A GUIDED TOUR OF THE LOGIC IN HARRY STOTTLEMEIER'S DISCOVERY

(Intended as a companion to "Minimal Requirements for Thinking Skill Instruction via Harry Stottlemeier's Discovery" and to Philosophical Inquiry: Manual to Accompany Harry Stottlemeier's Discovery.)

A remark concerning notation: References to the novel are indicated by the letter 'N', those to the manual by 'M'.

INTRODUCTORY COMMENTS

Logic forms the spine or backbone of the Harry syllabus, although it is by no means the only philosophical theme that arises there. The nature of thoughts and the mind, reality, dreaming and imagination, the purposes of education, differences of degree and of kind, causation, freedom and responsibility, the concept of a rule, empathy, duties and rights, and the concept of personhood are also topics which belong to the tradition of philosophical inquiry.

But the logical discoveries - exemplified in the persistence and single-mindedness of the central character Harry - constitute a recurring theme which weaves its way through the overall story - And, one hopes, through the thought and talk of the classroom community of inquiry. For it is no exaggeration to say that logic holds our thinking together: the rules and principles of logic provide criteria for judging better thinking from worse. It is logic in language which makes reasoning possible.

The contextual approach to the teaching of logic, as illustrated in the Harry syllabus, is worthy of further comment. It is a deplorable, but nevertheless undeniable, fact that the systematic teaching of thinking and reasoning in schools at all levels has been conspicuous by its absence. No doubt one part of the explanation for this sad state of affairs (sad when one reflects on the potential of such teaching to provide students with a range of indispensable intellectual skills) lies in the inadequacies of teacher education and subsequent lack of teacher expertise. From infant to senior high school grades, teachers have traditionally been more concerned with correcting errors in spelling and punctuation than in reasoning.

Some educationists have defended the lack of specific logic programs in the school curriculum on the ground that logic in isolation is too dry and abstract to engage the interest of children. Better, they say, to teach logical thinking within the context of the traditional disciplines. There is some merit in this position. Nevertheless, teachers who find themselves tempted to take this line of retreat should ask themselves why it is that traditional school subjects have failed to prepare students in the areas of reasoning and inquiry skills. Ironically, a proper resolution of this issue lies in the fact that the traditional discipline of philosophy provides an eminently suitable context for the teaching of elementary logic to children.

A word of caution to teachers of Harry: It should be inferred from the above remarks that the novel and manual (together with other activities and strategies which you may wish to incorporate) help to provide a rich context for the logical principles and ideas about to be described. It surely follows that this guide is *not*, in and of itself, a substitute or shortcut approach to the syllabus.

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The logic in Harry is known as Traditional, or Aristotelean, logic because it leads up to, and focuses on, the *syllogism.* What follows is a rough step-by-step guide to the development of this system of logic as it develops in the syllabus.

Traditional logic is not the only system of logical principles, and many university philosophy departments prefer to teach alternatives which are richer both in syntax and semantics. But, traditional logic has one special feature which should make it attractive to teachers and children: it is couched in ordinary language and does not involve symbols or other technical apparatus. In Harry, the development of the logical rules is intended to complement the development of cognitive skills in children of around 10-12 years.

Philosophy for Children does not subscribe to the view that logic - which involves abstract reasoning (as does philosophy generally) - is beyond the reach of these children. But it does seek to avoid imposing adult frameworks on children, or confronting them with logical systems which are beyond their capacities. Accordingly, there is no systematic development of logic in the Pixie or Kio and Gus programs. On the other hand, the logic in Harry is extended in the Lisa program which is intended for secondary school students.

Notes: (i) For the sake of continuity and (one hopes) clarity, discussion of a number of logic-related topics which arise in the Harry syllabus has been abbreviated in these notes, where it was felt that such topics do not bear directly on the system of syllogistic logic being developed. Nearly every chapter contains some treatment of induction, concept formation, detecting sound reasons, using the mind to "figure things out", etc. The absence of detailed discussion in regard to these issues is based on pragmatic considerations and should not be taken as implying that the tools of good thinking are purely deductive or syllogistic in nature. They are not.

(ii) Each chapter in the manual ends with some suggested answers and guidelines, as well as some questions aimed at self-evaluation. Don't ignore these but feel free to disagree with the answers given - if you have good reason to. Of course, many philosophical questions are open-ended and do not admit of clear answers.

(iii) One philosophically central topic which recurs throughout all the novels in the Philosophy for Children syllabus is the idea of treating one another as *persons* (in Harry, see N11-12, 24, 31-33, Ch. 9, 53-55, 60-61, 69-74, and Ch. 17; M35-36, 60-65, 132-134, 169, 177-179, 229-231, 278-280, 291, 298-299, 316-317, 365-373, 437-444). This idea is a crucial aspect of personal development and self esteem, and you should take every opportunity to discuss it carefully with your students.

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CHAPTER ONE

Basic logical structure of sentences beginning with "All" and "No" (N2-4; M11-12):

ALL (noun phrase) *ARE* (noun phrase).
NO (noun phrase) *ARE* (noun phrase).

Obviously, few sentences in ordinary English are naturally expressed in this way. Encourage your students to treat this procedure as a game: take a sentence in English and see if it can be paraphrased in one of the above forms (called "standard form"). Sometimes the paraphrase will involve some loss of meaning: let them be the judges of this. In logic, the noun phrase before "are" is called the *subject term*, and the one after "are" is called the *predicate term*. This terminology does not quite fit what they (and you) may remember from grammar. If it's likely to cause confusion, leave it out for the time being. Harry's "discovery" (as he sees it) is that sentences with the above logical form (i.e., sentences with "two kinds of things" in them, as Harry puts it) cannot be reversed; or rather, they can be reversed but if the original is true, the reversed sentence is false (N2-4, M12-16).

Some important points:

(i) "Reversing" a sentence in this context means exchanging the subject term with the predicate term.

(ii) Reversing only works when sentences are in standard form. So, for example, Harry's original example involving planets has to be paraphrased before reversing. Kids may take some time to appreciate this: let them discover it in their own way. If you like, you can insist that, in order to play the logic game by the rules, "All planets revolve around the sun" has to be paraphrased as "All planets are things that revolve around the sun" (the word "things" introduces a dummy noun phrase without changing the meaning). No doubt some children will try to reverse the original sentence, to obtain something like "All suns revolve around the planet." The class may sense that this is a fairly strange sentence - it's not clear what it means, let alone whether it is true or false. Rather than make a dogmatic ruling here, you might suggest that they put this example aside for the time being, and come back to it after considering other kinds of sentences. (Check that you have a method for reversing sentences like "All dogs bark.")

(iii) The rule which Harry initially gets so excited about is *false*: some sentences starting with "All" can be reversed (M14 - don't worry if no one thinks of this but many children do). More importantly, sentences beginning with "No" can be truly reversed (and there are no exceptions to that: if A's and B's don't overlap, then B's and A's don't either!). No one in the story discovers the first kind of exception but Lisa guides Harry to the second when she gives him the example, "No eagles are lions."

(iv) The issue of *truth* is immensely important in language, reasoning, and, more broadly, or dealings with one another. It arises in Chapter One because Harry implicitly chooses sentences that are true to begin with, in order to test what happens to their truth value when they are reversed (in fact, depending on the sentence chosen, the reversal may remain true, but in most cases is false). It was remarked above that logic is very much concerned with the preservation of truth. In other words, in building up a collection of logical rules, we are interested in finding out which kinds of linguistic alterations or inferences preserve truth, and which kinds don't. But this means that we should begin with true sentences rather than false ones. Or - and this is a better way of making the point - when playing the logic game, *pretend* that the sentences we begin with are true, even if they are not in fact.

(v) Throughout the novel, situations arise in which Harry and his friends are able to apply the logical rules which they are discovering (see, for instance, N4, 8, 13-14; M16, 34). Drawing the attention of your students to such applications - even better, encouraging them to come up with their own - helps them relate rules of thinking to their experiences outside the classroom.

CHAPTER TWO

Further practice in paraphrasing sentences into standard form. The children in the novel discover that a number of other words or modifiers are more or less synonymous with "All", e.g., "Each", "Every", "Any". (They are not strictly synonymous: look at "All/each/every one/any - of you may now step forward to receive an award." "Each" suggests one at a time, and the meaning of "Any" is highly context-dependent.) More puzzling for some children are "A" and "The" which may have either a singular or a plural sense, depending on the context.

Don't worry too much about the word "Only". If it comes up, just see how far you can get clarifying it in class. A simple rule to remember is that "Only" effectively reverses an "All" sentence. Thus: "Only those who work hard are eligible for promotion" may be restated as "All those eligible for promotion are hard workers" (M31-32b; see also M416).

There are also various kinds of sentences that can be expressed in the form "No...", using words such as "Never", "None", and "Not any". Note: Wherever possible, encourage students to realize that these logical discoveries do have some practical application. By the end of Chapter Two, Harry has found two instances. Can you identify them? You should try to come up with other "real life" examples to which your students can relate.

CHAPTER THREE

The nature of thoughts and thinking (a recurring topic): hence, *inference, reasoning, "figuring things out"* (N10, M48-51). Induction and faulty reasoning ("jumping to conclusions") (N11, M60-62). (Induction is dealt with in later chapters: see especially Chapter 5.)

The main point of Lisa's image involving the cat-like animals (N12, M66-69) is that, in fantasy, we can break the rules of logic and reason, because in her dream, the sentence "All cats are animals" can be truly reversed (although some children will deny that zebras and giraffes can *be* cats, even in a dream). The power of imaginative thinking is an important educational tool, but it is vital that children understand that fantasy and reality are two different aspects of our experience and should not be confused with one another. (See also M433 and Lisa's position at N95.)

Tony and his father discover a geometrical reason for Harry's rule of reversibility (N13-14, M70-72). "All jim-jams are mungos" can be represented as two circles: the class of jim-jams inside (or maybe coinciding with) the class of mungos. Incidentally, the other standard form sentences can also be represented using class membership diagrams. Those students who are more adventurous/artistic/mathematically inclined can explore this topic.

The diagrams bring out the connection between our standard form representations and the general subject of classification (M70).

CHAPTER FOUR

Ambiguity and vagueness (M87-89). Introducing the quantifier "Some" (N17-20, M93-96). So we end up with four kinds of logical sentences (N19):

All...are...
No...are...
Some...are...
Some...are not...

Note: Working out just how these four types of sentences are logically related is a fairly complex procedure. (To illustrate this, ask yourself which type is the "opposite" or negation of the original form, "All...are....") This process is developed in later chapters (see especially Ch. 12).

Important note about the use of the word "Some" in logic: In ordinary English, "Some" usually refers to an amount between "None" and "All". Here we need to extend its meaning to "*At least one, and maybe all.*" So, for example, "one apple", "a few apples", and "most apples" all standardize as "some apples" and "all apples" is compatible with "some apples". As the manual points out (p. 93 - take time to read through these explanatory sections), if you specifically want to rule out "All", use *two* sentences: e.g., "Nearly all the students in the room are Australian" would be paraphrased as "Some students in the room are Australian" and "Some students in the room are not Australian." Obviously, there is some loss of meaning here; but, in the paraphrase, we have only used the standard form sentences. The Standardization Chart on M94 is good practice for teachers and students.

CHAPTER FIVE

The logic briefly explored here is *Inductive Logic* (N21-22, M111-121). (*Analogical* reasoning is one important kind of inductive reasoning; so is the process of forming *generalizations*. See also M266-267.) Until now, the system we have been working with has been *Deductive Logic*. The main difference is that, in inductive reasoning, we cannot be sure that the conclusion follows with absolute certainty. Consider an example where "Some" may turn out to be compatible with "All": As a visitor to the school, I see a group of children in the playground behaving badly (and suppose these are the only students I see). I can say "(At least) some of the students are hooligans," leaving it open as to whether "All of the students are hooligans."

The basic problem of induction arises in cases where we simply cannot observe all the possible cases, and we are forced to judge that the objects we cannot see are going to be similar in relevant respects to those we can. Even though inductive reasoning is less "certain" than deductive reasoning, it is just as indispensable to our ordinary ways of thinking. As the Scottish philosopher David Hume pointed out, our most mundane actions and beliefs are totally dependent on inductive processes. For example, I eat a sandwich for lunch in the belief that it will nourish but not poison me. But this belief - which is about a future and, hence, undetermined event - is based on all those past experiences of sandwich-eating. The implicit inductive reasoning goes something like this: "Whenever I have eaten a sandwich in the past, it has nourished me, so it is likely that it will do so in the future." The use of polls to test public opinion is a good practical example of inductive thinking. In the novel, Harry realizes that a sample of brown candies does not determine the color of the unseen candies. Maria is wrong to insist that if some are..., then some are not..., but it would be equally wrong to infer from some are, that all are.

The difference between inductive and deductive reasoning becomes clearer when syllogisms are introduced. Syllogisms are examples of deductive reasoning because they involve inferences which are meant to be absolutely certain.

CHAPTER SIX

The main topic here is the nature of the mind and the Manual contains some interesting exercises plus a section for teachers on different theories of the mind (M150-151). *Logic Review* (M157-159). The exercises on detecting assumptions are a little tricky and should be discussed by the teachers beforehand. The topic is important, though, because many errors in reasoning occur through failing to detect dubious assumptions.

CHAPTER SEVEN

Differences of degree versus differences of kind (N31-32, M173-180). The discussion of this topic is important partly because children need to see that there is a difference between degree and kind (even if the difference is hard to define exactly), and partly because it leads into the topic of *relationships* (which is one of the recurring themes in the Pixie program).

Expressing relationships in ordinary language: and "turn-around" (or *symmetric*) relationships (N33-34, M181-184). This topic prepares the way for the introduction of the syllogism in Chapter Eight. Relationships can be classified as follows (M183):

1) where the sentence expressing the relationship remains true when turned around, e.g., "Jeff is the same height as Joan,"

2) where the sentence always becomes false when turned around, e.g., "Joan is the mother of Jeff," and

3) where the turned around sentence may be true or false depending on the circumstances, e.g., "Jeff is fond of Joan."

Encourage your students to explore why some relationships are type 1, others type 2, etc.

CHAPTER EIGHT

After further discussion of turn-around relationships (N38), Harry discovers that certain relationships "carry over" (N39-40, M207-213: these are sometimes called *transitive* relationships). In brief, this means that, where A relates to B and B relates to C, then A relates to C. Relationships of degree (taller than, faster than, warmer than, etc.) usually carry over. They are examples of type 1 relationships. As before, other relationships may be type 2 (never carry over) or type 3 (sometimes do and sometimes don't: you can't tell just from the relationship itself).

Note: Relationships that turn around or carry over in particular circumstances may nevertheless be type 3, rather than type 2. If four people are all fond of each other, the relationship "fond of" will turn around and carry over as long as we restrict it to these four people. But, we can easily imagine applying this relationship in circumstances where it does not turn around or carry over. So, it is a type 3 relationship in both cases.

The type 1 carry-over relationship gives us the basic pattern which the syllogism copies. Notice that the "middle term" - B above - drops out in the final sentence, but it occurs once in the first sentence and once in the second. So overall, each term (A, B, C) is mentioned twice (see Ch. 14 for more detailed discussion of the middle term "dropping out").

Syllogisms. If we think of the word "are" as expressing a relationship, roughly, "belongs to the class of", then we can construct arrangements of sentences which have the following pattern:

All A's are B's.
All B's are C's.
All A's are C's.

The horizontal line means that, from the first two sentences (called "premises") taken together (and assumed to be true), we can infer the third (called the "conclusion"). An *argument* can be defined as a collection of premises leading to a conclusion. Arguments that fit the above pattern are called *syllogisms.* And, because the inference or reasoning will always be correct when this particular pattern is present, these syllogisms are described as *valid.* I suggest you go through M211-213 very carefully before discussing this subject in class. And, encourage students to come up with their own examples.

Notes:

(i) The concept of validity is so fundamental in deductive logic that it defies straightforward definition.

Validity is that feature of arguments which makes them "work", logically speaking. It describes the connection between premises and conclusion which permits us to infer the latter from the former. And, it is tied to the concept of truth, as the following definition brings out: An argument is valid if, and only if, whenever we assume or pretend that the premises are true, the conclusion *must* thereby be true. The importance of "must" here should be clear from the following (obviously invalid) example:

All spaniels are dogs.
All cats are mammals.
Therefore, all apples are fruits.

Here, the premises and conclusion are all true, in fact. But, we can imagine a situation in which the premises remain true and the conclusion becomes false (imagine, for instance, that apples are a kind of reptile), and this confirms that the argument is not valid.

It is worth noting that, whereas logical inference is fundamentally concerned with the preservation of *truth*, it is - at this introductory level at least - less concerned with the preservation of *meaning*. Later on (N75-76), the children realize that drawing a conclusion from premises is not like equating numbers in arithmetic: the conclusion follows from the premises but it does not (normally) have the same meaning.

(ii) The particular pattern discussed in Harry is only one kind of valid syllogism. Remember that there are three other kinds of standard form sentences ("No A's are B's," "Some A's are B's," and "Some A's are not B's") and these can all be combined to yield syllogisms, some of which are valid and some invalid. But this is a topic for more advanced study (although some of your students may bring it up and, if they do, encourage them to explore it either for themselves, in groups or in class). Most textbooks on logic will contain a more detailed treatment of syllogistic (or traditional) logic.

CHAPTERS NINE, TEN, AND ELEVEN

These chapters contain no further development of our logical system, but they do raise the question of our ability to think logically and clearly - especially when the situation is one in which emotional feeling runs high. More specifically, we can examine the reasons we offer for our beliefs and actions, and realize that some reasons are much better than others (M253-258). Examples of "bad reasoning" which come up in these chapters include:

reasoning based on majority opinion (N44, M236-237);
reasoning based on appeals to alarm or fear (N49, M259-260);
reasoning based on appeals to authority (N49, M261-262).

Further examples of fallacious reasoning include: reasoning based on personal attack ("ad hominem"), reasoning based on equivocation (exploiting ambiguous terms), reasoning which appeals to pity or emotion, reasoning which begs the question (circular reasoning), reasoning which ignores the point at issue, reasoning which assumes that wholes are always just the sums of their parts and vice versa (see also N66, M329-331).

These chapters present an opportunity for you to help your students develop a sensitivity to the different forms of fallacious reasoning (they will meet many such forms during their lives!). Regrettably, these notes are not adequate in helping teachers develop the same sensitivity! Most introductory logic textbooks contain a discussion of fallacious reasoning (refer to sections under "Informal Fallacies").

CHAPTER TWELVE

The concept of *contradiction* is the main topic here, although the novel contains a brief discussion of sentence-reversal, this time relating to sentences beginning with "Some" (N58). It turns out that "Some...are..." sentences remain true when reversed, but "Some...are not..." sentences (like "All...are...") do not necessarily remain true.

On to contradiction (N58-62, M306-312 and 318). Intuitively, to contradict is to assert the opposite, or the negation of something. To contradict a simple sentence like "Fred is fat," we can just say "Fred is not fat." If a sentence is true, then its contradictory sentence must be false, and vice versa.

Note: The sentence used in the previous paragraph is not a "standard form" sentence and, as such, does not really belong to our system of logic. However, as the manual points out (M308), any coherent sentence can be contradicted by another sentence that we call its opposite or negation.

Now consider our four logical sentences involving quantifiers and noun phrases. To deny or negate "All pirates are criminals," it is not necessary to assert that "No pirates are criminals." Rather, it is to assert that at least one pirate is not a criminal, i.e., "Some pirates are not criminals."

So this last sentence is the genuine contradictory of the original. Similarly, to deny "No pirates are criminals" is to assert that at least one is, i.e., "Some pirates are criminals." Similar reasoning reveals that the contradictory sentences for "Some pirates are criminals" and "Some pirates are not criminals," respectively. This should become clearer if you think carefully about the logical meaning of "Some", and if you look at some examples. The situation is summarized at N59 (see also M307). Note that the episode involving Luther and his bike (N61-62) provides an illustration to the idea of contradicting an "All" sentence. "All cars stop at the intersection" is contradicted by "Some cars don't stop at the intersection," as Luther found out when just one car didn't stop.

The novel (N60) introduces the traditional abbreviations or nicknames for our four types of sentences: "A", "E", "I", and "O" (see M312). So, in summary, A and O contradict each other, as do E and I.

Note: Some students will insist that the contradictory of "All pirates are criminals" (A) is indeed "No pirates are criminals" (E); and the same for "Some pirates are criminals" (I) and "Some pirates are not criminals" (O). This is not really correct although it is not necessarily up to the teacher to insist on the point. They will discover it in their own way eventually. For your assistance, consider the following:

If an A sentence is true, then the corresponding E sentence must be false. But if an A sentence is false, the corresponding E sentence may not be true (so A and E are not genuine contradictories). Also, if an I sentence is false, the corresponding O sentence must be true. But if an I sentence is true, the corresponding O sentence may not be false (so I and O are not genuine contradictories). As the manual points out (M306), it is vital that students grow up with some understanding of contradiction, if only so that they can strive to avoid contradictions (and hence be consistent) in their own reasoning. But, as always, just how far you go with this concept depends upon how far your students can go.

CHAPTER THIRTEEN

No further development of the logical system as such but this chapter explores some key logical concepts which you and your students should find interesting. These include the concept of *cause* (N64-66, M328-329), *parts and wholes* and fallacious reasoning involving these (N66, M329-331), and *possibility* (the difference between possibility and truth and the "four possibilities": N66-68, M332-340).

Note: As the manual points out, the notion of possibility is central to the ideology of Philosophy for Children. Philosophy itself is as concerned with what is possible as with what is actually true. Many wonderful and exciting ideas can spring from considering what *might* be (or might have been) true. More specifically, by encouraging children to explore the realm of the possible, we are urging them to explore the very boundaries of thought - not an irrelevant activity for a thinking skills program! To borrow from M332, "The idea of possibility can be truly liberating." Make use of the logic review (M345-349) for yourself and for your students.

CHAPTER FOURTEEN

Note: The first part of this chapter (N69-73, M354-375) is one of the richest sections in the entire Philosophy for Children syllabus. It has a number of themes with perhaps the most basic being that of personal growth and development.

The development of syllogisms continues at N74 (M376), with the principle that in a valid syllogism, the middle term (i.e., the one mentioned twice in the premises) "drops out" of the conclusion. Notice also that the subject term in the conclusion is also the subject term in one of the premises, and the predicate term in the conclusion is the predicate term in the other premise (N75-78, M376-380). One point of caution: in the examples raised on N75-76, the premises are swapped (as compared with the examples from Chapter Eight). This makes no logical difference but may cause some initial confusion.

The other point raised in this chapter concerns a new kind of fallacious reasoning: when you construct a syllogism which does not have the pattern described in the previous paragraph, it may *not* be valid. This means that, in a real-life example, the conclusion may not be true even though the premises may both be true (N76-77, M378-379). Here is an example:

(a) All funnel-web spiders are poisonous. (True)
All tiger snakes are poisonous. (True)
Therefore, all funnel-web spiders are tiger snakes. (False)

Notice that, in this example, the middle term ("poisonous" or "poisonous things") does drop out of the conclusion, but the argument is not valid because, in the premises, *this term occurs in the predicate position twice.* It would also be invalid if, in the premises, the middle term occurred in the subject position twice. In a valid syllogism, the middle term appears *diagonally* in the premises and then drops out of the conclusion.

Note: The following syllogisms are also invalid. Can you see (1) that they are invalid, and (2) why they are invalid?

(b) All computers are machines.
All machines are breakable (things).
Therefore, all breakable things are computers.

(c) (from M377)
All Fords are automobiles.
All vehicles are machines.
Therefore, all Fords are machines.

The manual (M378-379) uses the terms "reliable/unreliable" as synonyms for "valid/invalid". But, there is also a more important development on these pages. Unreliable (i.e., invalid) reasoning arrangements *can have true premises and a true* *conclusion.* Recall this example from earlier in these notes:

(d) All spaniels are dogs.
All cats are mammals.
Therefore, all apples are fruits.

If you are bothered that (d) has too many terms to be considered plausible, consider another example (from M378):

(e) All dogs are animals.
All mammals are animals.
Therefore, all dogs are mammals.

This argument is not valid either, yet it has true premises and a true conclusion. So, validity is not the same as truth - remember the "definition" of validity that I suggested earlier:

"An argument is valid if, and only if, whenever we assume or pretend that the premises are true, the conclusion must thereby *be true."*

In (e), as with (d), the conclusion happens to be true, but its truth is not entailed or brought about by the truth of the premises. Observe what happens to (e) if you make one simple change: substitute "snakes" for "dogs".

(f) All snakes are animals.
All mammals are animals.
Therefore, all snakes are mammals.

Both (e) and (f) are so similar in shape or form that you would expect them to be either both valid or both invalid. But (f) is clearly invalid because it has true premises and a false conclusion. So, by this reasoning (which relies on an analogy), (e) is invalid as well. What we are beginning to discover here is that the logical value of an argument (i.e., valid or invalid) depends not on the actual terms or words used, but on the *shape, pattern or form* of the argument. Here is an argument form:

(g) All A's are B's.
All C's are B's.
Therefore, all A's are C's.

Can you see that this form is the "skeleton" of arguments (a), (e), and (f) above? Because it is an invalid form, you can expect that all arguments that have this form will themselves be invalid. I noted above that (f) is clearly invalid because it has true premises and a false conclusion. If this brief technical discussion has confused you, be aware of one crucial point at least. Logic is not directly about truth, but about *preserving* truth through reasoned argument (inference). It follows that, in a valid syllogism, the combination of true premises and false conclusion is *impossible.* If this combination were permitted, then we could logically pass from truth to falsehood - and that is the one move which logic wants desperately to exclude!

Exercise: Using (g) as a guide, can you (1) find other invalid forms for syllogisms, (2) find the one form, involving sentences beginning with "All", which is valid?

Note, finally, a practical application of the novel's discovery concerning reliable syllogisms (N77-78, M379-380). Notice on N78: more examples of arguments which have the shape of (g) above. Such practical uses of the rules of reasoning might help your students to appreciate the value of logical thinking. On the other hand, the manual makes the point that topics such as those discussed in this chapter may be beyond the comprehension of some students (M376, 378). It is the teacher's responsibility to help students decide between exploring a topic further and deferring it (this topic is taken up in the Lisa manual) or dropping it altogether. It is worth bearing in mind that, in the United States, Harry is part of the grade five syllabus. In Australia, it is usually not begun before grade six.

CHAPTER FIFTEEN

Once again, no further development of the logical system, but, once again, this chapter contains a great deal of conceptual material. Its main subject is *causality* and related concepts (action, explanation, description, reasons). These themes are central to the philosophy of science and it is no accident that part of the chapter is taken up with examples from science class. Not all though: Harry's discussion with his father on "what comes first", and his own reflections about causes and effects, are models of philosophical activities that don't depend on science or on the teacher.

The distinctions which are featured in this chapter are important and (once you start to think about them) puzzling. Laws that describe versus laws that prescribe (N81, M393), causes versus effects (N and M whole chapter but especially M394-401), explanations versus descriptions (N81-81, M402-403), and causes versus reasons (N83, M404-405). If you teach science, you will find much in this chapter to stimulate you and your students. Indeed, science courses which are so content-oriented as to discourage children from puzzling over these issues are largely responsible for the distorted view of science which prevails in the general community.

CHAPTER SIXTEEN

Extending the logical system. In this chapter, the pattern of the syllogism is extended to what is called *hypothetical (or conditional) reasoning*, i.e., arguments in which one (or both) of the premises is hypothetical. A hypothetical statement is one which has the form: "If...then...", where the gaps are to be filled in by ordinary statements which are either true or false (N84-89, M414-419). The logical term "If...then" is a very important tool in our reasoning, and this discussion gives a brief introduction of its power. Notice that in the story, the rules for hypothetical arguments develop, almost inevitably, as a result of the children reflecting on their own and their friends' experiences. (M414) In order to understand the nature of hypothetical reasoning, it is important to realize that, in a single hypothetical statement, there are three statements to consider:

i) the statement which occurs after "If" and before "then" (called the antecedent),

ii) the statement which occurs after "then" (called the consequent), and

iii) the hypothetical statement as a whole.

Note: In ordinary English, we often omit the word "then" and just put a comma. Also - and this can be misleading if you are not careful - we often reverse the order of antecedent and consequent. For example, the statement "You will pass the exam if you work hard" is equivalent to "If you work hard, then you will pass the exam." The moral here is always write the hypothetical statement in its "standard form" before using it in arguments. (This should remind you of the distinction between "if" and "Only if": see M32-32b, 416.) In hypothetical reasoning, we usually begin with the assumption that the hypothetical statement itself is *true.* So, we can take this statement as our first premise. The second premise can be any one of four statements, according to the following possibilities:

(i) antecedent true,
(ii) antecedent false,
(iii) consequent true,
(iv) consequent false. To borrow one of the examples in the manual, take as our first premise the hypothetical statement:

If the Australians are winning, then the New Zealanders are close behind (assumed to be true).

(i) When the antecedent is true, we may add it as our second premise: The Australians are winning.

Then we may validly conclude: The New Zealanders are close behind.

This is the basic form of hypothetical reasoning. *It allows us to infer the truth of the consequent of a hypothetical statement from the (truth of) the statement itself, plus the antecedent.* It is so basic that it cannot really be justified, except by asserting that it cannot be doubted by anyone who understands the English expression

"If...then...".

What of our other three possibilities?

(ii) First premise (as before).

If the Australians are winning, then the New Zealanders are close behind.

Assuming that the antecedent is false, its *negation* must be true, viz. *The Australians are not winning.*

From this, it may be tempting to infer: Therefore, the New Zealanders are not close behind. But this would be a fallacious inference: the New Zealanders may still be close behind even though the Australians are not winning. And - this is the important point - this scenario is quite consistent with the truth of the first premise (comparing the "Tuesday" case on N86). In other words, when the antecedent is false, *we can make no valid inference as to the truth or falsity of the consequent.*

(iii) First premise (as before).

If the Australians are winning, then the New Zealanders are close behind.

The New Zealanders are close behind.

This time it may be tempting to infer: Therefore, the Australians are winning. But once again, this does not follow: the New Zealanders might be close behind even though the Australians are not winning. And this scenario - as we have already observed - is consistent with the truth of the first premise (compare the "Wednesday" case on N86). In other words, when the consequent is true, *we can make no valid inference as to the truth or falsity of the antecedent.*

(iv) First premise (as before).

If the Australians are winning, then the New Zealanders are close behind.

The New Zealanders are not close behind.

Therefore, the Australians are not winning. Just as (ii) and (iii) are invalid for the same reasons, so (i) and (iv) are valid. In other words, *given a true hypothetical statement and the falsity of its consequent, we may logically infer the falsity (negation) of the antecedent.* If you are not convinced that this form of reasoning is reliable, then consider this. Let us agree that (i) is a reliable form of reasoning. Then, if the conclusion in (iv) were not true, it would follow that the Australians are winning. But this takes us back to argument (i), from which we could infer that the New Zealanders are close behind. However, this statement directly contradicts the second premise of (iv) - which we have assumed to be true.

Note: Study the pattern of reasoning employed in the previous few lines. It is very close to the pattern or form of reasoning which we have been discussing! In fact, hypothetical reasoning comes naturally to most of us: we do it all the time without being aware of it. Unfortunately, some of us also employ invalid forms of reasoning just as naturally and this is one reason why an examination of our thinking patterns can be so valuable. Shouldn't our students develop the capacity to detect fallacious reasoning whenever it occurs?

The manual observes (M415) that, when we affirm the truth of a hypothetical statement, we do not thereby affirm the truth of either the antecedent or the consequent. Indeed, we commonly use hypothetical statements when we know that the antecedent is false ("If the moon were made of green cheese, then..." - this is a *counterfactual* statement), and also when we have no idea whether it is true or not ("If you get caught, then..."). Such statements invite us to explore possibilities and imaginary situations that are still logical, even if not actually true. (There is a puzzle here which we won't explore. Clue: recall Lisa's comments at N12 and N95, and M66-69 and 433.)

The two valid and two invalid patterns involving hypothetical statements are discussed at length in both novel and manual. You will need to look at a number of examples and go over this with other teachers before all these patterns become familiar. This topic is not easy and you will have to gauge whether or not to emphasize it in class. As always, be guided not so much by what you understand (or don't understand), but by what your students do or would find interesting or puzzling.

Hunches and Hypotheses (N85, 89-90, M413, 420, 424-425). It is no easy matter to give precise definitions here (and why should we, since the concepts themselves are not precise!). A hunch is a kind of guess, but one supported by "a certain feeling." Hypotheses, on the other hand, come into their own when we are faced with a problem for which no clear solution presents itself. To put forward an hypothesis is to propose a possible solution or way of understanding the problem. In other words, hypotheses *purport to explain*, and the best hypothesis (when more than one is available) is the one that explains best. But what, I hear you ask, does "explains best" mean? A hard question to answer, and one which threatens to take us too far afield. One answer is that the best hypothesis is the one that survives after all the others have been discarded. The illustration offered below should cast some light on this idea.

It is important for your students to appreciate that the skill of proposing and then testing hypotheses is a fundamental feature of our lives as creatures who learn through experience. To put this another way: this skill allows us to perform certain kinds of inductive procedures. Scientists employ this skill in their attempts to comprehend natural phenomena, but then again, it is just as much a tool of trade for historians, psychologists, etc., (even philosophers!). Students who have some grasp of this skill and its place in our endeavours are likely to have a reasonable understanding of the nature and scope of human knowledge.

Incidentally, in case you are wondering, the relevance of this topic in the present chapter is quite easy to explain: hypotheses function, typically, as *antecedents* in hypothetical reasoning. Consider the following illustration.

I am driving across the Sydney Harbour Bridge on a hot day during peak hour. The traffic is extremely heavy and we seem to be moving at a snail's pace. Suddenly, the nightmare that we all fear in such situations comes true: my car gives a cough and a sputter and stalls right in the middle lane. I am an amateur mechanic and could probably fix things quickly if only I knew what went wrong. In my semi-deranged state, I formulate several hypotheses, as follows:

(i) The car has run out of petrol.
(ii) I've got a flat tire.
(iii) My firm's opponents have sabotaged the car so that I would be late for an important appointment.
(iv) The engine has overheated.
(v) Those gremlins are at it again!

In proposing (i), for example, I am implicitly arguing as follows: "*If* the car has run out of petrol, *then* this would explain why it stalled on the bridge." Your task is to select the best hypothesis based on the evidence - note, not just the one most likely to be true, but the one which would offer the best explanation of the facts. If you feel that one or more of the above hypotheses should be rejected, be clear as to your reasons for feeling this way. To make things more interesting, try adding various bits of information to the data given originally (for example: I filled the car with petrol just a few minutes before it stalled).

Hunches are worthy of separate discussion. One important point to bring out is that a hunch may be dangerous even when it turns out to be correct. We should not ignore our feelings - especially when they prove to be reliable time and time again - but neither should we ignore the methodology of careful inquiry which programs such as Philosophy for Children attempts to address. The concept and value of inquiry is the main focus of the final chapter.

CHAPTER SEVENTEEN

One further logical concept - that of a *tautology* - is raised here (N93, M434-435). Tautologies are statements whose truth is so self-evident as to render them virtually pointless. The classic form of a tautology is "A is A" or "All A's are A's," etc. Note the manual's observation (i) that the negation or opposite of a tautology is a contradiction (recall Chapter 12), and (ii) that tautologous statements sometimes have an idiomatic meaning ("A rose is a rose," for example; recall N50). However, this final chapter is fundamental for a quite different reason: it allows the children (both fictional and real) to reflect on the crucial distinction between subjective and objective points of view. It is worth spending some effort trying to grasp the views of the different characters in this chapter. Tony and Lisa are representatives (though not all the time) of the step-by-step and the intuitive ways (respectively) of thinking. Fran appreciates that they might be right because they are reflecting different points of view or perspectives. But Harry takes this a step further when he realizes that, although we often do see things differently from one another, *we can - with effort - see things from those other points of view.* Notice that Lisa has the last word, in one sense. However we choose to understand her poem (N95, reprinted in full at M439), she interprets it as a caution: *in our quest for greater understanding and wisdom, making mistakes can be a more fruitful enterprise than being "certain" of the truth.* The value of dialogue and inquiry - those aspects which are so strongly emphasized in this program - depends upon these remarkable facts. In a community of inquiry, where children learn to listen to, empathize with, and respect one another's thoughts and ideas, they can begin to move toward a mutual understanding of different perspectives, and hense a more objective understanding of the world and of themselves (M436, 442). It is the possibility of seeking objective knowledge and understanding from the seeds of our own subjective perceptions and ideas that Philosophy for Children offers.

Laurance Splitter