Ib2 – Some Basic Ideas about Logic

Dear: In the previous chapter, I claimed that there was "near-universal agreement" on the principle of causality; yet, the agreement isn't universal (or unanimous). I don't know of any animals that reject the principle of causality – although sheep, for example, don't seem to realize the full breadth of the principle's applicability, e.g., as they're led to be sheared or slaughtered! On the other hand, any human who "believes" that some god created this universe simultaneously rejects the principle of causality.

You see, religious people use their concept of god to "explain" the cause of everything (from sunsets to stars and from love to logic) – and they do so claiming conformity with the principle of causality (certain that "everything has a cause"). But if you dig deeper, if you ask them to identify the cause of their god, they abandon the principle of causality (which, as I'll show you later, they claim "proves" the existence of their god!), claiming that their god is "self caused", i.e., that there is an "effect" – the existence of their god – that has no "cause" (i.e., he caused his own existence). That, of course, is illogical – and that leads me to a set of fundamental scientific principles, as fundamental as the principle of causality and upon which all knowledge rests, namely logic.

Now, Dear, you may object to my description of logic as "a set of… scientific principles", for you may have been taught in school that logic is a branch of mathematics. In later chapters (e.g., in **R**, which deals with Reason, in **S**, which deals with Science, in the two **T**-chapters, which deal with Truth, and in **U**, which deals with Uncertainties), I'll try to show you that, of the two branches of mathematics ("pure" and "applied"), applied math is "just" a part of science, and pure math is "just" an application of logic. But, as I'll try to show you in this chapter, logic (or reason), itself, is basic science. Meanwhile, in your church, you might have been told that logic is "a gift from God", but I guarantee you, Dear (and will now begin to try to demonstrate to you), that such an idea is preposterous.

Yet, who am I to explain logic to you? When you were four years old and asked me why I didn't believe in god, and I responded that "I'll tell you when you're older", your logic devastated me: "I'm already older!" Somehow or other, the logic of a four-year-old shouldn't stump a grandfather!

In fact, you displayed amazing logic even by the time you were two. I agree that, when you'd wanted to play with those Russian dolls again ("Outrageous!"), I probably shouldn't have teased you so much: sometimes, when you were trying to reassemble the dolls (you never had any difficulty taking them apart!), I'd purposefully pass you the top half of a doll that was too big for the bottom half in your hand. Sometimes you'd test it (budding scientist that you were) to determine if it would fit, before you set it aside. But other times, you'd just look at the top half I gave you, look at the bottom half you had in your hand, and then just push my hand away. Did you see that the painted pictures didn't match? Could you judge dimensions sufficiently accurately, by sight, to know that the pieces wouldn't fit? Or was it, as I suspect, that – by the time you were two – you were already so competent in and confident with the fundamentals of logic that you just dismissed me and my lack of logic?!

Anyway, Dear, to start my explanation (even if it's superfluous), let me quote my version of Webster's dictionary:

> logic… […< Gr(eek)… *logos*, a word, reckoning, thought < *legein*, to speak, calculate, collect…] **1.** the science of correct reasoning; science which describes relationships among propositions in terms of implication, contradiction, contrariety, conversion, etc.… **2**. a book dealing with this science **3.** correct reasoning; valid induction or deduction… **4.** way of reasoning… **5.** the system of principles underlying any art or science **6.** necessary connection or outcome, as through cause and effect… **7.** the systemized interconnection of digital switching functions, circuits, or devices, as in electronic digital computers.

As any dictionary definition should, this definition just shows common usage. But in my view the above definition inadequately conveys the essential point: the fundamentals of logic are just some fundamental hypothesis about this universe that have been tested so many times that most people have given up trying to demonstrate that these hypotheses are wrong – although maybe this concept is contained in definition #5, listed above ("the system of principles underlying any art or science"). But if for you (as for me) the above definition isn't very helpful for explaining the essence of logic, let me try to show you the essence using some examples.

Thus, Dear, do you remember when you were in that other universe [:>)] – or was it when you were dreaming [;>)]? In that other universe (or in some weird dream) things were never as they seemed to be, as in some TVcartoon, as if by magic, like the miracles of some "holy book": a monkey reached for a banana, a baby reached for a bottle – and the banana was actually a baby bottle and the bottle was actually a banana, someone took a few loaves of bread and fed thousands of people, until they were satiated (and then there was still bread left uneaten), and you could see invisible pink elephants flying all over the place. In contrast, in this universe, every monkey, every baby, and even most adults have hypothesized, repeatedly tested, and wholeheartedly adopted the concept that (except in dreams, in some fanciful stories, and for the mentally ill) a banana is a banana, a baby bottle is a baby bottle, and in general, A ≡ A (where the "three legged equal sign", " ≡ ", is read "is identical to" or "is identically equal to").

The concept that A is identically equal to A (i.e., A ≡ A) is so fundamental, Dear, that in older books you'll find it called "a logical truth". In particular, in old books on logic, A ≡ A is commonly called "the law of identify". But notice, Dear, that, in reality, A ≡ A is neither "a truth" nor "a law": it's "just" a fundamental hypothesis that most of us have made about this universe – one which, in reality, seems to be approaching "truth".

A ≡ A is a symbolic representation of the scientific hypothesis that things exist: a banana is a banana (A ≡ A), a baby bottle is a baby bottle (A ≡ A), and so on. This fundamental hypothesis (or premiss or axiom) that things exist, that A ≡ A, is an assumption that we all make, based on a large number of observations, whose predictions have been tested so many times (by a huge number of monkeys, babies, and others!) that most of us have given up trying to demonstrate that it's wrong. Nowadays, A ≡ A is described as one of the fundamental *principles* of logic, known as the *principal of identity* – a principle about this universe (i.e., a scientific principle) discovered by fish, monkeys, and other animals, long before humans entered the scene!

Further, all fish, monkeys, and babies (and even most "grownups"!) assume not only that things exist (A ≡ A) but also that they're distinct. Eons ago, some monkey discovered that a specific banana located in a specific bunch of bananas at a particular time isn't the same as some other banana at some other location – being eaten by a different monkey! When you were a baby, you learned that your bottle wasn't the same as some other baby's bottle – although, sometimes you'd cry if you saw that other baby drinking from what you apparently assumed was your bottle!

This second fundamental principle of logic (i.e., a fundamental principle of science) is sometimes called the principle (formerly, the "law") of contradiction, but more appropriately should be called the principle of *non*-contradiction. In short-hand notation, this second fundamental principle of logic, that things are distinct, is usually stated as "A is not identically equal to [or "not identical to"] not-A", i.e., A ≢ (not A), where "≢ " is read either as "is not identically equal to" or "is not identical to". Here, as is fairly common, I'll abbreviate the word "not" with the symbol "¬", and therefore write A ≢ (not A) as A ≢ ¬A.[1]

Yet, Dear, just because two of the most fundamental principles of science are A ≡ A and A ≢ ¬A, and just because these two principles (that things exist and are distinct) are the basis of logic, it doesn't mean that they're "right"; it doesn't mean that they're "true"! Yet, Dear, if you ever do discover a case in which A ≢ A (i.e., A ≡ ¬A), then you should proceed with extreme care. I grant you that your discovery that A ≡ ¬A (for example, that a bottle is a banana) would potentially be extremely important, for which (if your discovery is confirmed) you will undoubtedly receive a Nobel Prize in physics or a similar prize in mathematics. But before you submit your result for publication (so that you won't be encouraged to visit a psychiatrist!), I strongly recommend that you investigate your conclusion with great care. Daily, the rest of us stake our lives on the principle that A ≡ A and A ≢ ¬A. For example, if there are no cars coming down the road, then it's safe to cross the street, because (as your mother told you time and time again): A ≡ A and ¬A ≢ A.

Nonetheless, of course there are reports that A ≡ ¬A, e.g., in TV-cartoons, in comic books, and in various "holy books" such as the Bible. For example, two loaves of bread (A), not enough to satiate thousands of people, is more than sufficient food (¬A) to do just that, something such as water with insufficient shear-strength to support a person's weight (A) supports a person's weight (¬A), dead people (A) are living (¬A), and so on. But such reports have never been justified – and no one who has learned from Mother Nature that A ≡ A and ¬A ≢ A takes such reports as anything but the

[1] Dear, you may find the statement "A is not identical to (not A)" written many different ways, depending on the capabilities of the writer's typewriter or word processor! I'll write A is not identical to (not A) as A ≢ ¬A, but sometimes you'll find it written as A ≢ ~A, or A ≢ !A, or A ≢ Ã, or A ≢ A^c or similar.

ingredients of some silliness to entertain little people – or to con big people out of their money!

Now, Dear, if you're thinking that all of this is "just too trivial", then great! Of course I would agree with you that $A \equiv A$ and $A \not\equiv \neg A$ are totally obvious – but please spend a few minutes thinking about some of their consequences. For example, consider the reports in the *New Testament* that Jesus walked on water, fed thousands with a single loaf of break, and performed various other "miracles". Really? Having the power of God, Jesus could arrange $\neg A \equiv A$? And similarly for the reports in the *Old Testament*: God could snap his fingers (or whatever) and make something (e.g., the universe) out of nothing ($A \equiv \neg A$)? Really?[2]

Besides conflicting with everything that even all monkeys and babies know to be so, would you want $A \equiv \neg A$ to be so? Would you really be pleased with the possibility that miracles were real? Those who dreamt up their concept of God to bring order into this universe simultaneously destroyed a fundamental order that humans already had (and still have!): $A \equiv A$ and $A \not\equiv \neg A$. Therefore, Dear, if anyone supplies you with some "holy book" and/or is prepared to lecture to you for hours, to "prove" to you, for example, that the unknown is known ($\neg A \equiv A$), that death is not death ($A \equiv \neg A$), and especially that your life belongs to someone else ($A \equiv \neg A$), then you may want to respond, "Thanks anyway, but for me, A is still A".

Millions of years ago, Mother Nature encouraged our ancestors to adopt the fundamental scientific principles that, in this universe, things exist and are distinct. All animals know that $A \equiv A$ and $A \not\equiv \neg A$: a coyote chasing a jack rabbit knows that a jack rabbit is not a sage brush – and won't be "miraculously" transformed into a sage brush, part way through the chase. Those animals that didn't learn that $A \equiv A$ and $A \not\equiv \neg A$ are no longer with us: their DNA molecules starved to death!

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[2] Dear: If you're jumping ahead of me here, concluding something similar to "Well, then, how come you claim that this universe made itself out of nothing – cause that, too, would mean $A \equiv \neg A$?", then first I'd congratulate you on seeing the problem, but then I'd suggest my solution: that's why I hinted in the first chapter, and will show you more in **Z**, that in reality, there's still nothing here – by which I mean, all electrical charge, all momentum (linear and angular), all mass-energy (including the negative "vacuum energy"),… still sums to exactly zero, i.e., A is still identically equal to A, but the original A (total nothingness) has been separated into all its positive and negative components [and of course we egotistical people like to say that our masses are made from some of the "positive" energy – at least those of us with a "positive mental attitude"].

Now, Dear, although the fundamentals of logic are "just" the fundamental scientific principles that things exist and are distinct (viz., $A \equiv A$ and $A \not\equiv \neg A$), how we (and animals!) apply these principles to "reason logically" can become quite complicated. I'll go into some of these complications in later chapters (e.g., in **R**, **S**, **T**, and **U**); in these **I**-chapters, however, because my goal is "simply" to show you some of the illogical (i.e., unscientific) ideas in all religions, I'll "try to stick to the simple stuff".

For example, to start, let me comment on the reasoning that leads to the conclusion that there's no such thing as a paradox (a conclusion that I've already used a number of times in earlier chapters). The reasoning that led to this conclusion was perhaps first described by Zeno of Elea, about whom you've probably heard in the phrase "Zeno's paradoxes" (some of which I'll get to in a later chapters and which he devised in ~500 BCE).

The word 'paradox', Dear, is a combination of the Greek prefix *para* meaning 'alongside' (as in *para*llel) plus the Greek word *doxa* meaning 'opinion' (from *dokein*, meaning to think or suppose) – but by 'paradox', we also mean that these "alongside opinions" contradict one another. Therefore, the reasoning behind the conclusion that a paradox can't exist is no more than a restatement (using the word 'paradox') of the fundamental scientific principle (discovered by monkeys, babies, and others) that things are distinct, i.e., $A \not\equiv \neg A$. That is, Dear, if ever you get the impression that $A \equiv \neg A$., then you can say: "No; that can't be so; that would be a paradox; we know $A \not\equiv \neg A$."

In a way, maybe Ayn Rand stated the principle a little too strongly (in her book *Atlas Shrugged):*

> Contradictions do not exist. Whenever you think you are facing a contradiction, check your premisses. You will find that one of them is wrong.

I say that she "stated it too strongly", because it's possible that contradictions (or paradoxes) do exist; it's just that, as yet, nobody has discovered one! She should have said something closer to: "If you reach a contradiction using sound reasoning, then check your premisses: one of them must be wrong – or else you just won yourself a Nobel prize (or a similar prize in mathematics)!"[3]

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[3] Incidentally, Dear, there is no Nobel prize in mathematics, because whoever established the criteria for the Nobel prizes (I don't know if it was Nobel, himself, or the executors of his will) apparently didn't

Anyway, Dear, what I hope that you're beginning to see (and will see even more clearly as I show you more) is that the fundamentals of logic are a group of (trivially simple!) hypotheses about this universe, which Mother Nature has taught us and which even animals and babies have tested, over and over again, never once finding these simple hypotheses to be invalid. That is, the principles of logic are just a few fundamental principles of science, as fundamental as (or maybe even more fundamental than) the principle of causality. Consequently, to "reason logically" (versus to "reason illogically") simply means that one's thinking is consistent with a few fundamental features of this universe.

As I'll show you in later chapters, Aristotle (384–329 BCE) was the first to examine how we put ideas together "logically" in the form of "syllogisms" (where *sy* is from the Greek preposition *syn* meaning 'together' and *logos* means 'thought'; so, creating a 'syllogism' means putting "thoughts together"). During the past ~2300 years, many people have justifiably criticized Aristotle's analysis of syllogisms. In later chapters, I'll show you some of these criticisms, but at the outset (and throughout!), please appreciate Aristotle's huge accomplishment. He addressed and made enormous progress answering the fundamental question: how do we – and how should we – put thoughts together to reach "logical" (or "sound") conclusions (typically introduced with words such as "therefore", or "hence", or "it follows that", or "obviously", or "consequently", and so on).

Aristotle based his analysis on the fundamental scientific principles that things exist and are distinct (i.e., $A \equiv A$ and $A \not\equiv \neg A$). Thus, in Part 3 of Book IV (or "Chapter IV") of his *Metaphysics* [which literally means "after (his book on) Physics"] he wrote:

> This, then, is the most certain of all principles… it is impossible for the same man [maybe Aristotle should have said "the *sane* man"!] at the same time to believe the same thing to be [$A \equiv A$] and not to be [$A \not\equiv A$]; for if a man were mistaken on this point he would have contrary opinions at the same time. It is for this reason that all who are carrying out a demonstration reduce it to this as an ultimate belief; for this is naturally the starting-point even for all the other axioms.

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realize that applied mathematics (in contrast to "pure mathematics") is a branch of science – and apparently the Nobel Prize Committee still doesn't realize it!

For reasons that I'll show you in later chapters, I question whether this principle (that things exist and are distinct) is "the ultimate belief" and the "starting-point even for all the other axioms", but I certainly would agree with Aristotle that this principle is a fundamental "axiom".

As you can see from your dictionary, Dear, 'axiom' is from the Greek word *axios,* meaning 'worthy'. My copy of Webster's dictionary gives for the meanings of 'axiom':

> **1**. a statement universally accepted as true; maxim **2**. an established principle or law of science, art, etc. **3**. a statement that needs no proof because its truth is obvious; self-evident proposition (Euclid's *axiom* that things equal to the same thing are equal to each other).

In the language that I've been using in these chapters, axioms are hypotheses about this universe (some made even by monkeys and babies!) that have been tested so many times that most humans have given up trying to prove that these hypotheses are wrong and therefore now call them "fundamental principles" (formerly called "laws"). Thereby, Dear, I think that my version of Webster's dictionary is quite wrong when it says that an axiom is "a statement that needs no proof because its truth is obvious". More nearly correct would be: axioms are principles of science that been tested so many times that people have become "sick and tired" of trying to demonstrate that these hypotheses are wrong!

Starting from his "most certain of all principles… it is impossible for the same man at the same time to believe the same thing to be [A ≡ A] and not to be [A ≢ A]", Aristotle performed an amazing analysis of how we put thoughts together. His next step, beyond recognizing that we assume things exist [A ≡ A] and are distinct [A ≢ A], was to account for our recognition that things possess various "attributes" (the sky is blue, water is wet, that boulder is heavy, etc.) and that such attributes can be compared (that boulder is heavier than the other one). Aristotle then investigated how people put thoughts together, evaluating and comparing such attributes. Of course, people had been putting thoughts together (evaluating and comparing attributes of various things) ever since they could first think, but Aristotle seems to be the first person who examined how humans create syllogisms.

In fact, other animals apparently have similar capabilities. To illustrate, let me return to the idea of (mathematical) sets of ideas, and let me suggest that even animals seem to use them. For example, Dear, all coyotes that I have encountered in the desert seem to mentally group everything they experience into at least four categories or "sets":

1) Things that have attributes of being nonthreatening and inedible "background stuff" (rocks, sage brush, other plants, clouds, sounds made by the wind, and so on),

2) Potential food (rabbits, field mice, birds, and whatever else coyotes eat),

3) Threatening "stuff" (bigger animals, humans, motor vehicles, etc.), and

4) Other "stuff", including other coyotes.

Thus, as with humans, coyotes distinguish elements of each set as having some common attribute and then group these elements into various categories (or sets) in which, as a first step, coyotes (similar to humans) seem to recognize that the ordering or the elements of the set is unimportant.

When the boundaries and membership for each set are simple and clear, then as coyotes apparently do and as first examined by Aristotle, the fundamental principles that $A \equiv A$ and $A \not\equiv \neg A$ can be used to develop rules for "reasoning logically" – which, in its simplest form, are no more than noncontradictory identifications of elements of predefined sets. For example, the other day in the desert, I witnessed a coyote putting thoughts together (creating "syllogisms") at a rate much faster than I'm able to write them – or you're able to read them:

1. "I'm hungry; *hunger* means I want food; therefore, I want food."

2. "I want food; *wanting food* means I want to eat; hence, I want to eat."

3. "There's a rabbit; a rabbit is food; it follows that I want to eat that rabbit."

4. "*To eat* means to chew something with my teeth that will nourish me; to chew something with my teeth, it must be in my mouth; consequently, to eat that rabbit, I must get it in my mouth."

5. "To get that rabbit in my mouth, I must be adjacent it; I'm not; obviously, therefore (unless the silly thing will come to me) I must transfer myself to be adjacent to it."

6. "The damnable rabbit is not cooperating in my attempt to put myself adjacent to it – it's running away; if I'm to accomplish my objective, I must compensate for this difficulty; consequently, I'll run faster."

Meanwhile, the jackrabbit constructed his own syllogism, even more quickly: "I wanna live; that beast wants to kill me; I'm outta here!" Which then leads me, Dear, to outline the rules of "Aristotelian logic" used by coyotes, rabbits – and by "logical" people.[4]

Actually, though, most of the above syllogisms constructed by the coyote are far more complicated than those considered by Aristotle – but Aristotle deserves huge credit for starting the examination of how humans put thoughts together. His emphasis was on what he called "a perfect syllogism", which starts with defining two sets, say A and B, and with a single "proposition" (or "premiss") of one of the following four forms: 1) "All A's are B's", or 2) "No A's are B's", or 3) "Some A's are B's", or 4) "Not all A's are B's". A classic example is: "All men are mortal [i.e., all men die]; Socrates was a man; therefore, Socrates was mortal [and therefore died when he drank the hemlock]." Coyotes and rabbits also seem to sometimes use "perfect syllogisms", because somewhere in the coyote's analysis was the premiss "all rabbits are food", and somewhere in the rabbit's syllogism is the premiss "all coyotes are bad news".

By 'proposition', Aristotle meant a statement about (or a description of, the assignment of an attribute to, or a "predicate" of) some subject.[5] Aristotle

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[4] Dear, "Aristotelian" (as in "Aristotelian logic") is pronounced as if it were spelled "Aris-toe-teal-yan".

[5] I belabored that sentence, Dear, because the word 'predicate' (common in logic) is one of those unfortunate Latin words that don't make much sense in English: certainly 'predicate' doesn't mean "pre-dicTate", it means closer to "post-dictate"! Similar to the word 'indicate' (form the Latin prefix *in* meaning 'toward' and *dicare* meaning "make known"), 'predicate' uses the Latin prefix *prae* (or pre) meaning 'beforehand' with *dicare* (again meaning "make known"), resulting in 'predicate' meaning "make known beforehand" – even though the clause describing the subject is commonly at the end of the sentence, e.g., "This stuff is awfully confusing!" I never studied Latin, but maybe it's similar to German, with the verb normally at the end of the sentence. At any rate, 'predicate' means "to proclaim or preach about". Another example of confusion from Latin (one that has confused even your grandmother, and she studied Latin!) is 'inflammable', which doesn't mean "not flammable", but actually means the same as 'flammable'. Sorry about that, Dear, but don't blame me!

restricted his considerations to only those propositions that are either true or false. Similarly, the coyote accepted as "true" his premiss that "all rabbits are food", as did the rabbit his premiss that "all coyotes are bad news". These restrictions can be removed by using concepts from probability theory (either using "fuzzy logic" or Bayes' theorem), as I'll sketch in later chapters.

Now, Dear, although you're probably finding this "just too trivial" and may be thinking "get on with it", there is potentially a huge complication, here, if words are used carelessly. To see the potential complication, consider the following three statements: 1) A *is* A (which I spent most of this chapter trying to explain, i.e., A ≡ A !), 2) A *is* B (e.g., "that rabbit is food" or "that coyote is bad news"), and 3) A *is* B plus C.

If you will look at those three statements carefully, you'll see that the word 'is' (or the verb "to be") is being used with three different meanings: 1) to express existence, e.g., "I am", 2) to express an attribute or state (the 'is' of predication), e.g., "I am happy", and 3) to express identification or identity (or equality in quantity), e.g., "I'm as tall as the two of you grandchildren put together". And actually, there's another use of the word 'is' (or the verb "to be"), namely, 4) as an auxiliary verb, as in "I'm getting confused!" Normally, we deduce the meaning of the verb "to be" from its context (i.e., from the rest of the sentence), but if you ever want to take special care, Dear, then use different words or other symbols.

To illustrate the need to take care with definitions, let me return to the fundamental scientific principle that A ≡ A, which in logic is called "the 'law' of identity". If you will think about the statement A ≡ A for a while, it can start to "drive you up the wall": it can seem to be one of the most useless statements ever made – a "tautology" that says nothing! If this happens to you, Dear, you can regain control of your mind if you will see that the source of the confusion is from the definition of the word "is" (or the expression "is identical to"): what's the meanings for "is" (or the verb "to be") in the expression "is identical to"?

If you chase those questions for a while, you'll see that the problem is that one needs to define "existence" – which, as I've said before, is one of those "base words" that can't be defined in terms of more basic words. Thus, Dear, what A ≡ A means is just "A exists" – and those who want to know more about what ‘existence’ means will need to kick it (or hug it, or whatever), until they get an idea about what ‘existence’ means, “phenomenologically”, i.e., by experiencing it. Similarly, $A \not\equiv \neg A$ means that things are distinct, i.e., whatever exists as A is different from what exists as not-A.

But going further with the need to take care with definitions, suppose one states A = B (where please note that I used an equal sign, = , rather than the identity sign, ≡). At first, the statement A = B may seem totally stupid, especially after your old grandfather has repeated so many times that $A \equiv A$! Yet, it’s clear that we make such statements all the time: I am happy (A = B), she’s pretty (A = B), my grandfather is weird (A = B), and so on. In this case, the verb “to be” (or “is equal to”) is not used to indicate “existence” but to indicate an “attribute” or a “predicate” of the subject, Thus, to predicate (or “preach”) that A = B is not a statement about existence but a statement describing some attribute of A.

The need to take care can be easily demonstrated. For example, suppose someone stated the following syllogism to you:

> *Nothing is more important than love.*
> *Nothing is a hole in a doughnut.*
> *Therefore, a hole in a doughnut is more important than love.*

I trust you’d respond: “Hey, wait a minute! Somethin’ crazy is goin’ on!”

Dear, if ever you’re ever puzzled by such “mumbo jumbo” (which someone alleges to be logic), then I’d encourage you to respond slowly. If you have the time, write down what has been said, and then try to re-write it in ways that make more sense to you. If you don’t have the time, if you’re intimidated to respond quickly (although please never forget: “You don’t have to answer the phone!”), then ask the speaker to rephrase the statements, which will probably slow him down, and in addition, keep interrupting him as he’s trying to restate his position, until you get that statement in a form that makes sense to you.

In the case of the above “crazy” syllogism, what’s “goin’ on” is a shift in the meaning of the word ‘is’. In the second proposition, “Nothing is a hole in a doughnut”, the word ‘is’ is being used to express identity or identification (i.e., to express a silly-sort of definition for the word ‘nothing’). In the first statement, however (i.e., in "Nothing is more important than love"), the word 'is' is NOT being used to identify (or to define) but to express an attribute (i.e., it's the 'is' of predication). That is, in this syllogism, the word 'is' is being used with two different meanings.

If you'll look at the above syllogism again, you can see that the subject of the predicate in the first statement is not "nothing" but actually "love". You can see that easily if the statement is recast into a form such as "Love is more important than anything" or "Love is the most important thing in the world" or similar. And if you demand that the first statement be expressed in one of these equivalent ways, then when the clown who tried to pull this "logical fallacy" off on you starts talking about a "hole in a doughnut", suggest to him that he's got a hole in his head: logic demands that in any syllogism, all words (including the verb "to be") must be used with consistent meaning.

As I already wrote, one way to eliminate confusion from the multiple meanings for the most fundamental verb in our language (i.e., "to be") is to use different words. I've read that the verb "to be" is absent in Hebrew or Chinese, and although I don't know if this "fact" is correct, I know that some semanticists have argued for the elimination of "to be" in languages (such as ours) derived from Latin. Let me illustrate how this elimination could be done, in which I'll use an arrow, → , to mean "change to" or "replace by" (although in mathematics, such an arrow usually means "implies"). Thus, in the cases when the verb "to be" is used

1. To express existence: I am → I exist,

2. To describe an attribute or predicate: I am happy → I feel happy,

3. To identify or define: I am human → Count me among the humans,

4. As an auxiliary verb: I'm beginning to understand → Slowly the concepts have meaning for me!

But perhaps obviously, it's unlikely that the verb "to be" WILL BE eliminated from our language any time soon: it IS too convenient, and most of us ARE too lazy to change, unless we ARE convinced of the need. But, Dear, BE careful – if what IS BEING said IS important to you.

And in case you're unconvinced of the need to take care, then let me show you another example. Suppose someone offered the following little syllogism as his "proof" for the "existence" of "God":

> *God is love.*
> *Love exists.*
> *Therefore, God exists.*

Now, although "fellow believers" would probably be very pleased with this "neat little proof of God's existence", I hope that you would at least say: "Hmmm… let me think about that."

What the above silliness relies on, first, is a statement in the New Testament (*1 John 4,* 9) that "God is love." I trust you agree that this statement uses the verb "to be" of predication (to express a proposed attribute of God) not the "to be" of identity – in part because two lines earlier, in *1 John 4,* 7, it states "Love is from God", and in part because if "God is love" were meant to be an identity, then there are major problems with trying to explain how "love" snapped its fingers (or whatever) to create the universe in six days (as well as with trying to explain all the other alleged "miracles" described in the Bible, such as "love" killing essentially everyone in a flood, "love" murdering all the Egyptian first born so that the Israelites would have a story to tell, and so on). Thus, the first statement of the above syllogism could equivalently be stated as: "One of God's attributes is love."

Then, turning to the next statement, "Love exists", obviously this is a statement not of an attribute but about existence. Therefore, again a switch has been made in the meaning of verb "to be": in the first proposition ("God is love"), 'is' is used to express an attribution (the 'is' of predication) and then, in the conclusion of the syllogism, it's as if 'is' were used to express existence. Consequently, Dear, the conclusion should be not "Therefore, God exists", but instead, the entire set of statements can be replaced by the single statement: "I assume that an attribute of God is love, and I know that love exists", to which the rest of us can respond:

> "That's cute, but so what? As described in your Bible, an attribute of your God is also incredible evil, drowning all the birdies and the beasties in the flood, killing all those Egyptian children so that the Israelites would have a story to tell, and so on."

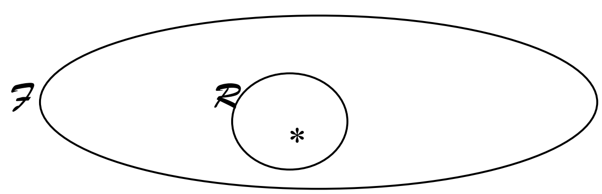
That is, Dear, with equal (or more) justification, the original statement could have been: "I assume that an attribute of God is evil, and I know that evil exists." And to this statement, also, the rest of us could also respond: "So what?"

From all of which, Dear, you might profit by adopting a simple "rule of thumb": *if ever a logical argument is confusing, then first eliminate all instances of "is" (i.e., all cases of the verb "to be").* As an alternative to using different words to eliminate confusions arising from the four meaning of the verb "to be", mathematicians use different symbols. For example, returning to the case of the coyote chasing a particular rabbit R_i (where I use the subscript "i" to identify the particular rabbit that the coyote has identified), then when the coyote concludes "that rabbit (R_i) is food ($\mathcal{F}$)", he's not making a proposition about the existence of the particular rabbit R_i – for as soon as he saw the rabbit, he accepted its existence!

That is, the coyote isn't making the all-too-human mistake of saying that R_i is identically equal to $\mathcal{F}$, i.e., he knows $R_i \not\equiv \mathcal{F}$. [Notice that here I used the "three-legged equal sign" and that the statement is to be read "the identified rabbit is not identically equally to $\mathcal{F}ood$".] Also, the coyote isn't making a statement about the size (or weight or similar attribute) of the rabbit relative to a similar quantity of food, i.e., he knows $R_i \neq \mathcal{F}$. [Notice that I've used the equal sign (not the identity sign) and that the statement is to be read "the identified rabbit is not equal (in size, weight, or whatever) to $\mathcal{F}ood$".]

Instead, the coyote's syllogism is starting from two premisses: one deals with the particular rabbit being chased, R_i, and a second premiss that predicates (or "preaches about") some characteristic of all rabbits, $\mathcal{R}$ (of which the rabbit being chased, R_i, is an identified member). Thus, the coyote first assumes that the identified rabbit is a member of the set of all things called rabbits: $R_i \in \mathcal{R}$ (which is read: "the identified rabbit is an element of the set of all things called rabbits"). Second, the coyote "knows" (from experience, from what his mother taught him, from his instincts, i.e., from programming in his DNA, or whatever!) that the set of all rabbits is contained with the set of all things known as food: $\mathcal{R} \subset \mathcal{F}$, where "$\mathcal{R} \subset$ …" is read "$\mathcal{R}$ has the attributes of…" or "$\mathcal{R}$ belongs to…" or "$\mathcal{R}$ is a subset of… the set $\mathcal{F}$, i.e., all rabbits, $\mathcal{R}$, are edible (viz., food, $\mathcal{F}$!]." Similarly, a coyote's premiss that the set of all things called "sage brushes", $\mathcal{S}$, isn't a subset of the set called food, $\mathcal{F}$, can be written symbolically as $\mathcal{S} \not\subset \mathcal{F}$.[6]

If you read some of Aristotle's books on logic, Dear, you'll see that he used a great many words to analyze a simple syllogism such as the coyote's: "All rabbits are food; there's a rabbit; therefore, that rabbit is food." Approximately 2,000 years after Aristotle, the Swiss mathematician Euler (1707-1783) simplified the analysis by applying the old Chinese saying "one picture can be worth more than 10,000 words" If Euler's method is used here, first we draw a closed figure representing the set of all things that a coyote would consider as food, $\mathcal{F}$ (e.g., rabbits, chickens, mice, birds, and whatever else coyotes eat). Inside this figure, we draw a second figure for the set of all rabbits, $\mathcal{R}$:



This figure then represents the statement that the set of all rabbits, $\mathcal{R}$, is contained in the set of all things that the coyote considers as food, $\mathcal{F}$, i.e., $\mathcal{R} \subset \mathcal{F}$. In addition, this figure shows pictorially what the coyote (and human!) brain does when it concludes that the particular rabbit $R_i \in \mathcal{R}$, which the coyote was chasing (and which I've indicated with the * in $\mathcal{R}$), has the attribute known as "food"!

According to Aristotle, the coyote uses the following fundamental principles to construct his syllogism:

1) "the 'law' of identity", i.e., that the particular rabbit exists ($R_i \equiv R_i$) and is distinct ($R_i \not\equiv \neg R_i$),

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[6] Notice, Dear, that the symbol $\subset$ is normally used to mean "subset of" [another set] whereas the closely related symbol $\in$ is normally used to mean "element of" [a particular set].

2) "the 'law' of non-contradiction", i.e., that rabbits cannot both be food and not be food (i.e., it cannot be true that both $\mathcal{R} \subset \mathcal{F}$ and $\mathcal{R} \not\subset \mathcal{F}$), and

3) "the law of the excluded middle", i.e., there's no "middle ground" between "food" and "not food" (i.e., either $\mathcal{R} \subset \mathcal{F}$ or $\mathcal{R} \subset \neg\mathcal{F}$).

Earlier in this chapter, I already spent a lot of time (too much time?!) explaining "the 'law' of identity", that things exist and are distinct. Here, before I show you that the other two "laws" are equally obvious, let me first quote Aristotle's description of "the 'law' of the excluded middle" [from Part 11 of Book I (or Chapter I) of his book *Posterior Analytics*]:

> It is impossible to affirm and deny simultaneously the same predicate of the same subject.

Next, I'll quote his statement about "the 'law' of non-contradiction" [from Part 3 of Book IV (or "Chapter IV") of his *Metaphysics*]:

> For a principle which everyone must have who understands anything… which everyone must know who knows anything, he must already have when he comes to a special study. Evidently, then, such a principle is the most certain of all; which principle this is, let us proceed to say. It is, that the same attribute cannot at the same time belong and not belong to the same subject…

That is, as the coyote concluded, "either $\mathcal{R} \subset \mathcal{F}$ or $\mathcal{R} \subset \neg\mathcal{F}$" (i.e., either the rabbit is food or not food, for there is no "middle ground") and also, "there are no contradictions", i.e., it can't be that $\mathcal{R} \subset \mathcal{F}$ and $\mathcal{R} \not\subset \mathcal{F}$ (e.g., when the coyote catches him, the rabbit can't all of sudden become inedible).

Now, all of those words and symbols are "all well and good", but not knowing either words or symbols, what does the coyote really do – i.e., what really are the principles of logic adopted by all coyotes, rabbits, and most humans? First (I assume!) the coyote identifies the particular rabbit R_i as a member of the set of all things called rabbits ($R_i \in \mathcal{R}$). Undoubtedly, he assumes that the rabbit exists ($R_i \equiv R_i$) and that it's distinct ($R_i \not\equiv \neg R_i$). Then, based on his experience (or whatever), he "knows" that all rabbits are food ($\mathcal{R} \subset \mathcal{F}$), and thereby, he knows that the rabbit is not "not food" ($\mathcal{R} \not\subset \neg\mathcal{F}$), for that would be a contradiction, and he knows that there is no "middle ground" (knowing that everything is either food or not food). The coyote's application of these rules of logic, then, is just the coyote's ability to group things into sets in a noncontradictory manner – and so, too, for most humans. That is, as Ayn Rand summarized in her book *Philosophy, Who Need It?:* "[Aristotelian deductive] logic is the art of non-contradictory identification."

Coyotes, rabbits, and most humans can use more complicated reasoning, but showing you details would take too long. For example, as the rabbit ran past me, I'm pretty sure I heard him say: "That beast is going to kill me unless: 1) I run as fast as I can, 2) when he gets near me, I turn more sharply than he can, and 3) thereby, I reach the pile of branches that I call home before he catches me." As you can see in books on logic or on the internet, Dear, the English mathematician George Boole (1815–1904), and subsequently others, developed symbolic methods (now called "Boolean algebra") to analyze such cases of "compound logic statements", but it would take me too long to go into them here – and with too little return on the invested time. Instead, what I want to show you (in a later chapter of this group of **I**-chapters) is how Aristotle used his newly developed rules of logic to make some enormous errors, in particular, how he (and subsequent people who used his method) made enormous errors in their "logical proofs" of the existence of God![7]

Finally for this chapter, Dear, I want to go back to something that I wrote at the beginning of these "**I**-chapters", namely, that I'd need a "double dose" of your patience, first when I introduced some topic and didn't explain it completely, and then in a later chapter, when I pick up the topic again. Such is the case here. In this chapter, I've only introduced some basic ideas in logic. As I'll show you later (e.g., **Ih**, dealing with Hypotheses and Probabilities and in **R**, dealing with Reason), there's substantially more to logic than the outline given in this chapter (which, basically, is "Aristotelian logic"), and as I'll show you later (e.g., in **T**, dealing with Truth, and in **U**, dealing with Uncertainties) there are some very serious limitations on Aristotelian logic.

The most significant limitation of Aristotelian logic is that it doesn't permit things to change. To understand change, one needs to introduce the principle of causality – and then try to understand what caused or causes the change (using the scientific method). What I've introduced so far, however,

[7] Dear: as I'll be showing you in **R** and **T**, all such "proofs" will always be erroneous, because it's even theoretically impossible to "prove" the existence of anything: a statement of existence of anything is just a hypothesis!

should be sufficient for what I need in the rest of these "**I**-chapters", namely, to show you that all "proofs" of the existence of god (any god) are illogical.

And though I haven't finished showing you all that I want to show you about reasoning logically, I hope that already you have a better appreciation for what I wrote in the previous chapter. Thus, in the list of ways that the scientific method can be used to "filter" ideas, please think again about the items that are italicized below.

- Reject all hypotheses (or better, "just speculations") that have no observational support (such as "all invisible flying elephants are pink"),

- Reject all speculations and hypotheses that conflict with knowledge already gained (such as, "all… flying elephants are…", because elephants, on their own, can't fly),

- *Reject all speculations and hypotheses that are illogical* (such as "all invisible… are pink", because if they were invisible, how could their color be determined?),

- Reject all speculations and hypotheses that can't be tested (e.g., such as "all invisible flying elephants are pink" – unless, of course, someone, someday, captures a herd of invisible flying pink elephants – and discovers a way to determine their color!), and as already mentioned,

- Reject all hypotheses whose predictions fail their experimental tests.

That is, Dear, I hope you'll reject all hypotheses that are illogical, because (by the time you were two!) Mother Nature had taught you that any hypothesis must be consistent with *the fundamental principles of this universe that things exist and are distinct (i.e., $A \equiv A$ and $A \not\equiv \neg A$).*

And maybe there is an idea that I should add. Dear: please notice that ideas needn't be logical (e.g., ideas about love!), but for those ideas for which something exists in the reality external to our minds, then when considering such ideas, our thoughts should be logical – because logic reflects some fundamental characteristics of things that exist in the reality external to our minds. But for now, that's enough (too much?) of some basic ideas in science – which includes all of logic! Now, to regain some balance in your life, wouldn't it be logical for you to get some exercise?