from eternity. 6 An eternal, most powerful, and most knowing being is what is called 'God'. If despite all this I were to come across someone so unreasonable as to suppose that

- only man is and wise, that
- all the rest of the universe acts blindly and haphazardly, and that
- he is the product of mere chance events belonging to that blind haphazard,

I would advise him to study at his leisure Tully's firm and reasonable rebuke: 'What can be more stupidly arrogant than for a man to think that *he* has reason and understanding, but that there is no intelligence that governs this whole vast universe?' From what I have said it is plain that we have a more certain knowledge of the existence of God than of anything else external to us.

**Theo:** I assure you perfectly sincerely that I'm most distressed to have to find fault with this demonstration; but I do so only so as to get you to fill the gap in it. It is mainly at the place where you infer that 'something has existed from all eternity'. I find an ambiguity there. If it means that

there has never been a time when nothing existed, then I agree with it, and it really does follow with entirely mathematical rigour from the preceding propositions. For if there had *ever* been nothing, there would *always* have been nothing, because a being can't be produced by nothing; and if nothing had been produced we ourselves wouldn't have existed, which conflicts with the first truth of experience. But you go straight on in a way which shows that when you

say that something has existed from all eternity you mean an eternal thing, ·so that your sentence means ‘There is a thing that has always existed’·. But from what you have asserted so far it doesn’t follow that if there has always been something then one certain thing has always been, i.e. that there is an eternal being. For some opponents will say that I was produced by other things, and these by yet others, ·and so on backwards, so that there were always things that could produce later things, but nothing lasted through all time·. Furthermore, there are those who admit eternal beings (as the Epicureans do with their atoms) but don’t regard themselves as committed to granting that there is an eternal being that is the sole source of all the others. They will agree that whatever confers existence also confers the things’ other qualities and powers, but they will deny that *a single thing* gives existence to the others, and will say that for each thing the joint action of several others is required. Thus, we shan’t be brought by your argument, unaided, to *one* source of all powers. It is indeed highly reasonable to believe that there is such a source, and that wisdom rules over the universe. But those who believe that •matter can *have* sense won’t be inclined to accept that •matter can’t possibly *produce* sense; at least, it will be hard to adduce a proof of this that doesn’t also show that matter is entirely incapable of sense. Also, supposing that our thought does come from a thinking being, can we take it for granted, without harming the demonstration, that this being must be God?

**Phil:** I have no doubt that Locke is capable of making this demonstration flawless; and I shall try to induce him to do so, as there is hardly a greater service that he could render to the world at large. You wish for this too, which leads me to believe that you don’t believe that 7 to silence the atheists we should make everything turn on *the existence of the idea*

*of God within us*; like those who are so fond of that darling invention that they reject all other demonstrations of God’s existence or at least try to weaken them, and forbid us to listen to them as being weak or fallacious. They say this about the proofs that our own existence and the perceptible parts of the universe so clearly and forcefully present to our thoughts that I don’t think any thoughtful person can possibly withstand them.

**Theo:** Although I support innate ideas, and especially that of God, I don’t believe that the Cartesians’ demonstrations from the idea of God are complete. I have shown fully elsewhere . . . . that the demonstration that Descartes borrowed from Anselm is truly most elegant and ingenious but that there is still a gap to be filled. . . . The argument runs more or less as follows:

God is the greatest or (as Descartes says) the most perfect of beings; which is to say that he is a being whose greatness or perfection is supreme, containing within himself every degree of it. That is the notion of God. Now here is how existence follows from that notion. Existing is something more than not existing, i.e. existence adds a degree to the greatness or to the perfection—as Descartes put it, existence is itself a perfection. So this degree of greatness and perfection (or rather this perfection) which consists in •existence is *in* that wholly great and wholly perfect supreme being; for otherwise he would be lacking in some degree, which is contrary to his definition. And so it follows that this supreme being exists.

The Scholastics . . . . held this argument in low esteem, regarding it as fallacious; but this was a great mistake on their part, and Descartes, having studied scholastic philosophy for a good while at the Jesuit College of La Flèche, was quite

right to revive the argument. It isn't fallacious, but it is an incomplete demonstration that assumes something that should also be proved in order to render the argument mathematically evident. The point is that the argument silently assumes that this idea of a wholly great or wholly perfect being is *possible* and doesn't imply a contradiction. Even without that assumption Descartes's argument enables us to prove something, namely that *If God is possible he exists*—a privilege that no other being possesses! We are entitled to assume the possibility of any being, and above all of God, until someone proves the contrary; so the foregoing metaphysical argument does yield a demonstrated *moral* conclusion, namely that in the present state of our knowledge *we ought to judge* that God exists and to act accordingly. But it is desirable that able people should fill the demonstration out, so as to achieve strict mathematical evidentness, and I have said something elsewhere that I think may contribute to that end. Descartes's other argument, which undertakes to prove the existence of God on the grounds that

- the idea of him is in our souls and that it must have come from that *of* which it is an idea,

is even less conclusive because it has two defects. **(1)** This argument shares with the preceding one the defect of assuming that there is such an idea in us, i.e. that God is possible. Descartes argues that when we speak of God we know what we are saying and therefore have the relevant idea; but that is a misleading sign; for when we speak of perpetual mechanical motion, for example, we know what we are saying, and yet such motion is an impossibility and so we can only appear to have an idea of it. **(2)** The argument doesn't adequately prove that the idea of God, if we do have it, must come from that of which it is an idea; but I don't want to dwell on that now. You may say: 'Since you acknowledge that the idea of God is innate in us, you oughtn't to

entertain doubts about whether there is such an idea!' But I allow such doubts only in the context of what purports to be a rigorous demonstration based wholly on the idea; for we have from other sources enough assurance of the idea and of the existence of God. You will remember, too, that I have shown how ideas are in us—not always so that we are aware of them but always in such a way that we *can* draw them from our own depths and bring them within reach of our awareness. I think it is like that with the idea of God, whose possibility and existence I hold to have been demonstrated in more than one way—the pre-established harmony itself provides a new and unassailable method. I believe indeed that almost all the methods that have been used to prove the existence of God are sound, and could serve the purpose if they were rendered complete; and I don't *at all* think that we should ignore the proof based on the order of things.

**Phil: 8–9** It may be relevant to dwell a little on the question of whether a thinking being can come from a non-thinking being, one devoid of sense and knowledge, such as matter might be. **10** It is pretty obvious that a chunk of matter can't by itself produce anything and can't put itself into motion; so that any motion it has must also be from eternity or else be added to matter by some more powerful being. If this motion were eternal, it could never produce knowledge. Divide matter into parts as tiny as you like—as though to *spiritualize* it—vary the shape and motion of it as much as you please, make of it a globe, cube, cone, prism, cylinder etc. whose diameters are a billionth of an inch. Such a particle of matter, however small it is, will operate on other similar bodies in exactly the way that much bigger bodies act on ones of *their* size. Now, would it be reasonable to think that sense, thought and knowledge could arise from putting large chunks of matter together in a certain array and hav-

ing them bump into one another? Obviously not! Well, it is just the same with the tiniest chunks of matter there are: they, like the big ones, can't do anything except to bang into one another; so they can't produce knowledge or thought or sensation. But if matter *could* draw sense, perception and knowledge from within itself, doing this *immediately* and without any mechanism, i.e. without the help of shapes and motions—then sense etc. must be a property inseparable from matter and every particle of it. And there's a further point. Although our general or specific conception of matter makes us speak of it as one thing, yet really all matter is not one individual thing that exists as one material being or one single body that we know or can conceive. So if matter *were* the eternal first thinking being, there wouldn't be

- one eternal infinite cogitative being, but
- infinitely many eternal infinite cogitative beings, independent one of another, of limited force and distinct thoughts;

but those could never produce that order, harmony, and beauty that is to be found in nature. From which it necessarily follows that the first eternal being can't be matter. I hope you will be better satisfied with this reasoning than you were with the preceding demonstration by the same celebrated author.

**Theo:** This present reasoning strikes me as perfectly sound, and as being not only rigorous but also deep and worthy of its author. I utterly agree with him that material particles, however small they might be, couldn't be shaped and assembled in such a way as to produce perception; seeing that large particles couldn't do so (as is obvious), and that in small particles everything is proportional to what can occur in large ones. Locke makes here another important point about matter when he says that it shouldn't be regarded as

one thing, or (in my way of putting it) as a true and perfect monad or unity, because it is only a mass containing infinitely many beings. At this point he was only one step away from my system. For what I do is to attribute perception to all this infinity of beings: each of them is like an animal, endowed with a soul (or some comparable active principle that makes it a true unity), along with whatever it needs in order to be passive and to have an organic body. Now, these beings have received their

active nature and their passive nature, i.e. their immaterial and their material features,

from one universal and supreme cause; for otherwise, as Locke has so well said, their mutual independence would have made it impossible for them ever to have produced this order, this harmony, this beauty that we find in nature. But this argument, which appears to have only moral certainty, is brought to a state of absolute metaphysical necessity by the new kind of harmony that I have introduced, namely the pre-established harmony. Here is how: each of these souls expresses in its own manner what occurs outside itself, and

it can't do this through any influence from other particular beings,

or, to put it a better way,

it has to draw up this expression from the depths of its own nature.

So each soul *must* have received this nature—this inner source of the expressions of what lies outside it—from a universal cause, on which all of these beings depend and which brings it about that each of them perfectly agrees with and corresponds to the others. That *couldn't* occur without infinite knowledge and power. And great ingenuity would be needed, especially, to bring about the spontaneous agreement of the machine with the actions of the rational soul; so great, indeed, that a distinguished writer [Bayle] who offered

some objections in his wonderful Dictionary came close to doubting whether all possible wisdom would suffice for the task—for he said that the wisdom of God didn't appear to him to be more than was needed for such a result! He acknowledged, at least, that our feeble conceptions of divine perfection—which are the best we can do—have never been made to stand out so sharply.

**Phil:** What pleasure I get from this agreement between your thoughts and Locke's! I hope you won't mind if I tell you the rest of his reasoning on this topic. **12** First, he considers whether the thinking being on which all other knowing beings (and therefore all other beings) depend is material or not. **13** He considers the objection that a thinking being could be material. But he replies that even if that were so, it is enough that this should be an eternal being, with infinite knowledge and power. Furthermore, if thinking and matter can be separated, the eternal existence of matter won't follow from the eternal existence of a cogitative being. **14** Those who make God material are further asked whether they believe that every particle of matter thinks. If so, it will follow that there are as many Gods as particles of matter. But if the individual particles of matter don't think, then once more we have a thinking being made up of unthinking parts—which has already been refuted. **15** To say that just one atom of matter thinks and that the other parts, though equally eternal, don't think—this is to say quite arbitrarily that non-eternal thinking beings are produced by one part of matter that is infinitely above the rest. **16** If it is maintained that the eternal and material thinking being is a certain particular mass of matter whose parts are unthinking, we are back with something that has already been refuted; for nothing is achieved by combining the parts of matter—all they acquire is a new set of spatial relations among the parts,

which can't possibly give them *knowledge*. **17** It makes no difference whether this mass is immobile or in motion. If it is •not moving it is merely one inactive lump, and so can't do anything that an atom can't do. If it is •moving, this motion that distinguishes it from other parts must be what produces the thought; and so all the thoughts will be accidental and limited, because each part by itself lacks thoughts and has nothing that regulates its movements. There will thus be neither freedom nor choice nor wisdom, any more than there is in pure blind matter. **18** Some people may believe that matter is at least co-eternal with God. But they don't say why. If their point is that it would be too difficult even for God to bring the material universe into existence out of nothing, then I say: bringing a thinking being into existence (which they do allow) is much more difficult than the production of matter, which is less perfect. 'Indeed,' Locke writes,

'if we freed ourselves from vulgar ideas and raised our thoughts as far as they would reach to a closer contemplation of things, we might be able to aim at some dim and seeming conception of *how matter might at first be made*—brought into existence—by the power of that eternal first being; whereas to bring a spirit into existence would turn out to be a *more* inconceivable effect of omnipotent power. But this idea about the creation of matter might lead us too far from the notions on which the philosophy now in the world is established, in which case it wouldn't be pardonable •to deviate so far from those notions as to think in terms of the idea I have referred to; or •to inquire (as far as grammar would enable us to) whether the common settled opinion really *does* conflict with this personal view about how matter might have been created. This is especially so in this place on the earth where the commonly accepted doctrine serves

well enough to for my present purpose, and leaves no room for doubt that once we have supposed the creation of any one SUBSTANCE out of nothing, there is no further difficulty in supposing the creation of all other substances except the CREATOR himself.'

**Theo:** You have given me real pleasure by recounting something of a profound thought of Locke's, which his over-scrupulous caution has stopped him from offering in its entirety. It would be a great pity if he suppressed it and, after bringing us to a certain point with our mouths watering, left us standing there! I assure you that I think there is something fine and important hidden under this rather enigmatic passage. The word 'substance' in capital letters might make one suspect that he is thinking of the production of •matter along the lines of the production of •accidents ·or qualities·; there isn't thought to be any problem about *their* being derived from nothing. And when he distinguishes his personal thought from the philosophy that is now established in the world or 'in this place on the earth', I suspect that he has the Platonists in mind: they took matter to be something fleeting and transitory, in the way accidents are, and had an entirely different idea of minds and souls. [The phrase 'in this place on earth' follows Leibniz who follows the French translation; but what Locke wrote was only 'in this place', meaning 'in this place in my book'. For an account of what lay behind the 'enigmatic passage', see <http://www.earlymoderntexts.com/jfb/howmat.pdf>.]

**Phil: 19** Finally, if anyone were to deny the creation by which things are made out of nothing, on the grounds that they can't conceive it, Locke (writing without knowledge of your discovery concerning the explanation of the soul's union with the body) objects that nor do they understand how •voluntary movements are produced in bodies by •the will of the soul, and yet they still believe that this happens, being convinced

of it by experience. . . . And there couldn't be a finer remark than the one he adds at this point: Anyone who limits what God can do to what we can *conceive* of his doing is to make our comprehension infinite or God finite!

**Theo:** Although in my opinion the difficulty about the union of soul and body has now been removed, other difficulties remain. I have shown *a posteriori* through the pre-established harmony that all monads were created by God and depend on him; yet we can't understand in detail *how* this was done; and basically the preservation of monads is nothing but a continual creation, as the Scholastics knew very well.

## Chapter xi: Our knowledge of the existence of other things

**Philaethes: 1** Our own existence is necessarily connected with the existence of God but not of anything else; so our having an •idea of something no more proves •the existence of that thing than a •picture of a man shows •that he exists in the world. **2** However, my sensations make me as •certain of the white and black on this paper as I am of the movement of my hand, and this is surpassed only by my knowledge of my own existence and of God's. **3** This •certainty deserves the name of 'knowledge'. For I don't think that anyone can seriously be so sceptical as to be uncertain of the existence of the things he sees and feels. Anyway, someone who *can* take his doubt that far will never get into an argument with me, because he can't be sure that I say anything contrary to his own opinion! **4** Our perceptions of sensible things are produced by external causes affecting our senses. We don't acquire these perceptions without the ·relevant sense· organs, and if the organs alone were enough they would produce these perceptions constantly, ·which

they don't. **5** Furthermore, I sometimes find that I •can't avoid having these ideas produced in my mind—for instance *light* when I'm open-eyed in a place where the daylight can enter—whereas I •can lay aside the ideas that are in my memory. So •in the eyes-open case• the lively impression that I have must come from some exterior cause whose power I can't resist. **6** Some of those perceptions are produced in us with pain yet afterwards are remembered quite comfortably. Though mathematical demonstrations don't depend on the senses, we test them by diagrams, and that involves putting great trust in the evidence of our sight, treating it as being almost as certain as the demonstrations themselves are. **7** Also, our senses in many cases bear witness to each other. If someone has doubts about a fire that he •sees, he can also •feel it; and while I write these words I see that I can change the appearance of the paper; and can tell in advance what new idea it will present to the mind. But once the words have been written I can't choose afterwards to see them other than as they are. Also, the sight of those words will draw the same sounds from another man •as they do from me•. **8** If anyone believes that all this is merely a long dream, I invite him to dream that I give him this answer:

The certainty we get on the basis of our senses is as great as our •make-up is capable of and as great as •our condition needs. Someone who sees a candle burning and experiences the heat of its flame, which harms him if he doesn't withdraw his finger, will have all the certainty he needs to govern his actions. And if you, dreamer, didn't take your finger out of the flame, you would wake up!

Thus, such assurance is enough for us, being as certain to us as our pleasure or pain, and beyond that we needn't care about the knowledge or existence of things. **9** But beyond our *actual* sensation there is no •knowledge but only •likelihood,

as when I believe that *there are other men in the world*; this has a very high probability, but I don't at this moment see any of them because I am now alone in my study. **10** So it would be foolish to •expect demonstration in everything, and to •refuse to act on the basis of very clear and evident truths just because they can't be demonstrated. Aman who was willing to conduct himself in that way would be sure of nothing but of perishing quickly.

**Theophilus:** I have already pointed out during our earlier discussions, that truth about sensible things is established by the links amongst them [page 178]. These links depend on •intellectual truths, grounded in reason, and on •observations of regularities among sensible things themselves, even when the reasons are not apparent. Since these •reasons and •observations provide us with means to make judgments about the future as it bears on our interests, and since the outcome confirms our judgments when they are reasonable, we can't ask for—and indeed we can't *have*—any greater certainty about such objects. Furthermore, we can even explain dreams and how little they are linked with other phenomena. Still, I believe that the terms 'knowledge' and 'certainty' could be extended beyond actual sensations, since clarity and evidentness, which I regard as a kind of certainty, go beyond them, and it would certainly be insane to seriously doubt that there are men in the world when we don't see any. To doubt seriously is to doubt in a *practical* way. We might adopt this:

'certainty' means 'knowledge of a truth such that to doubt it in a practical way would be •insane'.

Sometimes it is taken even more broadly:

'certainty' means 'knowledge of a truth such that to doubt it in a practical way would be •blameworthy'.

(Whereas *evidentness* is shining certainty, where we have no doubt because of how we can see the ideas to be linked together.) On this definition of ‘certainty’—i.e. the first of the two given above—we are certain that Constantinople is in the world, and that Constantine, Alexander the Great and Julius Caesar have lived. Of course some peasant from the Ardennes could justifiably doubt this, for lack of information; but a man of letters or of the world couldn’t do so unless his mind was unhinged.

**Phil: 11** We are reliably assured of many past things by our memory, but we can’t certainly judge whether they still exist. I saw water yesterday, and a certain number of very fine colours on the bubbles on that water. I am now certain that the bubbles existed as well as the water, but it is no more certainly known to me that the water exists *now* than it is that the bubbles exist *now*, though the former is infinitely more probable because it has been observed that water lasts while bubbles disappear. **12** Finally, apart from ourselves and God, we know of other Spirits only by revelation, and have only the certainty of faith regarding them.

**Theo:** I have already pointed out that our memory sometimes deceives us. Whether or not we put our faith in it depends on how vivid it is and how closely linked with things that we know. And even when we are sure of the main point, we can often be in doubt about the details. I remember having known a certain man, because I sense that his image is familiar to me, and his voice too, and this double indication is a better warrant than either one of them alone; but I can’t remember where I have seen him. However, it does happen, though rarely, that we see a person in a dream *before* seeing him in flesh and blood. I have been assured that a lady at a well-known court saw in a dream the man she later married and the room where she became engaged to him, and she

described these to her friends, all before she had seen or known either the man or the room. This was attributed to some secret presentiment or other; but events like this don’t happen often, so they could be mere matters of chance; and in any case the images in dreams are a little hazy, which gives one more freedom in subsequently connecting them with others.

**Phil: 13** We can conclude that there are two sorts of propositions:

- particular ones, concerning existence—e.g. that an elephant exists;
- general ones, concerning the dependence of ideas—e.g. that men ought to obey God.

**14** Most of these general certain propositions are called eternal truths, and all of them indeed are so; not because they are eternal propositions actually formed somewhere from all eternity, nor because they are engraved on the mind from any patterns that always existed, but because we can be sure that any properly equipped creature, when he focuses his thoughts on his ideas, will know the truth of these propositions.

**Theo:** The distinction you draw appears to amount to mine between •propositions of fact and •propositions of reason. Propositions of fact can also become general, in a way; but that is by induction or observation, so that what we really have is only a multitude of similar facts. For example the observation that *all mercury is evaporated by the action of fire*—this doesn’t have perfect generality, because we can’t see its necessity. General propositions of reason are necessary, although reason also yields propositions that aren’t absolutely general, and are only likely—for instance, when we assume that an idea is possible until a more accurate inquiry reveals that it isn’t. Finally there are •mixed propositions

that derive from premises some of which come from facts and observations while others are necessary propositions. These include a great many of the findings of geography and astronomy about the sphere of the earth and the paths of the stars, arrived at by combining the observations of travellers and astronomers with the theorems of geometry and arithmetic. But logicians have a principle saying that a conclusion can't be more certain than the least certain of the premises; so these mixed propositions have only the level of certainty and generality that observations or propositions of fact have. As for eternal truths: basically they are all conditional. They say, in effect: given so and so, such and such is the case. For instance, when I say: *Any figure that has three sides will also have three angles*, I am saying nothing more than that *Given that there is a figure with three sides, that same figure will have three angles...* The Scholastics hotly debated the question

How can a proposition about a subject have a real truth if the subject doesn't exist?

The answer is that its truth is a merely conditional one saying that *if* the subject ever *does* exist it will be found to be thus and so. But then the question arises:

What is the basis for this connection?

for it must have a basis, since the conditional proposition contains a reality that doesn't mislead. The reply to this second question is that the connection is based on the linking together of ideas. Final question:

Where would these ideas be if there were no mind?

What would *then* become of the real foundation of this certainty of eternal truths?

This question brings us at last to the ultimate foundation of truth, namely to God, the supreme and universal mind who can't fail to exist and whose understanding is indeed the domain of eternal truths. . . . If you are tempted to think

that there's no need to bring God's mind into the story, bear in mind that these necessary truths contain the determining reason and regulating principle of existent things—the laws of the universe, in short. Thus, these necessary truths are *underpinnings of* the existence of •contingent beings and therefore can't be in any way *based on* such beings; so they must be based on the existence of a •necessary substance. That is where I find the pattern for the ideas and truths that are engraved in our souls. They are engraved there not in the form of propositions, but rather as sources which, by being employed in particular circumstances, will give rise to actual assertions.

## Chapter xii: Ways of increasing our knowledge

**Philaethes:** We have discussed the kinds of knowledge we possess. Let us turn now to the ways of increasing knowledge, i.e. of finding out the truth. **1** It is the commonly accepted opinion among men of letters that *maxims* are the foundations of all knowledge, and that every science is built on certain *praecognita* [= 'things already known']. **2** Admittedly the great success of mathematics seems to favour this method, and in our discussions you have relied a good deal on that fact. **3** But there is still a question as to whether it isn't the •connection of ideas that has served this purpose rather than •two or three general maxims laid down at the start. A young lad knows that *his body is bigger than his little finger*, but he doesn't know it by virtue of the axiom *The whole is bigger than a part*. Knowledge began with particular propositions, but then there was a desire to use general notions so as to relieve the memory from its bulky load of particular ideas. If the language were so imperfect that it

didn't include the relative terms 'whole' and 'part', couldn't one still know that the body is larger than the finger? That is how Locke argues, but from what you have already said I think I foresee how you will be able to reply.

**Theophilus:** I don't know why he dislikes maxims so much that he has to attack them all over again. If they serve to relieve the memory of a load of particular ideas, as he acknowledges, they must be *very* useful even if they are good for nothing else! But let me add that that's *not* what gives rise to them, since we don't discover them by induction from instances. Someone who knows that

ten is more than nine, that  
his body is larger than his finger, and that  
the house is too large to be able to escape through the  
door,

knows each of these particular propositions by means of a single general principle. The principle is embodied in and coloured by them, as it were—like a picture which does its work just by the lay-out of the lines but which is further decorated by having the lines in colour. Now, this single principle is the axiom *The whole is bigger than a part*, which is known implicitly, so to speak, though not at first standing out on its own in that general form. The instances derive their truth from the embodied axiom; the axiom isn't based on the instances. And since this axiom that is common to these particular truths is in the minds of all men, you can readily see that someone can be shot through with it—drenched in it—without having the words 'whole' and 'part' in his vocabulary.

**Phil:** 4 But isn't it dangerous to give authority to assumptions disguised as axioms? One person will follow some of the ancients in assuming that

Nothing exists but matter;

another will agree with Polemo that

The world is God;

and a third will lay it down as a fact that

The sun is the chief god.

Think what a religion we would have if *that* were permitted! Nothing can be so dangerous as principles taken on board without questioning, especially if they concern morality. . . . So 5 principles must be *certain*. 6 But this certainty comes only from the the inter-relating of ideas; so we don't need any other principles—by following this one rule of attending to (dis)agreements between our ideas we'll get further than by putting our minds at the disposal of others.

**Theo:** I am surprised that you bring against maxims, i.e. against *evident* principles, the accusation that could and should be brought against principles that are *arbitrarily assumed*. When we ask for *praecognita* in the sciences, i.e. for antecedent knowledge to serve as the foundation for a science, we are asking for *known* principles, not for arbitrary assumptions of propositions whose truth is unknown. Aristotle himself understood that the subordinate sciences borrow their principles from other higher sciences within which these principles have been demonstrated. The only exception is the first or highest of the sciences, which we call 'metaphysics': according to Aristotle, metaphysics asks for nothing from the other sciences, and provides them with the principles they need. And when he says that 'the apprentice ought to believe his master' he means that he should do so only for the time being, until he has been instructed in the higher sciences—so that the belief he is recommending is only provisional. This is very far from being receptive to arbitrary principles. I should add that even principles that aren't completely certain can have their uses, if we build on them purely demonstratively. Although all our conclusions

from them would then be merely conditional, and would be worth having only if the principle in question were true, nevertheless the very fact •that this connection holds would have been demonstrated, as would •those conditional assertions. That is, even if P is false, deductively deriving Q from it shows •that P and Q are connected in that way, and shows •that *If P then Q* is true. So it would be a fine thing if many books were written in this way: the reader or student, having been warned about the condition to which the book is subject, would be in no danger of error. And behaviour would be governed by these conclusions only to the extent that the initial assumption was independently verified. This same method has another use, namely to verify assumptions or hypotheses, in cases where many conclusions flow from them that are known on other grounds to be true; sometimes the process can work perfectly in reverse, yielding a demonstration of the truth of the hypothesis. . . . Conring reproved Pappus for saying that

analysis undertakes to discover the unknown by assuming it and then proceeding to infer known truths from it.

This, he said, is contrary to logic, which teaches that truths can be inferred from falsehoods, so that P isn't shown to be true by a demonstration of Q—which is known to be true—from it. But I showed him that analysis makes use of •definitions and other •reciprocal •or if-and-only-if• propositions, which provide a way of reversing the process and running a demonstration in the other direction. And even when this reverse process is not demonstrative—in natural science, for instance—it still sometimes yields great likelihood, when the hypothesis easily explains many phenomena that would be otherwise puzzling and are quite independent of one another. That is, if Q, R, S and T report four phenomena that puzzle us and seem to have nothing to do

with one another, a demonstration that hypothesis P entails *each* of those four makes P highly probable. I maintain that all principles are governed by the super-principle *Make good use of ideas and of experiments*; but if we dig down into this we'll find that so far as ideas are concerned this 'good use' is just the connecting of definitions by means of axiomatic identities. Still, it isn't always easy to attain to such an ultimate analysis [= 'a solid demonstration depending on nothing but definitions and identities'], and geometers haven't yet been able to do this, much as they (or at least the ancient ones) have evidently wanted to. (If Locke were to complete this undertaking, which is a little harder than it is thought to be, he would make them very happy!) Euclid, for instance, includes in his axioms what amounts to the statement that *two straight lines can meet only once*. We can't on the basis of our sense-experience *imagine* two straight lines meeting more than once, but *that* is not the right foundation for a science. Anyone who thinks that his imagination presents him with connections between distinct ideas can't be properly informed about the source of truths, and would count as immediate—i.e. as basic, rock-bottom, not needing or admitting of proof from anything more basic—many propositions that really are demonstrable from prior ones. This matter hasn't been properly thought out by many people who have found fault with Euclid: *images* of this sort are merely *confused ideas*; someone who knows about straight lines only from his images won't be able to demonstrate anything about straight lines. Euclid had no distinctly expressed idea of a *straight line*, i.e. no definition of it (for the one he offers provisionally is unclear, and useless to him in his demonstrations), so he had to resort to two axioms that •served him in place of a definition and that •he uses in his demonstrations:

Two straight lines don't have any parts in common.

Two straight lines don't enclose a space.

Archimedes gave a sort of definition of *straight line* when he said that it is *the shortest line between two points*. But in his demonstrations, using Euclid-type elements based on the above two axioms, he tacitly *assumes* that the properties spoken of in those axioms are possessed by the line that he has defined. So if you and your friends appeal to the ‘agreement and disagreement of ideas’ to justify your belief that it was and still is permissible to •admit into geometry what images tell us, without •looking for the rigorous demonstration from definitions and axioms that the ancient geometers insisted in this science . . . . then I must tell you that this may be good enough for those who only want rough-and-ready •practical geometry but it won’t do for those who want a •science of geometry—a science by which even the practical kind of geometry is improved. If the ancients had taken that view, and had been lax about this matter, I believe they would have made hardly any progress and would have left us only an empiric geometry such as the Egyptians apparently had and the Chinese seem to have still. This would have deprived us of the most beautiful discoveries of •natural science and •mechanics, which •geometry has enabled us to make, and which are unknown wherever our geometry is unknown. It is likely, too, that by allowing our senses and their images to guide us we would •not only cut ourselves off from scientific truths but also •be led into errors. We see an example of that in the fact that people who haven’t been taught strict geometry believe, on the authority of what they can imagine, that it is beyond doubt that *two lines that continually approach each other must eventually meet*. Whereas geometers offer as counter-examples to that certain lines that they call asymptotes. But apart from that, we would be deprived of what I value most in geometry—considered as a purely theoretical study—namely its letting us glimpse the true source of •eternal truths and of •how we can come to

grasp their necessity—which is something that the confused ideas of sensory images can never make clear to us. You will object that Euclid still had to settle for certain axioms whose evidentness can be seen only confusedly, by means of images. So indeed he did; but it was better to •content himself with a small number of truths of that nature, which appeared to him the simplest, and to deduce from them the other truths that someone less rigorous would have taken as certain without demonstration, than to •leave a great deal undemonstrated and—worse still—to leave people free to relax their rigour as the mood takes them. So you see that what you and your friends have said about the ‘connection of ideas’ as the genuine source of truths needs to be clarified. If you are willing to be satisfied with seeing such connections confusedly, you’ll weaken the rigour of demonstrations; Euclid did incomparably better by reducing everything to definitions and a small number of axioms. But if you want this connection of ideas to be exhibited and expressed distinctly, you will have to avail yourselves of definitions and axiomatic identities, as I require. . . .

**Phil:** I am beginning to understand what a distinctly known connection of ideas is, and I plainly see that in this case axioms are required. 7 I also see plainly why the method we follow in our inquiries into ideas must be modelled on that of the mathematicians, who from very plain and easy beginnings—which are nothing other than axioms and definitions—by •gentle degrees and •a continued chain of reasonings proceed to the discovery and demonstration of truths that appear at first sight to be beyond human capacity. The techniques for finding proofs—the admirable methods men have discovered for singling out intermediate ideas and ordering them properly—*those* are what have produced such wonderful and unexpected discoveries. Will something like

this ever be discovered for ideas other than those of magnitude? I shan't go into this here, except to say: if other ideas were pursued in the way familiar to mathematicians, they would carry our thoughts further than possibly we are apt to imagine. **8** And that *could* be done in morality in particular, as I have several times said.

**Theo:** I believe that you are right, and I have long been inclined to set about fulfilling your predictions. [In the next two speeches 'science' is used strictly in the 17th century sense = 'knowledge embodied in a highly unified, rigorously structured, and very specific body of doctrine'.]

**Phil: 9** With regard to the knowledge of bodies, we have to proceed quite differently, because our lack of ideas of their real essences sends us to experience. **10** I don't deny that someone who is given to rational and regular experiments will be able to make better guesses—better than the rest of us can make—at the still unknown properties of bodies, but still this is only •judgment and •opinion, not •knowledge and •certainty. This makes me suspect that we can't ever turn natural philosophy into a science. Still, we do have experiments and reports on experience, and from these we can learn things that benefit our health and make our lives easier.

**Theo:** I agree that the •whole of natural philosophy will never be perfectly a science for us; but still we shall be able to have •some science of nature, and indeed we have some samples of it already. For instance, magnetology can be regarded as such a science: from a few assumptions grounded in experience we can demonstrate by rigorous inference a large number of phenomena that do in fact occur in the way we see to be implied by reason. We can't hope to account for every experiment; even the geometers have still not proved all their axioms. But just as they have been satisfied with

deducing a great number of theorems from a small number of rational principles, similarly it will be enough if practitioners of natural science [now using 'science' in our looser sense] can, by means of certain principles of experience, account for a great many phenomena and even predict them in practice.

**Phil: 11** We aren't equipped to penetrate into the internal fabric of bodies, so we should consider it enough that our faculties reveal to us •the existence of God and •the knowledge of ourselves, sufficiently to lead us to a full and clear discovery of our duty and of •other things that concern us, especially ones that bear on •our chances of being in heaven for •eternity. And I think I can conclude that •morality is the proper study—and the real business—of •mankind in general, while •the different arts that deal with different parts of nature are to be dealt with by •particular men. For instance, ignorance of the use of iron may well be the reason why America, which is rich in natural resources, lacks most of the conveniences of life. **12** Far from undervaluing the study of nature, then, I hold that this study, when rightly done, can bring greater benefit to mankind than everything that has been done up to now.

- He who first invented printing did more for the spread of knowledge,

- he who discovered the use of the compass did more for the supply and increase of useful commodities, and

- he who made public the powers of quinine saved more people from the grave,

than the founders of colleges and hospitals and other monuments of showy charity that have been so expensively created.

**Theo:** You couldn't have said anything more to my liking. True morality or piety . . . ought to stimulate us to cultivate

the practical arts. And as I said not long ago [page 185], better policies could provide us some day with far better medical knowledge than we have now. That can't be urged strongly enough—it is second only to the concern for virtue.

**Phil: 13** Although I recommend experimentation, I don't lack respect for probable hypotheses; they can lead us to new discoveries and are at least great helps to the memory. But our mind is very apt to go too fast, and to be content with flimsy conjectures rather than taking the time and trouble needed to test them against a multitude of phenomena.

**Theo:** The art of discovering •the causes of phenomena, or •genuine hypotheses, is like that of deciphering: an inspired guess often provides a generous short-cut. Bacon started putting the art of experimenting into the form of rules, and Boyle was a gifted practitioner of it. But unless we add to that the techniques for using experiments and of drawing conclusions from them, we can spend a fortune •on experiments• and still achieve less than an acute thinker could

discover in a moment. . . .

**Phil: 14** Once we have established clear and distinct ideas with settled names, the great way to enlarge our knowledge is through skill in finding the intermediate ideas that can show us the agreement or conflict between the ideas whose inter-relation we are investigating. **15** Maxims won't help. A man who doesn't have an exact idea of a right angle will fail in his struggles to demonstrate something about a right-angled triangle. Whatever maxims he employs, he'll have trouble proving with their help that the squares on the sides containing the right angle are equal to the square on the hypotenuse. He may pore on those axioms for as long as he likes without ever seeing more clearly into mathematical truths. . . .

**Theo:** It is useless to 'pore on axioms' unless you have something to apply them to. Axioms often serve to connect ideas. [He goes on to give a very technical mathematical example.]