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Richard J. Hall
Major professor

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NECESSARY A POSTERIORI TRUTH

By

Cynthia Jayne Bolton

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ABSTRACT

NECESSARY A POSTERIORI TRUTH

by

Cynthia Jayne Bolton

Traditionally, philosophers have used the analytic/synthetic, a priori/a posteriori, and necessary/contingent distinctions to categorize statements. And traditionally, philosophers have used these distinctions to categorize necessary statements as a priori statements. Yet certain statements seem better categorized as necessary and a posteriori. Examples of such statements include: (1) Heat is the form of energy constituted by the motion of atoms and molecules in solids; (2) Gold is the element with atomic number 79; and (3) Water is H_2O. For while we believe that these statements express empirical discoveries, we also believe that they express the essence of their subjects.

I wish to justify the claim that these statements are both necessary and a posteriori. My justification includes a synthesis of the causal theory of reference with the network theory of meaning. But once this synthesis is carried out, we have a rather complicated notion of necessity. We no longer have one notion of necessity, but four notions. One notion is the logical positivist's. A statement is necessary if it expresses a linquistic convention. The

second notion is the network theorist's. A statement is necessary if it is central to our theoretical network. The third notion is the causal theorist's. A statement is necessary if it is a singular statement of identity between two rigid designators. And the fourth notion is the essentialist's. A statement is necessary if the predicate expresses the essence of the subject. But this essence must be a structural property that plays an explanatory role within our theoretical network. Of these four notions of necessity, only the first must be a priori. The other three are ultimately a posteriori. Statements (1)-(3) fall under the fourth notion. And thus, they are necessary and a posteriori.

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Chapter One

The topic of necessary truth centers about two questions. There is the metaphysical question: Are there such things as necessary truths? And there is the epistemological question: How do we distinguish those truths that are necessary from those that are not? These two questions are interrelated since much of our interest in the metaphysical question would be lost without an answer to the epistemological question. Postulating necessary truth would be an idle exercise if we could not determine which truths are necessary.

For most of this century, the notion of necessity has been intertwined with the notion of meaning. According to this notion, a statement is necessary if and only if its truth stems solely from the meaning of the words used to express that statement--if its truth depends upon anything else, then it is not necessary. This analysis, at the very least, has the virtue of answering both the metaphysical and epistemological questions. It tells us that there are necessary truths--they are just those statements that are true in virtue of meaning. And it tells us how to distinguish necessary truths from other truths--we examine the role that meaning plays in determining the truth value of a statement. This examination alone will enable us to separate those statements that are necessary from those that are not. This analysis proved quite popular. While

it was originally formulated by the logical positivists, it was soon adopted and advocated by philosophers of other per-suasions as well. And only recently have philosophers come to admit that this analysis is possibly wrong.

In this chapter, I would like to focus on the logical positivists' notion of necessary truth. We shall examine why the logical positivists tied necessity to meaning; and we shall examine a problem with this analysis. To do this, we must focus on three distinctions: the analytic/synthetic distinction, the a priori/a posteriori distinction, and the necessary/contingent distinction. But since the logical positivists' account of these distinctions owes much to Leibniz, Hume, and Kant, we should situate their analysis within some sort of historical perspective because only then can we understand why the logical positivists tied necessity to meaning.

Setting the State: Leibniz and Hume

Leibniz and Hume are principally concerned with just one distinction--the distinction between knowledge that is demonstrative and knowledge that is empirical. To make this distinction, Leibniz contrasts truths of reason with truths of fact while Hume contrasts relations of ideas with matters of fact where both truths of reason and relations of ideas refer to demonstrative knowledge while truths of fact and matters of fact refer to empirical knowledge.[1]

Since they are concerned with just one distinction, it may seem rather odd to begin our discussion with Leibniz and Hume. But the distinctions that concern us--the analytic/synthetic, the a priori/a posteriori, and the necessary/contingent distinctions--originate to a great extent with Leibniz's and Hume's distinction between knowledge that is demonstrative and knowledge that is empirical.

While Leibniz and Hume disagree on the origin[2] and the extent[3] of demonstrative knowledge, they agree on its foundation. Both believe that demonstrative knowledge is based upon the principle of contradiction. Leibniz, for example, argues that

> (LD) x is a truth of reason if and only if its truth is established by the principle of contradiction.[4]

while Hume argues that

> (HD) x is a relation of ideas if and only if its truth is established by the principle of contradiction.[5]

According to Leibniz and Hume, demonstrative knowledge, by whatever name we choose to call it, owes its truth to the principle that it is impossible for something to be and not to be at the same time.

Since demonstrative knowledge is based upon the principle of contradiction, it is necessary. By claiming that demonstrative knowledge is necessary, Leibniz and Hume are claiming that such knowledge must be true. It is impossible for such knowledge to be false. To understand the role

that the principle of contradiction plays in guaranteeing the truth of demonstrative knowledge, consider the following statement: 'An equilateral triangle is a triangle'. Although Leibniz would describe this statement as a truth of reason while Hume would describe it as a relation of ideas, they would agree that the statement is necessary. They would argue that it is impossible for it to be false since the statement can only be false if there is an equilateral triangle that is not a triangle. Or simply put, the statement is false only when we have something that is both a triangle and not a triangle at the same time. But this would most definitely violate the principle of contradiction.

Since demonstrative knowledge is based upon the principle of contradiction, it must also be a priori. According to Hume, we discover demonstrative knowledge by means of reason. He writes

> Propositions of this kind [relations of ideas] are discoverable by the mere operation of thought, without dependence on what is anywhere existent in the universe. Though there were never a circle or a triangle in nature, the truths demonstrated by Euclid would forever retain their certainty and truth. [6]

As this passage shows, demonstrative knowledge is a priori not only because experience is not needed to determine its truth but also because its truth does not even depend upon what exists empirically.

But why would the principle of contradiction lead to

a priori knowledge? Traditionally, this principle has been used to separate the possible from the impossible. Whatever is in accordance with this principle is possible while whatever is in violation of this principle is impossible. Think about a triangle. While it is possible for a triangle to be a triangle, it is impossible for a triangle not to be a triangle. The former accords with the principle of contradiction while the latter violates it. Now if something is possible, it is thinkable. Similarly, if something is impossible, it is unthinkable. Whether triangles exist or not, we can certainly think of a triangle (although we cannot think of a triangle that is not a triangle). Demonstrative knowledge, which is founded upon the principle of contradiction, is tied to the notion of possibility. As such, it is thus tied to the thinkable. And since it is tied to whatever can be thought, demonstrative knowledge can be discovered by thought alone. In this explanation, the principle of contradiction acts as a psychological principle.

But simply because something is possible, this does not mean that it is actual. While it is entirely possible for something to be a triangle, this does not mean that triangles actually exist. Possibility and actuality are two different things. While demonstrative knowledge concerns the possible, empirical knowledge concerns the actual. Since the principle of contradiction deals with the

possible and not the actual, empirical knowledge must be founded on some principle other than that of contradiction. Although empirical knowledge cannot violate the the principle of contradiction, it cannot be based solely on it.

When it comes to empirical knowledge, Leibniz and Hume break company. While they agree that we gain our knowledge of truths of fact or matters of fact from experience, they disagree on the basis of this knowledge. Leibniz, on one hand, argues that

> (LE) x is a truth of fact if and only if it is based upon the principle of sufficient reason. [7]

Hume, on the other hand, argues that

> (HE) x is a matter of fact if and only if it based on the relation of cause and effect. [8]

It is at this point that the difference between Leibniz, the rationalist, and Hume, the empiricist, becomes most obvious.

Although Hume explicitly states that matters of fact are based upon the relation of cause and effect, in reality, this comes down to the claim that matters of fact are based upon experience. Consider the following matter of fact: 'Caesar is the person who crossed the Rubicon in the year 49 B.C.'. What is our justification for believing this? Hume argues that our justification for any matter of fact always comes back to another fact; and the relation

that allows us to connect these facts is that of cause and effect. But this relation, says Hume, is itself empirical. He writes that

> the knowledge of this relation is not, in any instance, attained by reasonings a priori; but arises entirely from experience... [14]

Our justification for our belief in the relation of cause and effect ultimately comes back to experience; in particular, our experience that one event regularly follows another.

Leibniz concedes to the empiricists that when it comes to empirical facts, we, as human beings, need experience to learn these facts. But as a rationalist, he wants to claim that every truth, truths of fact as well as truths of reason, can be deduced by means of reason alone. He justifies this claim by arguing that every statement expresses a relationship between two concepts--the concept expressed by the predicate term and the concept expressed by the subject term. If the statement is true, the concept of the predicate is contained in the concept of the subject. If the statement is false, then the concept of the predicate is not contained in the concept of the subject.[10] Since the concept of the predicate is contained in the concept of the subject, we can, in principle, supply an a priori proof for any true statement, not withstanding its status as a truth of reason or as a truth of fact.

When it comes to truths of reason, it is fairly easy

to see that one concept is contained in the other. Consider the statement 'An equilateral triangle is a triangle'. It is easy to see that the concept of the predicate term 'triangle' is contained in the concept 'equilateral triangle'. But when it comes to truths of fact, it is not so easy to see that one concept is contained in the other. Consider the truth of fact 'Caesar is the person who crossed the Rubicon in the year 49 B.C.'. The concept 'the person who crossed the Rubicon in the year 49 B.C.' is not obviously contained in the concept 'Caesar'. But Leibniz believes that this concept is nonetheless contained in the concept 'Caesar'. According to Leibniz, "the individual notion [concept] of each person includes once for all everything which will ever happen to him."[11] And just as we can deduce 'triangle' from the concept 'equilateral triangle' so can we deduce 'the person who crossed the Rubicon in the year 49 B.C.' from the concept 'Caesar'.

The difference between truths of reason and truths of fact, according to Leibniz, is not that the former are a priori while the latter are a posteriori. Rather, the difference is that truths of reason depend solely upon the principle of contradiction while truths of fact depend also upon the principle of sufficient reason. It is this principle that enables us to determine what is actual as opposed to what is merely possible. Leibniz writes

> ...we consider that no fact can be real or existing and no proposition

> can be true unless there is a sufficient reason, why it should be thus and not otherwise... [12]

For anything and everything that is actual, there must be a reason to explain why this particular possibility, out of all the various possibilities, became actual. For anything and everything that has happened to Caesar, for example, there must be a sufficient reason to explain why these things happened. If we knew these reasons, we could deduce everything that happened to Caesar from the mere concept of 'Caesar'. We could not only deduce that Caesar crossed the Rubicon in the year 49 B.C., but we could also deduce the precise point where he crossed the Rubicon and why he crossed the Rubicon. Since we lack knowledge of these sufficient reasons, we cannot make these deductions. We need to rely on experience to learn the truth of 'Caesar is the person who crossed the Rubicon in the year 49 B.C.'. But in principle, we could rely on reason alone.

Setting the Stage: Kant

The logical positivist's primary debt to Kant is that he is perhaps the first philosopher to recognize that the analytic/synthetic, a priori/a posteriori, and necessary/contingent distinctions were distinctions worthy of analysis in their own right. While Leibniz and Hume made use of the a priori/a posteriori and necessary/contingent distinctions and while Leibniz did everything but identify the

analytic/synthetic distinction, their interest in these distinctions stemmed solely from the standpoint of their interest in the distinction between demonstrative and empirical knowledge. It was Kant who gave up one all encompassing distinction in favor of three independent distinctions.

Kant's version of the analytic/synthetic distinction owes its genesis to Leibniz. With Leibniz, Kant believes that every statement expresses a relationship between the concept of its predicate term and that of its subject. Furthermore, Kant agrees with Leibniz that this relationship takes one of two forms. Either the concept of the predicate belongs to the concept of the subject or it does not. But while Leibniz believes that in the case of true statements, the concept of the predicate always belongs to the concept of the subject, Kant does not. Even in the case of true statements, the relationship between subject and predicate can take one of these two forms. And depending upon which form it takes, the statement is either analytic or synthetic. Kant suggests that

> (KA) A statement is analytic if and only if the concept of the predicate is is contained in the concept of the subject.
>
> (KS) A statement is synthetic if and only if the concept of the predicate is not contained in the concept of the subject. [12]

Analytic statements, according to Kant, depend solely upon

the principle of contradiction. Since the concept of the predicate is contained in the subject, we cannot deny the truth of an analytic statements without violating this principle. Synthetic statements, in contrast, do not depend solely upon the principle of contradiction. Although synthetic statements may not violate this principle, they cannot be founded upon it, for as Kant says

> ...it is evident... that in synthetic judgments I must have besides the concept of the subject something else (X), upon which the understanding may rely, if it is to know that a predicate, not contained in this concept, nevertheless, belongs to it. [14]

Up to this point, the discussion may seem vaguely reminiscent of the discussion in the preceding section. Analytic statements, like demonstrative knowledge, depend upon the principle of contradiction while synthetic statements, like empirical knowledge, depend upon something else.

The difference is that Kant does not stick with just one distinction but goes on to present two additional distinctions. Although Leibniz and Hume certainly presuppose the existence of the a priori/a posteriori distinction, Kant is careful to define it. He argues that

> (KP) x is a priori if and only if it meets one of the following conditions:
> (a) x can be known independently of all experience; or
> (b) x can be known prior to experience.
>
> (KT) x is a posteriori if and only if knowledge of x is dependent

on experience. [15]

Kant's notion of the a posteriori should sound familiar since it is the same notion that we found with Leibniz and Hume; and since it will be the same notion that we will find with the logical positivists. His notion of the a priori, on the other hand, is not so familiar.

Kant's provides us with two conditions for (KP). These conditions correspond to two different senses for the phrase 'a priori'. The first condition corresponds to the epistemological sense. When we use 'a priori' in this sense, we are asserting that experience is irrelevant. All that is needed is reason. The second condition corresponds to the "psychological" sense; where by the term 'psychological', we mean to refer to certain sorts of mental processes. Experience is not irrelevant to these processes. But we say that these processes are prior to experience in that our experience, from the very beginning, is structured according to these processes.

This "psychological" element becomes even more pronounced when we examine Kant's version of the necessary/contingent distinction. Early in The Critique of Pure Reason, he presents this distinction as thus:

(KN) x is necessary if and only if x meets both the following conditions:
(a) x holds with strict universality; and
(b) x must be the case.

(KC) x is contingent if and only if

> x meets the following conditions:
> (a) x does not hold with strict universality; or
> (b) x may not be the case. [16]

By framing the necessary/contingent distinction in terms of strict necessity, Kant contrasts universal statements that must be true with universal statements that merely happen to be true. Consider the following two statements:

> (i) 5+7=12.
> (ii) Every president of the United States during the 19th century was a white male.

Both (i) and (ii) are universally true; but only (i) holds with strict universality. While we believe that (i) is necessary, we believe that (ii) is contingent; and while we believe that (i) must be true, we believe that (ii) merely happens to be true. If we examine the class of presidents of the United States during the 19th century, we will discover that it is made up entirely of white males; but even so, we do not think that it had to consist solely of white males.

But how can we distinguish between those statements that hold with strict universality from those that simply hold universally? We can answer this question by examining the relationship between the necessary/contingent distinction with the a priori/a posteriori distinction. Kant argues that

> (K1) A statement is necessary if and only if it is a priori.

(K2) A statement is contingent if and only if it is a posteriori.

Kant equates necessity with the a priori because he agrees with Hume that "experience can teach us that a thing is so and so, but not that it cannot be otherwise."[17] Experience may be sufficient to prove that a statement is universally true; but it is not sufficient to show us that that statement is strictly universal. If we believe that a statement is strictly universal, we must do so on a priori grounds.[18] Reconsider statements (i) and (ii). We accept the truth of (ii) on a posteriori grounds. Thus, it is contingent. But in the case of (i), we argue for its truth on a priori grounds; and that, according to Kant, is the reason why (i) is necessary.

Kant also argues for the following:

(K3) If a statement is analytic, then it is a priori.

Since the concept of the predicate term is included within the concept of the subject term, we need not consider anything beyond the concepts used within that statement. In particular, we need not rely on experience.[19] From (K1) and (K3), we can infer

(K4) If a statement is analytic, then it is necessary.

Given that analytic statements depend upon the principle of contradiction, and given what we learned about this principle in the preceding section, (K4) is exactly what we would expect.

Not too surprisingly, Kant also argues for the following:

(K5) If a statement is a posteriori, then it is synthetic.

We have already noted that Kant argues that we need something, some (X), to unite the concepts of the predicate and the subject for a synthetic statement. In the case of a posteriori statements, this (X) is experience.

Although Kant argues that every analytic statement is both a priori and necessary, he does not argue that every synthetic statement is both a posteriori and contingent. In fact, Kant refuses to equate synthetic statements with a posteriori statement. He argues instead that

(K6) If a statement is synthetic, then it it is either a priori or a posteriori.

(K7) If a statement is a priori, then it is either analytic or synthetic.

Kant believes that certain statements are both synthetic and a priori. And among such statements are the statements of mathematics and various metaphysical principles.

Let us once more consider statement (i). Since this statement depends upon the principle of contradiction, we may be inclined to argue that it is a priori and analytic. But Kant argues that it is synthetic. While the statement '5+7=12' does not violate the principle of contradiction; nevertheless, the concept of '12' is not contained in the concept of the sum '5+7'; and thus, the statement is synthetic. Reasoning in this manner, Kant writes that

> Arithmetical propositions are therefore always synthetic. This is still more evident if we take larger numbers. For it is then obvious that, however we might turn and twist our concepts, we could never, by the mere analysis of them, and without the aid of intuition, discover what is the sum. [20]

Kant also believes that certain "metaphysical" principles are also synthetic and a priori. For example, the principle 'Every effect has a cause', according to Kant, belongs in this category. (This conclusion has not been widely adopted. Those philosophers who agree with Kant that the principle is a priori argue, however, that it is a priori because it is analytic--the concept of 'cause' is contained in the concept of 'effect'--while those philosophers who agree with Kant that the principle is synthetic argue that it is synthetic because it is a posteriori--it is a principle that is justified by experience.) Kant concedes that statements that are both synthetic and a priori are somewhat problematic. Since they are synthetic, we need something to unite the concepts of the predicate and subject. But since they are a priori, this something cannot be experience. But if it is not experience, what can it be?

It is at this point where Kant begins to rely upon his second sense of 'a priori'--the psychological sense. Kant argues that we bring certain a priori intuitions and concepts to particular statements. In the case of mathematical statements, we bring our a priori intuitions of space

and time. In the case of metaphysical principles, we bring certain a priori concepts--the categories. It is these a priori intuitions and concepts that enable us to unite the subject and predicate within mathematical and metaphysical statements. But Kant does not believe that these intuitions and concepts are irrelevant to experience. Rather, it is these intuitions and concepts that structure our experience.

The Stage is Set: The Logical Positivists

The logical positivists owe a great deal to the work of Kant and to the work of Leibniz and Hume. Like Leibniz and Hume, the logical positivists essentially have one overall distinction--the distinction between knowledge that is demonstrative and knowledge that is empirical. But they analyze this distinction in terms of Kant's three distinctions. To distinguish demonstrative knowledge from empirical knowledge, they rely upon the analytic/synthetic distinction, the a priori/a posteriori distinction, and the necessary/contingent distinction.

While the logical positivists credit Kant for recognizing the importance of the analytic/synthetic distinction, they do not adopt his version of the distinction. Instead, they claim that:

> (LA) A statement is analytic if and only if its truth value is determined completely by linquistic conventions.

(LS) A statement is synthetic if and only if its truth value is not determined completely by linquistic conventions.

These linquistic conventions, in turn, are governed by the principle of contradiction. Hence, analytic statements are governed entirely by the principle of contradiction while synthetic statements are not.

Examples of analytic statements include the following:

(a) A bachelor is an unmarried man.
(b) P v -P.
(c) 5+7=12.

According to the logical positivists, the truth value of each statement is determined by various linquistic conventions. The truth of (a) is determined by the conventions that govern the use of English. The truth of (b) is determined by the conventions that govern the use of logical connectives in an appropriate propositional calculus. The truth of (c) is governed by the conventions that govern arithmetic. In each case, we cannot deny the truth of these statements without also violating the principle of contradiction.

As we can see, the logical positivists waste little time breaking with Kant. While Kant believed that the mathematical statements were synthetic, the logical positivists believe that they are analytic. Ayer argues that Kant relied on two different criteria when he formulated his analytic/synthetic distinction. One criterion was logical--the principle of contradiction--and it is this

criterion that the logical positivists continue to accept. The other criterion was psychological--whether the concept of the predicate was thought in the concept of the subject or not--and it is this criterion that the logical positivists reject.

We can contrast statements (a)-(c) with the following synthetic statements:

(d) Bachelors are neurotic.
(e) Jones knows that 'P v -P' is true.
(f) This board is seven feet long.

To determine the truth value of these statements, we must go beyond linquistic conventions. Bachelors may very well be neurotic; but we cannot discover this fact simply by examining the conventions that govern the use of the term 'bachelor'. And while 'P v -P' is true, we cannot determine whether Jones knows that it is true by linquistic analysis. And the only way we can know that a particular board is seven feet long is by measuring it. Since linquistic conventions are not sufficient to tell us the truth values of statements (d)-(f), these statements are synthetic.

The logical postivists' version of the a priori/a posteriori distinction also differs from Kant's version. They claim that:

(LP) A statement is a priori if and only it can be known independently of experience.

(LT) A statement is a posteriori if and only if knowledge of it is dependent

on experience. [15]

The logical positivists only worry about Kant's epistemological sense of the phrase 'a priori'. Since they reject Kant's critical project, they have no interest in the psychological sense. They have no interest in the a priori conditions that structure experience. Or to be more accurate, they believe that the conditions that structure experience are empirical and can be studied in psychology.

When it comes to the necessary/contingent distinction, the logical positivists again present us with the familiar version. They argue that

> (LN) A statement is necessary if and only if it must be true--it is impossible for it to be false.
>
> (LC) A statement is contingent if and only if it may be false--it is possible for it to be false.

This is, of course, the same version of necessity that we first encountered with Leibniz and Hume.

Like Kant, the logical positivists equate necessity with the a priori. They argue that:

> (L1) A statement is necessary if and only if it is a priori.
>
> (L2) A statement is contingent if and only if it is a posteriori.

The logical positivists, like Kant before them, are responding to Hume's scepticism. Ayer, for example, admits that

> ...it is impossible on empirical principles to account for our knowledge of

> necessary truths. For, as Hume conclusively showed, no general proposition whose validity is subject to the test of actual experience can ever be logically certain. No matter how often it is verified in practice, there still remains the possibility that it will be confuted on some future occasion. [21]

But the logical positivists also believe that necessary knowledge is a priori because we never allow experience to falsify such knowledge. Ayer writes that

> Whatever instance we care to take, we shall always find that the situations in which a logical or mathematical principle might appear to be confuted are accounted for in such a way as to leave the principle unassailed. ...The principles of logic and mathematics are true universally simply because we never allow them to be anything else. [22]

Consider the statement '5+7=12'. Suppose we pushed a pile of 5 pebbles into a pile of 7 pebbles and discovered that the resulting pile was something other than 12 pebbles? Would we then conclude that the principle '5+7=12' has been falsified. Of course not. We would conclude that we had miscounted the number of pebbles in one of our original piles. We do not allow '5+7=12' to be falsified by any sort of experience. But if we do not allow this principle to be falsified by experience, then we must not verify it by experience.

So, how do we verify the truth of a statement such as '5+7=12'? The logical positivists argue that:

> (L3) A statement is a priori if and only if it is analytic.

To justify this claim, the logical positivists point out that apart from what they tell us about linquistic conventions, analytic statements have no empirical content whatsoever. And since they lack empirical content, we do not use experience to determine their truth or falsify. The statement '5+7=12' owes its truth to the conventions that govern our use of arithmetic. And this explains why experience cannot falsify '5+7=12'.

From (L1) and (L3), we can infer that

(L4) A statement is necessary if and only if it is analytic.

The fact that we can determine the truth or falsity of analytic statements merely by examining linquistic conventions also explains why these statements are necessary. Ayer writes

> They [analytic statements] simply record our determination to use words in a certain fashion. We cannot deny them without infringing the conventions which are presupposed by our very denial, and so falling into self-contradiction, and that is the sole ground of their necessity. [23]

By tying necessity to analyticity, the logical positivists tie necessity to the principle of contradiction. We violate this principle whenever we violate the conventions that we have chosen to adopt. And this explains why analytic statements are necessarily true.

Running parallel to these claims are the following:

(L5) A statement is a posteriori if and only if it is synthetic.

(L6) A statement is contingent if and only if it is synthetic.

Since we cannot determine the truth value of synthetic statements by linquistic analysis, how can we determine their truth value? The logical positivists argue that the truth value of synthetic statements is determined by experience. Synthetic statements, according to the logical positivists, make claims about the empirical world; and thus, it is only fitting that experience verifies or falsifies these statements. But as we have already noted, experience cannot guarantee necessity. Thus, these statements will all be contingent. This applies even to "metaphysical" statements, such as 'Every effect has a cause'. We accept this statement only in so far as it continues to be corroborated by experience.

Thus, we can see that the logical positivists only permit two classes of statements: we have those statements that are analytic, a priori, and necessary and we have those statements that are synthetic, a posteriori, and contingent. Demonstrative knowledge consists of those statements that belong to the former class while empirical knowledge consists of statements that belong to the latter. Moreover, we can now understand precisely how necessity has been tied to meaning. Necessity is equivalent to analyticity.

Problems

An assumption that underlies the distinctions that we have examined is that these distinctions are exclusive and exhaustive. Every statement is either analytic or synthetic, a priori or a posteriori, necessary or contingent. The purpose that underlies Kant's and the logical positivists' analyses is to explain why a particular statement falls into one category as opposed to another. But consider the following three statements:

(1) Heat is the form of energy constituted by the motion of atoms and molecules.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

How should we categorize these statements? Are they analytic or synthetic? A priori or a posteriori? Necessary or contingent? As we shall soon see, the analyses provided by Kant and the logical positivists give us great leeway in categorizing these statements.

By using the analysis provided by the logical positivists, we can argue that these statements are analytic, a priori, and necessary. If we look in any reasonably decent dictionary, we will discover that these statements are the definitions for 'heat', 'gold', and 'water'. Thus, we could say that statements (1)-(3) are true by definition. But if they are true by definition, then they express the linquistic conventions that govern the way we choose to talk about heat, gold, and water. But this means that

statements (1)-(3) are analytic. But if they are analytic, then they are also a priori and necessary.

But we can also use the logical positivists' analysis to argue that statements (1)-(3) are synthetic, a posteriori, and contingent. We did not originally accept the truth of statements (1)-(3) by means of linquistic analysis. The fact of the matter is that it was an empirical discovery that heat is a form of energy associated with the motion of atoms and molecules. It was an empirical discovery that gold has an atomic number of 79. It was an empirical discovery that water is H_2O. The truth of statements (1)-(3) was settled empirically, not by an examination of our linquistic conventions. Thus, statements (1)-(3) are a posteriori. And if they are a posteriori, then they are also synthetic and contingent.

But while we may be quite willing to concede that statements (1)-(3) are a posteriori, we should not be quite so willing to concede that they are contingent. Heat occurs if and only if there is atomic or molecular motion. Something is gold if and only if it has atomic number 79. Something is water if and only if it is H_2O. We do not believe that statements (1)-(3) express mere correlations. We tend to believe that if our scientific theories are correct, then these statements are necessary.

The situation is no better if we use Kant's analysis rather the logical positivist's. We can use Kant's

analysis to argue that statements (1)-(3) are analytic, a priori, and necessary. Our concept of heat includes the concept of a form of energy constituted by the motion of atoms and molecules. Our concept of gold includes the concept of an element with atomic number 79. Our concept of water includes the concept of H_2O. Thus, by Kant's criterion, statements (1)-(3) are analytic. And since they are analytic, they are also a priori and necessary.

But once again, we can also use Kant's analysis to argue that statements (1)-(3) are synthetic, a posteriori, and contingent. The fact remains that it was an empirical discovery that heat is a form of energy constituted by the motion of atoms and molecules, that gold is an element with atomic number 79, that water is H_2O. Given the state of chemistry in his day, Kant undoubtedly did not include the concept of atomic or molecular motion within his concept of heat, or the concept of the atomic number 79 within his concept of gold, or the concept of H_2O in his concept of water. We could argue that Kant has a different conception of heat, gold, and water than we do. We could say that the concepts of heat, gold, and water have changed since Kant's day. But such a suggestion overlooks the fact that these changes were driven by empirical findings. The fact of the matter is that the truth of statements (1)-(3) was settled empirically and not by examining our concepts. Thus, we can argue that statements (1)-(3) are a posteriori; and

since they are a posteriori, they are also synthetic and contingent.

But once again, we may be unwilling to describe state-statements (1)-(3) as contingent. Our concept of water, for example, includes a great many other concepts. It includes the concept of H_2O; but it also includes the concept of a liquid that boils at 100°C and freezes at 0°C; it includes the concept of a colorless and odorless liquid. Yet while our concept of water may include concepts other than H_2O, we feel that the concept of H_2O is somehow more important than these other concepts.

If we take Kant's and the logical positivists' analyses seriously, then we can categorize statements (1)-(3) as either analytic, a priori, and necessary or as synthetic, a posteriori, and contingent. In either case, we go against certain intuitions that we have about these statements. On the one hand, we believe that statements (1)-(3) provide the definitions for 'heat', 'gold', and 'water'. But on the other hand, we established these definitions empirically. We believe that these statements are necessary; but we also believe that they are a posteriori. But every analysis of necessity that we have examined equates necessity with the a priori.

Why are statements (1)-(3) so difficult to categorize? The problem is that although we may think that that these statements are definitions, we do not think that they

simply express linquistic conventions. Intuitively, we feel that these statements express the essence of their subject; and it is for this reason that we accept these statements as definitions. Aristotle, for example, argues that there are two types of definitions. One type gives the essential nature of its subject while the second type is only a nominal expression. The first type expresses the inherent nature of a thing while the second merely expresses the meaning of a word.[24] These two types of definitions are related. We may use the essential nature of a thing as the meaning of the word that designates that thing. For example, the essential nature of water may be H_2O. We may then end up using 'H_2O' as the definition of 'water'. But we have chosen to define 'water' as 'H_2O' because H_2O is the feature that constitutes the inherent constitution or essence of water. We have reason for defining 'water' in a particular way; but this definition is not the result of linquistic convention. Rather, our linquistic conventions, in the case of 'water', follows our empirical discoveries.

Now we could bite the bullet, as many logical positivists (and possibly Kant) would recommend, and insist that statements (1)-(3) are synthetic, a posteriori, and contingent. The only reason why we think statements (1)-(3) are necessary is because, intuitively, we feel that they express the essence of their subject. But perhaps

this intuition tells us less about statements (1)-(3) than it tells us about ourselves. By feeling that statements (1)-(3) express the essence of their subjects, we have a certain attitude towards these statements. But an attitude is hardly sufficient to describe these statements as necessary.

Chapter Two

If we rely on the criteria provided by the logical positivists, then we have considerable leeway when it comes to categorizing the following statements:

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

On one hand, we can argue, and we can argue persuasively at that, that these statements are analytic, a priori, and necessary. But on the other hand, we can argue, and we can argue just as persuasively, that these statements are synthetic, a posteriori, and contingent. Needless to say, the logical positivists did not intend their criteria to be quite so flexible as this.

In this chapter, we shall examine the causal theory of reference, a theory of meaning that has been proposed by Kripke and Putnam. Proponents of this theory argue that statements (1)-(3) are both necessary and a posteriori. This is a rather convenient claim. It not only takes into account our intuitive convictions that these statements express something essential about the nature of their subjects but also the fact that the truth of these statements was established empirically. But there is a problem. Although the causal theorists may be correct in claiming that statements (1)-(3) are both necessary and a posteriori, their justification for this claim leaves something to be

desired.

Modifying the Traditional Distinctions

Surprisingly enough, the causal theory is reminiscent of logical positivism. This is because the causal theorists draw the analytic/synthetic, a priori/a posteriori, and necessary/contingent distinctions in much the same way as the logical positivists. They accept these distinctions with only a few minor modifications. Yet it is these modifications, minor as they may appear, that enable the the causal theorists to reject the conclusion that necessary statements must be a priori.

When it comes to the analytic/synthetic distinction, for example, the causal theorists agree with the logical positivists that while analytic statements owe their truth to linquistic conventions, synthetic statements do not. But the causal theorists undermine the importance of this distinction by two moves. First, they deny that this distinction is exhaustive. Putnam, for instance, argues that while some statements are analytic and others are synthetic, many are neither.[1] Second, since we decide whether a statement is analytic or synthetic by examining the meaning of the signs used within that statement, the causal theorists argue that this distinction is essentially a semantic distinction. And since it is a semantic distinction, the causal theoriests restrict the analytic/

synthetic distinction to semantics.[2]

When it comes to the a priori/a posteriori distinction, the causal theorists agree with the logical positivists that while a priori statements are independent of experience, a posteriori statements are not. But just as they restrict the analytic/synthetic distinction to a particular area so do they also restrict the a priori/a posteriori distinction. Since this distinction concerns the grounds and nature of knowledge, the causal theorists argue that it is fundamentally an epistemological distinction. And since it is an epistemological distinction, the causal theorists restrict the a priori/a posteriori distinction to epistemology.[3]

When it comes to the necessary/contingent distinction, the causal theorists agree with the logical positivists that a statement is necessary if it is impossible that it is false and it is contingent otherwise. But once again, they restrict this distinction. The causal theorists argue that this distinction is basically a metaphysical distinction. And since it is a metaphysical distinction, the causal theorists restrict the necessary/contingent distinction to metaphysics.[4]

By restricting these distinctions to particular areas, the causal theorists have, in effect, divorced the necessary/contingent distinction from both the a priori/a posteriori distinction and the analytic/synthetic distinction.

The causal theorists argue that these three distinctions are independent. And since these distinctions are independent, we cannot conclude anything about a statement's semantical or epistemological status on the basis of its metaphysical status. Simply because a statement is necessary, we cannot conclude that it is also analytic and a priori. And thus, we cannot rule out the possibility that certain statements are both necessary and a posteriori.

Proper Names and Necessary A Posteriori Statements

The causal theorists identify two classes of statements that are both necessary and a posteriori. The first class, as we have already noted, consists of statements such as

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

The second class consists of statements such as

(4) Currer Bell is Charlotte Bronte.
(5) Jolmo Lungma is Mt. Everest.
(6) The Malvinas Islands are the Falkland Islands.

The causal theorists believe that these two classes are analogous. Statements (1)-(3) are necessary for much the same reason that statements (4)-(6) are necessary. In fact, to understand just why statements (1)-(3) are necessary, we need to first understand why statements (4)-(6)

are necessary.

Since it is clear that we cannot verify the truth of statements (4)-(6) by the use of reason alone or by linquistic analysis, there should be little debate over the claim that these statements are a posteriori. In order to know that Currer Bell is Charlotte Bronte, we need some empirical evidence like an admission from Bronte herself or from some member of her publishing company. To know that Jolmo Lungma is Mt. Everest, we need to ask both Tibetans and non-Tibetans the name of a particular mountain. To know that the Malvinas Islands are the Falkland Islands, we need to ask both the Argentine government and the British government the name of two small islands in the Atlantic Ocean. In each case, we need some sort of empirical evidence.

While it is obvious that statements (4)-(6) are a posteriori, it is less obvious that they are necessary. As a matter of fact, we may even be tempted to argue that these statements are contingent. It is certainly contingent that Charlotte Bronte chose to publish her first novel under the pseudonym 'Currer Bell'. It is certainly contingent that the Tibetans chose to name a particular mountain Jolmo Lungma while the British chose to name it Everest. It is certainly contingent that while the Argentines chose to call two islands by one name, the British chose another. All this seems to suggest that statements (4)-(6) are

contingent. But the causal theorists argue that such a suggestion is mistaken. Statements (4)-(6), contrary to what we may think, are actually necessary.

To understand why the causal theorists believe that these statements are necessary, we need to first understand their analysis of proper names. For much of this century, the issue of proper names came down to a choice between two theories. There was Russell's theory and there was Wittgenstein's. Kripke, in Naming and Necessity, argues that while these theories pose as competitors, they are, for all intents and purposes, the same theory. They are both descriptive theories of meaning. While Russell argues that a name is an abbreviation for a definite description, a description that holds only for the referent of that name, Wittgenstein argues that a name is an abbreviation for a cluster of descriptions, some of which may be false but of which a sufficient number hold for the referent of that name. They may disagree on the number of required descriptions, but both Russell and Wittgenstein agree that a name is an abbreviation for some number of descriptions.

Consider the name 'Aristotle'. There are any number of definite descriptions associated with this name: 'the last great philosopher of antiquity', 'the most famous pupil of Plato', 'the teacher of Alexander', 'the author of the Metaphysics'. According to Russell, the name 'Aristotle' is simply an abbreviation for some description of

this type; and it is the description that gives 'Aristotle' its meaning. According to Wittgenstein, 'Aristotle' is not the abbreviation for some single description but for a cluster of descriptions; and it is this cluster that gives 'Aristotle' its meaning. In either case, the meaning of the name is due to description.

In Naming and Necessity, Kripke argues that the problem with such an account is that it fails in counterfactual situations. Suppose 'Aristotle' is an abbreviation for the definite description 'the last great philosopher of antiquity'. Now suppose that Aristotle had chosen medicine over philosophy. He certainly could have made such a choice. But if Aristotle had chosen a career in medicine, the description 'the last great philosopher of antiquity' would refer to someone other than Aristotle; so if the name 'Aristotle' is an abbreviation for 'the last great philosopher of antiquity', then the name 'Aristotle' no longer refers to Aristotle. But our intuitions are very clear that 'Aristotle' would still refer to Aristotle. When we say that Aristotle might have gone into medicine, we are specifically using 'Aristotle' to refer to Aristotle in a counterfactual situation where Aristotle is not the last great philosopher of antiquity.

Nor are things much better if we rely upon a cluster of descriptions rather than a definite description. Not only can we conceive of a counterfactual situation where

Aristotle chose medicine over philosophy but we can also conceive of situations where he was not the most famous pupil of Plato, where he was not the tutor of Alexander, where he did not write the Metaphysics. As Kripke points out, we can conceive of a counterfactual situation for almost any description that applies to Aristotle. In such a case, if the cluster of descriptions refer to anyone, it is not Aristotle. And once again, the name 'Aristotle' no longer refers to Aristotle, contrary to our intuitions.

The major presupposition that underlies the descriptive theory of meaning is that the sense of a name, which is given by either a definite description or a cluster of descriptions, constitutes its meaning. It is this presupposition, according to the causal theorists, that is false. Kripke argues that names do not obtain their meaning from their sense. (In fact, Kripke does not even believe that names have a sense.) He argues that names, instead, obtain their meaning from their reference. The name, 'Aristotle', for example, obtains its meaning by a certain causal connection to Aristotle. 'Aristotle' is nothing more than the tag we use to refer to a particular person. And it is the person that gives the name its meaning. This is not to say that description is pointless. Descriptions may be used to fix a reference. For example, if someone were to ask me who Aristotle was, I might very well reply that Aristotle

was the last great philosopher of antiquity. After all, it is easier to supply a definition than it is to supply Aristotle. But fixing a reference is not the same thing as fixing a meaning.

This account of meaning has the advantage over the descriptive theory in that it has no problems with counterfactual situations. Since names are tags that we use to refer to particular entities, we can continue to use them in counterfactual situations. Kripke argues that names are rigid designators. They designate, or pick out, the same entities in every counterfactual situation or in every possible world. The name 'Aristotle' not only allows us to pick out Aristotle in this world but in every possible world (or at the very least, in every possible world where Aristotle exists). Descriptions, on the other hand, are not rigid designators. The description 'the last great philosopher of antiquity' may pick out Aristotle in this world; but it does not pick out Aristotle in every possible world.

It is the fact that names are rigid designators that explains why statements (4)-(6) are necessary. Consider (4). The name 'Charlotte Bronte' picks out the same entity in every possible world. 'Currer Bell', although a pseudonym, is also a name; and as such, it too picks out the same entity in every possible world. In this world, 'Charlotte Bronte' and 'Currer Bell' designate the same object. But

if they designate the same object in this world, and since they are rigid designators, they must designate the same object in every possible world. Thus, the statement 'Currer Bell is Charlotte Bronte', if true in this world, is true in every possible world. This means that it is impossible for statement (4) to be false--it must be true; and thus, (4) is necessary. Similar arguments can be made for statements (5) and (6). In general, Kripke argues that if we have an identity statement '$R_1=R_2$', where R_1 and R_2 are rigid designators, then if that statement is true, it is necessarily true.[5]

Kripke argues that statements (1)-(3) are analogous to statements (4)-(6). These statements, too, are both necessary and a posteriori. There should be little debate over the claim that (1)-(3) are a posteriori. It was an empirical discovery, after all, that heat is caused by the motion of atoms and molecules. It was an empirical discovery that gold is the element with atomic number 79. It was an empirical discovery that water is H_2O.

The causal theorists argue that the same sort of analysis that proved the necessity of statements (4)-(6) also proves the necessity of statements (1)-(3). The causal theorists argue that natural kind terms, terms such as 'heat', 'gold', and 'water', are analogous to proper names. In fact, we should think of natural kind terms as the names for natural kinds. And just as proper names

obtain their meaning from their reference so too do the terms for natural kinds obtain their meaning from their reference. 'Water', for example, obtains its meaning by a certain causal connection to water. 'Water' is nothing more than the tag we use to designate a particular kind of substance. And it is this substance that provides 'water' with its meaning.

Since natural kind terms are analogous to proper names, we can now understand why statements (1)-(3) are necessary. Natural kind terms, like proper names, are rigid designators. While a proper name designates the same entity in every possible world, a natural kind term designates the same substance (or phenomena or species) in every possible world. Kripke argues that statements (1)-(3), as theoretical identities, involve two rigid designators. For example, consider (3). As a natural kind term, 'water' designates the same substance in every possible world. While 'H_2O' is not exactly a name for a natural kind, it is a name for a chemical kind; and as such, it, too designates the same kind in every possible world. In this world, 'water' and 'H_2O' designate the same substance. Since they designate the same substance in this world and since they are rigid designators, they designate the same substance in every possible world. This means that the statement 'Water is H_2O', if it is true in this world, (which it is), is true in every possible world. Thus, we

may conclude that statement (3) is necessary. And according to Kripke, similar arguments can be made for (1) and (2).[6]

But at this point, we may have a few niggling doubts about this account. We may agree with Kripke that natural kind terms obtain their meaning from their reference. We may agree that natural kind terms are rigid designators. We may agree that statements (1)-(3) are both necessary and a posteriori. We may even agree that the statement 'Water is H_2O' is necessary for exactly the reason that Kripke gives. But we soon run into one little problem. The phrases 'the form of energy constituted by the motion of atoms and molecules in solids' and 'the element with atomic number 79' bear a suspicious resemblance to definite descriptions. In fact, the more cynical among us may even claim that 'H_2O' is actually a definite description rather than a name of a chemical kind. But this makes it rather difficult to argue that statements (1)-(3) owe their necessity to the fact that we have two rigid designators that name the same substance.

This suggests that statements (1)-(3) are not entirely analogous with statements (4)-(6). This does not imply that statements (1)-(3) are therefore contingent; but it does imply that if these statements are necessary, their necessity hinges on grounds other than those for (4)-(6). This should not surprise us. If we compare statements

(4)-(6) with statements (1)-(3), we intuitively feel that the latter are, in some sense, necessary while the former are, in some sense, contingent. This is because we feel that statements (1)-(3) express something essential about the nature of their subjects while (4)-(6) do not. However necessary statements (4)-(6) may be, the fact remains that they are also trivial. They say nothing of any importance about the nature of their subjects.

Underlying Assumptions

Although the causal theory provides an account of natural kind terms, it does not provide an account of natural kinds. But why is this important? Basically, it is important because while natural kind terms may be alike, natural kinds are not. Hull, for example, writes that

> From the beginning, a completely satisfactory explication of the notion of a natural kind has eluded philosophers. One explanation for this failure is that the traditional examples of natural kinds in the philosophical literature have been geometric figures, biological species, and physical elements. By now it should be clear that all three are very different sorts of things. No wonder a general analysis, applicable equally to all of them, has eluded us. [7]

But so long as natural kind terms are alike, why should we care if natural kinds are not? There is no reason why we cannot agree with Hull that there are different sorts of natural kinds while we still agree with the causal theorists that natural kind terms obtain their meaning from

their reference. Only the issue of meaning is relevant for the causal theory. Or is it?

Let us assume that Hull is correct. Let us assume that there are different sorts of natural kinds. And let us assume further that these different sorts are the sorts that Hull identified--geometric figures, biological species, and physical elements. Now consider the following statements:

(a) The triangle is a plane figure with an area enclosed by three straight lines.
(b) The snow rose is the Hellaborus niger.
(c) Gold is the element with atomic number 79.
(d) Currer Bell is Charlotte Bronte.

We already noted that the causal theorists believe that (c) and (d) are necessary for substantially the same reason. We also noted that this claim is incorrect. But perhaps the causal theorists merely chose the wrong example. By keeping in mind that natural kinds are not alike, we can develop a slightly different analysis:

	essence	non-essence
a priori	(a) The triangle is a plane figure with an area enclosed by three straight lines.	(b) The snow rose is the Hellaborus niger.
a posteriori	(c) Gold is the element with atomic number 79.	(d) Currer Bell is Charlotte Bronte.

figure 1

The advantage of this chart is that it gives a more accurate picture of which statements are analogous and for what reasons. While the vertical axis says something about the epistemic status of our four statements, the horizontal axis says something about the source of their necessity. As we can see, while statements (c) and (d) are analogous in that they are both a posteriori, they are not analgous in the source of their necessity.

When it comes to the source of their necessity, statements (a) and (c) are analogous. Both (a) and (c) owe their necessity to the fact that they express the essence of their subjects. (Granted, we may believe that (a), as the definition of 'triangle' only expresses a nominal essence while (c) expresses an Aristotelian essence; but for the time being, let us treat (a) and (c) as though they are completely analogous in this respect.) Both (a) and (c) express the essence of their subjects in terms of a definite description. Since many causal theorists accept essentialism,[8] they can certainly accept the necessity of (a) and (c). But should they? Offhand, it may seem as though they should not. After all, they have already rejected description when it comes to the meaning of natural kind terms. So, how can they suddenly rely upon description when it comes to the essence of a natural kind?

The answer to this question is that while the causal theorists reject any role for description when it comes to

the meaning of a natural kind term, they allow description a role in fixing the reference of that term. Perhaps it is true that natural kind terms, such as 'gold', obtain their meaning by a causal connection to gold. But still, how do we decide what is gold? Natural kind terms may obtain their meaning from their reference; but what is included within this reference is often open to question. Compared to the referent of a proper name, the reference of a natural kind term is somewhat open--a fact acknowledged even by the causal theorists. So, how do we determine the reference of a natural kind term? Putnam writes that

> The use of a word such as 'gold' depends upon our possessing paradigms, standard examples that are agreed to be model members of the kind. ... What makes something gold is having the same nature as the paradigm. [10]

And how do we decide that something has the same nature as our paradigm? We rely upon description.

Once we have our paradigm, we choose certain properties to characterize that paradigm. These properties (or descriptions) then permit us to identity additional members of that kind. But this set of properties does not constitute any sort of meaning. For one thing, it is subject to change. Kripke goes so far as to argue that it is the task of science to produce better sets of properties. He writes that

> ...science attempts by investigating basic structural traits to find the nature, and thus the essence (in the

philosophical sense) of the kind.[11]

As scientists discover the basic structure that members of a kind share, they reflect this knowledge in their choice of properties that characterize that kind.

Yet when it comes to certain natural kinds, it seems as though scientists have actually discovered the essence of the kind. Sober writes that

> A paradigm case [of essentialism] has been the periodic table of elements, which seems to tell us that the essence of each element is its atomic number. ... The atomic number 14 is a characteristic that all and only Nitrogen atoms share, and that an atom must have this atomic number if it is to be Nitrogen. Essentialism of this sort holds that it is no accident that the property of being an atom of Nitrogen and that of having a given atomic number go together; indeed they must covary since the atomic number is the nature or essence of Nitrogen. [12]

Or let's consider gold. Being the element with atomic number 79 is not some mere property of gold--it is the defining property. This property tells us what gold is. If something is gold, it must have atomic number 79; and if anything has atomic number 79, then it is gold. This is because the statement 'Gold is the element with atomic number 79' expresses the essence of gold. Or, according to Aristotelian terminology, this statement gives the "real" definition of gold.

Since the causal theorists divorced a statement's metaphysical status from its epistemic status, it should

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not bother us that although (a) and (c) are both necessary, one is a priori while the other is a posteriori. We can use the same method to discover the essence of either kind. And this method has been described by Aristotle. According to Aristotle, if we wish to find the essence of a kind, we begin with induction and then follow a method of division. He writes

> We must start by observing a set of similar--i.e., specifically identical--individuals, and consider what element they have in common. We must then apply the same process to another set of individuals which belong to one species and are generically but not specifically identical with the former set. When we have established what the common element is in all members of this second species, we should again consider whether the results established possess any identity and persevere until we reach a single formula, since this will be the definition of the thing. [13]

This process, however, can be either a priori or a posteriori. In the case of triangles, we start by examining various triangles and seeing what features these triangles have in common. But since triangles are mental entities, we can carry out this examination by the use of reason alone. In the case of gold, we start by examining our paradigmatic examples and seeing what features these examples have in common. But since gold is a physical element, we need experience to carry out this examination. Yet in either case, the process is similar.

While statements (c) and (d) may not be analogous in

the source of their necessity, as the causal theorists thought, statements (b) and (d) are. If the causal theorists had compared (b) to (d), their argument would have been much stronger. Certainly 'snow rose' and 'Hellaborus niger' are comparable to proper names. Hull argues that the names for biological species, whether a taxonomic name or an ordinary name, obtain their meaning from their connection to the species and not from some description. Although Hull points out that he is not a causal theorist, he makes much the same points that they do when he writes

> As important as the traits listed in [zoological] diagnoses and descriptions may be for a variety of purposes, they are not definitions. Organisms could possess these traits and not be included in the taxon; conversely, organisms could lack one or more of these traits and be clearcut instances of the taxon. [14]

Hull continues to borrow features from the causal theory when he stresses the similarities between the names of biological species and proper names. While the following passages are taken from Hull, they could have just as easily been written by Kripke.

> A taxon [species] has the name it has in virtue of the naming ceremony, not in virtue of any trait or traits it might have. If the way in which taxa are named sounds familiar, it should. It is the same way in which people are baptized. [15]

> If 'homo sapiens' is or is not a cluster concept, it will be for the same reason that 'Moses' is or (more likely) is not. [16]

Hull mentions that if philosophers examined how scientists designate biological entities like tigers or mallards or the snow rose, they would have found "rules explicitly formulated in the various codes of nomenclature which were in perfect accord with Kripke's analysis--but for the wrong reasons."[17] By "wrong reasons", Hull is referring to Kripke's essentialism. Scientists, according to Hull, do not even attempt to find essences. Hull accepts Kripke's account on meaning; but he rejects Kripke's essentialism.

As a matter of fact, we need not presuppose any sort of essentialism for either (b) or (d). In the preceding section, we did not need to presuppose essentialism to argue that (d) was necessary. Nor do we need to presuppose essentialism to argue that (b) is necessary. Since species names function like proper names, they are rigid designators. The name 'snow rose' designates the same kind in every possible world; and the name 'Hellaborus niger' also designates the same kind in every possible world. In this world, 'snow rose' and 'Hellaborus niger' designate the same kind. Since they are rigid designators, and since they designate the same kind in this world, they designate the same kind in every possible world. Thus, statement (b) is necessary. The very same sort of argument that justifies the claim that 'Currer Bell is Charlotte Bronte' is necessary also justifies the claim that 'The snow rose is the Hellaborus niger' is necessary. And neither argument

relies in any way on essentialism.

While (a) and (c) owe their necessity to essentialism, (b) and (d) owe their necessity to some other assumption. In the arguments we have seen, both in the preceding section and this section, the causal theorists appeal to our intuitions. And many of the assumptions that underlie these intuitions remain implicit. In "Identity and Necessity", Kripke provides a formal version of this intuitive argument. And in this formal version, implicit assumptions become explicit.

Kripke's argument goes like this

(i) $(x)(y)[(x=y)\rightarrow(Fx\rightarrow Fy)]$.

This premise states that if x is y, then any property of x is also a property of y.

(ii) $(x)\Box(x=x)$.

This premise is the principle of self-identity which states that everything is necessarily identical to itself.

(iii) $(x)(y)(x=y)\rightarrow[\Box(x=x)\rightarrow\Box(x=y)]$.

This premise is a substitution instance of (i). From (iii) and (ii), we can infer the following:

(iv) $(x)(y)[(x=y)\rightarrow\Box(x=y)]$.

This conclusion states that if x is y, then x is necessarily y. Kripke makes it very clear that the substitution instances for x and y must be rigid designators and not descriptions. If we substitute rigid designators for x and y, and these designators refer to the same thing, they do

so necessarily. On the other hand, if we substitute descriptions for either x or y, and they refer to the same object, they only do so contingently. On the basis of this, we may argue that if the statements 'Currer Bell is Charlotte Bronte' and "The snow rose is the Hellaborus niger' are true, they are necessarily true.

This argument makes explicit an assumption that up until now has only been implicit. This assumption is the principle of self-identity. Statements such as (b) and (d) owe their necessity to this principle. Without it, we cannot argue that these statements are necessary. This fact is made explicit in the second argument. But the principle of self-identity is also assumed in the first argument, albeit implicitly. When we argue that the statement 'Currer Bell is Charlotte Bronte' is necessary, we are relying implicitly upon the fact that this statement follows from the fact that Currer Bell is Charlotte Bronte and the fact that Currer Bell is necessarily Currer Bell. If it were not true that everything is necessarily identical to itself, then it would not be true that Currer Bell is necessarily identical to Charlotte Bronte where Currer Bell is Charlotte Bronte.

This second argument is also interesting in that it makes it obvious that we justify the necessity of statements (b) and (d) via an a priori argument. Whatever their epistemic status may be, their metaphysical status is de-

termined by an a priori argument. And this is just as true of (d) as it is for (b). In the case of (b), it may strike us as odd that the metaphysical status of an a posteriori statement can be determined by an a priori argument. But when we argue that (b) and (d) are necessary, we are relying upon the following inference pattern (where once again, the substitution instances for x and y are rigid designators).

(i) $x=y$.
(ii) $(x=y)\rightarrow\Box(x=y)$.
(iii) $\Box(x=y)$.

The conclusion, (iii), owes its metaphysical status to premise (ii). This premise, (ii), is merely a simplified version of the conclusion from Kripke's argument in "Identity and Necessity". The fact that premise (ii) is necessary explains why our conclusion is also necessary. The conclusion owes its epistemic status, however, to premise (i). In the case of (d), we justify the truth of premise (i) empirically. Thus, the conclusion will be a posteriori. In the case of (b), we justify the truth of premise (i) without the use of experience. Thus, the conclusion is a priori.

Although statement (b) resembles (d) on metaphysical grounds, since (b) is a priori, the causal theorists cannot use it to justify their claim that certain statements are necessary and a posteriori. Or could they? Certainly it is true that philosophers, in the past, believed that (b)

was necessary and a priori. Hahn, for example, writes

> I talk about a well-known plant... and I make the stipulation: Let us call any plant of this kind "snow rose," but let us also call it "hellaborus niger." Thereupon I can pronounce with absolute certainty the universally valid proposition: "every snow rose is a hellaborus niger." It is certainly valid, always and everywhere: it is not refutable by any sort of observation. ...The statement merely expresses a convention concerning the way we wish to talk about the plant in question. [18]

But is Hahn correct?

According to Hahn's account, the statement 'The snow rose is the Hellaborus niger' is analogous to the statement 'A bachelor is an unmarried man' in that each expresses some sort of linquistic convention. We choose to use 'Hellaborus niger' as the taxonomic name for a particular kind of plant just as we choose to use 'bachelor' as a name for a particular class of humans. The problem, though, is that Hahn's account applies just as easily to the statement 'Currer Bell is Charlotte Bronte' as it does to 'The snow rose is the Hellaborus niger'. After all, didn't Bronte stipulate that she was to be known as Currer Bell in a certain situation? Thus, if the statement 'The snow rose is the Hellaborus niger' is a priori, then so is 'Currer Bell is Charlotte Bronte'.

We can also argue that if 'Currer Bell is Charlotte Bronte' is a posteriori, then so is 'The snow rose is the Hellaborus niger'. It is not that unusual for botanists,

particularly botanists who work in the rain forest, to give a particular species a taxonomic name before they discover that the plant has a folk name. In such a case, couldn't we say that the botanists have made an empirical discovery? Isn't such a discovery just as empirical as the discovery that Currer Bell is Charlotte Bronte?

The a priori/a posteriori distinction is not as clear-cut for statements such as 'The snow rose is the Hellaborus niger' and 'Currer Bell is Charlotte Bronte' as we might like. The problem is that these statements concern names. And naming concerns conventions. We tend to describe conventions as a priori. But our knowledge of a particular convention may very well be a posteriori. And our knowledge that two conventions coincide may also be a posteriori.

De Re or De Dicto?

Towards the beginning of this chapter, we brought up two classes of statements. One class consisted of statements such as

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

The second class consists of statements such as

(4) Currer Bell is Charlotte Bronte.
(5) Jolmo Lungma is Mt. Everest.
(6) The Malvinas Islands are the Falkland

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The causal theorists claim that both classes consist of statements that are both necessary and a posteriori. This is an important point to reiterate. For while the causal theorists are mistaken in their belief that these two classes are analogous, they are not mistaken in their belief that the statements in both classes are necessary and a posteriori. But if these statements are necessary and a posteriori, then we need some account of necessity other than that of logical positivism.

Earlier in this chapter, we noticed that while the causal theorists, accept, more or less, the logical positivist's version of the necessary/contingent distinction, they restrict this distinction to metaphysics. But there is yet another difference between the logical positivist's version of the necessary/contingent distinction and the causal theorist's. This difference concerns the nature of necessity. Or to be more precise, it concerns the nature of necessity as a modal property.

Necessity is a modal property. As such, it is either de dicto or de re. If it is de dicto, then it is a property that is predicated of statements. If it is de re, then it is a property that is predicated of objects or things. Consider the following two statements:

(i) A Bachelor is an unmarried man.
(ii) Gold is the element with atomic number 79.

Both statements express necessary truths. But in the case of statement (i), it is only the statement that is necessary. We certainly do not believe that particular individuals, who happen to be bachelors, are necessarily bachelors and therefore necessarily unmarried. In the case of (ii), it is the object gold that is necessarily the element with atomic number 79. Statement (ii) is necessary only because gold is the sort of thing that is necessarily the element with atomic number 79. In one case, necessity is predicated only of a statement. In the other case, necessity is predicated of an object. Thus, in one case, necessity is de dicto while in the other case, it is de re.

Why is this distinction between necessity de dicto and necessity de re so important? Basically, it is because the logical positivists acknowledge necessity only as a de dicto property. This is hardly surprising since they equate necessity with analyticity; and analyticity is a property that belongs only to statements. But this also means, as we saw in chapter one, that the logical positivists are also forced to acknowledge necessity as an a priori property.

The causal theorists, on the other hand acknowledge necessity as both a de dicto and a de re property. In fact, statements (1)-(6) are all necessary de re. Consider (2). As we already saw, this statement is necessary because gold is necessarily the sort of object that is the element with atomic number 79. Now consider (4). Thanks

to the principle of self-identity, Currer Bell is necessarily the sort of object that is Charlotte Bronte. The statements in our two classes may not have been analogous in quite the way that the causal theorists thought; but they are analogous in that they are all necessary de re. And it is the fact that they are necessary de re that explains why they are a posteriori. While gold is necessarily the sort of object that is the element with atomic number 79, we only discover that gold is the element with atomic number 79 through experience. And while Currer Bell is necessarily Charlotte Bronte, we only discover that Currer Bell is Charlotte Bronte through experience.

Yet many philosophers continue to reject de re modalities. Consider statements (1)-(3). These statements owe their necessity to the fact that they express the essence of their subjects. But many philosophers believe that this sort of necessity only makes sense within some sort of context. Quine, for example, writes that

> Mathematicians may conceivably be said to be necessarily rational and not necessarily two-legged; and cyclists necessarily two-legged and not necessarily rational. But what of an individual who counts among his eccentricities both mathematics and cycling? Is this individual necessarily rational and contingently two-legged or vice versa? Just insofar as we are talking referentially of the object, with no special bias toward a background grouping of mathematicians as against cyclists or vice versa, there is no semblance of sense in rating some of his attributes as necessary and others as contingent. [19]

Quine's point is this: properties are necessary or contingent only within a particular context. If we are focusing on an individual as a mathematician, then rationality is a necessary property. But it is a necessary property within this context. If we focus on this individual as a cyclist, then two-leggedness is a necessary property. But again, it is a necessary property only within this context. If we wrench this individual from these contexts, then it does not make sense to describe either rationality or two-leggedness as necessary.

Quine's point becomes pertinent once we realize that statements (1)-(3) are necessary only within a particular context. Statements (1)-(3) express the essence of their subjects only within a context where we are interested in the internal structure of heat, gold, and water. Without this context, we have no reason to suggest that the internal structure of heat, gold, and water is somehow more important than their other properties. In fact, in some other context, we may not even consider these properties necessary. For example, the fact that gold has a particular atomic number is absolutely irrelevant when it comes to economics.

Or consider statements (4)-(6). These statements owe their necessity to the principle of self-identity. Mackie suggests that

> ...these de re modalities are, in a very broad sense, de dicto after all. Though

> these necessities apply to individual things and natural kinds, that they so apply is primarily a feature of the way we think and speak, of how we handle identity in association with counterfactual possibility. They reflect implicit rules for the ascription of identity, for the recognition of the same person or thing or stuff or species, in neutrally described merely possible situations. The topic of names (and certain general terms) comes in only because such names (etc.) are intended to belong to things (etc.) whose identity is determined by these rules. [20]

Insofar as we follow certain rules in talking and theorizing about Currer Bell and Charlotte Bronte, for example, the statement 'Currer Bell is Charlotte Bronte' can be described as de dicto. Even though the principle of self-identity applies to Currer Bell and Charlotte Bronte as objects, the fact that this principle applies to these objects is due to the way we talk and think.

Thus, we can argue that statements (1)-(6) are actually necessary de dicto. An object, by itself, may have various properties, but these properties are neither necessary or contingent until we consider those properties within a particular context. The fact that we choose to describe certain properties of an object as necessary within a given context reflects our interests and theories about that object. The fact that we choose to handle identity and self-identity in a particular manner reflects the way that we talk and think. But if we decide which properties are necessary, and if we base this decision on our

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theories, then necessity is, in a broad sense, de dicto. The object simply has properties. Whether these properties are necessary or not depends upon us, not the object.

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Chapter Three

In chapter two, we learned that the causal theorists categorized the following statements as both necessary and a posteriori:

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

Now while this suggestion fits nicely with our intuitions, it is by no means the only suggestion that philosophers have made.

A great many philosophers argue that the reason why statements (1)-(3) prove so difficult to classify is because our distinctions are fundamentally flawed. These philosophers argue that the logical positivists did not err in misunderstanding the nature of their distinctions; they erred in accepting these distinctions in the first place. And according to these philosophers, rather than tinker around with the traditional distinctions, we should simply reject them altogether. And this conclusion becomes even more compelling once we adopt a particular theory of meaning.

The Network Theory

For the past thirty years, several philosophers have proposed various theories of meaning that are commonly described as network theories of meaning. Among the

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philosophers who proposed such theories are Churchland (Scientific Realism and the Plasticity of Mind), Field ("Logic, Meaning, and Conceptual Role"), Hanson ("Causal Chains"), Harman ("Conceptual Role Semantics"), Kuhn (The Structure of Scientific Revolutions), Lewis ("Psychophysical and Theoretical Identifications"), and Loar (Mind and Meaning). While these various theories differ in many respects, they all agree that the meaning of a term is given by its role and position within a theoretical network. Even those terms which are commonly defined by means of necessary and sufficient conditions actually depend upon some sort of theoretical context for their meaning.

To a certain extent, the claim that the meaning of a term depends upon its theoretical context is quite plausible. Take the term 'castling' from chess. If we consulted a chess dictionary, we would find something like the following:

> castling: a move in chess that is accomplished by first moving the King two squares along the first rank in the direction of the Rook that is to be used; and then moving the Rook to the other side of the King and placing it on the square immediately next to the King. [1]

Obviously, in order to understand this definition, we need to know what is meant by 'King', 'Rook', 'square', and 'rank'. But if our entire knowledge of castling consisted of this definition, then we can hardly be said to understand the meaning of the term 'castling'. To understand

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'castling', we also need to know a few rules of chess, particularly those rules that govern castling. To understand 'castling', we should recognize the move when we see it. To understand 'castling', we should be able to make the move ourselves. Thus, to understand 'castling', we need to know a fair amount about chess. And as a matter of fact, when we first learn chess, we do not learn a few terms and rules in isolation. Rather, we are given a great deal of information about the game as a whole from the very start.

The network theorists claim that all terms resemble 'castling' in respect to the fact that all terms obtain their meaning within some sort of theoretical context. Take the term 'group' from algebra, for example. 'Group' has a very precise definition that is given by means of necessary and sufficient conditions.

> A group is a nonempty set that is closed under a binary operation and that meets the following conditions:
> (i) The associative law holds.
> (ii) There is an identity element.
> (iii) Every element has an inverse.

But to understand this definition, we first need to know what is meant by 'set', 'binary operation', 'associative law', 'identity element', and 'inverse element'. By the time we know all this, we have more than a fleeting acquaintance with mathematics. Thus, while we may define 'group' by means of necessary and sufficient conditions, the fact remains that these conditions are understood only

within the context of mathematics.

This view is also plausible when it comes to "theoretical" terms--terms such as 'quark', 'atom', 'force', 'DNA', 'gene', and 'energy'. After all, we describe these terms as theoretical to emphasize the fact that they occur within various theories. Yet many theoretical terms, especially those from physics, are defined in terms of equations. In the case of 'energy', for example, we have the equation '$e=mc^2$'. Couldn't we argue that this equation provides the full meaning of 'energy'? Not according to the network theorists. They agree with Putnam when he writes

> The concept 'energy' is an excellent example of a law-cluster concept. It enters into a great many laws. It plays a great many roles, and these laws and inference roles constitute its meaning collectively, not individually. [2]

Despite our equation for energy, Putnam argues that the meaning of 'energy' is not given by a single defining law or a single defining characteristic. Rather, it takes its meaning from its overall role and position within physics. The term 'energy' is best understood within the overall context of physics.

Although we may be willing to concede that game terms and terms from mathematics and science obtain their meaning from their theoretical context, we may not believe that all terms obtain their meaning from their context. For example, consider observation terms--terms such as 'hot', 'soft', 'white', or 'sweet'. Intuitively, we tend to think

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that these terms obtain their meaning from their connection to a particular sensation. 'Hot' means the sensation hot, for example. But the network theorists argue that even these terms obtain their meaning from their role and position within a theoretical network. But how can they justify this claim?

They could justify this claim by appealing to Wittgenstein's point that even observation terms have public criteria for their use. If I describe newly fallen snow as red, for example, few people, apart from my optometrist and physician, will care what my visual sensation happened to be. Perhaps it was red or perhaps it was white. But most people will simply say that my description is incorrect. This is because we have public criteria for our use of color terms. Taking this point, network theorists can argue that public criteria are provided by some sort of theoretical network.

Churchland supports this claim by means of the following thought experiment. He proposes that we imagine a species of beings who perceive temperature visually. According to Churchland, the world looks to them much as it looks to us in black-and-white pictures taken with infrared sensitive film. Next, Churchland asks us to imagine that these beings speak a language that resembles English in every respect but two: First, their language lacks a color vocabulary. And second, the temperature vocabulary is

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learned visually rather than tactilely. So, Churchland asks, how should we interpret their terms 'hot', 'warm', and 'cold'? If we believe that sensation terms obtain their meaning from their relationship to a sensation, then we should interpret their terms 'hot', 'warm', and 'cold' as 'white', 'gray', and 'black'. After all, the sensation that these beings call 'hot' is the sensation that we call 'white'.

But such a translation seems incorrect. Our intuition is that these beings mean the same thing by 'hot' that we mean by 'hot'. Moreover, Churchland points out that such a translation also makes many of their beliefs about temperature incorrect. Churchland concludes from this that observation terms do not obtain their meaning from sensation. He writes that

> The meaning of a term (or the identity of a concept) is not determined by the intrinsic quality of whatever sensation happens to prompt its observational use, but by the network of assumptions/beliefs/principles in which it figures. Sensations are just the causal middlemen in the process of perception, and one kind will serve as well as another so long as it enjoys the right causal connections. [3]

We happen to use tactile sensations to learn our temperature vocabulary. Churchland's beings use visual sensations to learn their temperature vocabulary. But so long as we share the same beliefs, assumptions, and principles about temperature as these beings, their temperature terms

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have the same meaning as our temperature terms. So long as we share the same theoretical network, terms have the same meaning.

We may or may not find the network theory of meaning convincing. But one reason why philosophers have felt drawn to this theory is because it is a response to logical positivism. Or to be more accurate, it is a response to the failure of logical positivism. But the reason for failure of logical positivism is the failure of the traditional distinctions. Many philosophers have adopted the network theory as they gave up the traditional distinctions.

What Happens to the Analytic/Synthetic Distinction?

As we know from Chapter One, the logical positivists draw the analytic/synthetic distinction as follows:

(LA) A statement is analytic if and only if its truth value is determined completely by linquistic convention.

(LS) A statement is synthetic if and only if its truth value is not determined by linquistic convention.

According to the network theorists, if we base the analytic/synthetic distinction on the notion of linquistic convention, then we cannot justify a sharp demarcation between those statements that we wish to describe as analytic and those that we wish to describe as synthetic.

The logical positivists believe that there are two

notions of analyticity. One type can be described as the logical notion of analyticity. The statements that fall under this type include statements such as 'Bachelors are bachelors' and 'Fv-F'. The linquistic conventions that determine the truth value of these statements are the conventions that govern our use of logical words and logical participles. Quine says that

> The logical truths, then, are those true sentences which involve only logical words essentially. What this means is that any other words, though they may also occur in a logical truth (as witness 'Brutus', 'kill', and 'Caesar' in 'Brutus killed or did not kill Caesar'), can be varied at will without engendering falsity. [4]

The second type of analyticity is what Putnam describes as the linquistic notion of analyticity. The statements that fall under this type include 'Bachelors are unmarried men' and 'Brothers are male siblings'. The conventions that govern these statements are synonymy relations. The statement 'Bachelors are unmarried men', for example, owes its truth to the fact that in English, 'bachelor' is synonymous with 'unmarried man'.

In 'Two Dogmas of Empiricism", Quine attacks the linquistic notion of analyticity. Quine argues that we cannot provide an account of synonymy that is not circular. How do we know that 'bachelor' is synonymous with 'unmarried man'? We could argue that they are synonymous because 'bachelor' is defined as 'unmarried man' in the dictionary.

But as Quine points out, the dictionary does not make 'bachelor' synonymous with 'unmarried man'--it only reports that 'bachelor' and 'unmarried man' are synonymous. We could argue that 'bachelor' and 'unmarried man' are synonymous because they are interchangeable. But what do we mean by "interchangeable"? Do we mean that they are interchangeable because they are extensionally equivalent or because they are intensionally equivalent? When we claim that 'bachelor' and 'unmarried man' are synonymous, Quine argues that we are making a stronger claim than that they are extensionally equivalent. 'Morning star' and 'evening star' are extensionally equivalent; but they are hardly synonymous. So, we want to claim that 'bachelor' and 'unmarried man' are interchangeable because they are intensionally equivalent. But how do we know when two terms are intensionally equivalent? According to Quine, when we say that two terms are intensionally equivalent, we mean that a statement that unites the terms, such as 'Bachelors are unmarried men', is analytic. Thus, to justify the analyticity of 'Bachelors are unmarried men' by the use of synonymy, we are already presupposing that the statement is analytic.

Quine attacks the logical view of analyticity in "Carnap and Logical Truth". Although logical and mathematical statements have, in the past, been described as true in virtue of their self-evidence, the logical positivists

argue that these statements owe their truth to linquistic conventions. But the linquistic conventions that apply to these statements do not depend upon relations of synonymy. Rather, we organize the truths of logic and mathematics into formal axiomatic structures. We then assign meanings to the axioms, definitions, and inference rules that belong to these structures. We stipulate the conventions that govern our use of these truths.

But Quine argues that this account is misleading. He points out that the axioms and definitions (and presumably the inference rules as well) of axiomatic structures are either discursive or legislative. If they are discursive, then we have chosen certain truths that allow us to derive the rest from a pre-existing set of truths. But as Quine points out,

> ...this is not truth by convention. The truths were there, and what was conventional was merely the separation of them into those to be taken as starting point (for the purpose of the exposition at hand) and those to be deduced from them. [5]

Neither discursive axioms or definitions can be said to institute truth by convention. We picked these truths to serve as axioms and definitions, in part, because we already knew that they were true. On the other hand, legislative axioms and definitions do institute truth by convention. In the case of legislative axioms and definitions, we explicitly adopt a convention. We stipulate that certain axioms and definitions are true; and thus, we can say

that they are true by convention.

The problem, however, is that this distinction between the legislative and the discursive describes only how we came to accept certain axioms and definitions--it does not describe these axioms and definitions themselves. Quine writes

> The distinction between the legislative and the discursive refers thus to the act, and not to its enduring consequences... So conceived, conventionality is a passing trait... It is a trait of events and not of sentences. [6]

Although we may adopt certain axioms and definitions on the basis of legislation, this does not mean that we continue to accept these axioms and definitions on the basis of convention.

Scientists, for example, could adopt a particular law on the basis of legislation. Putnam writes that

> The principle '$e=\frac{1}{2}mv^2$' may have been introduced, at least in our fable, by stipulation; the Newtonian law of gravity may have been introduced on the basis of induction from the behavior of the known satellite system and the solar system (as Newton claimed); but in subsequent developments these two famous formula were to figure on a par. [7]

According to Putnam's "fable", scientists adopted '$e=\frac{1}{2}mv^2$' on the basis of legislation. They stipulated that this statement was true. But after they adopted it, they treated it the same way they treated every other statement within their theory--they treated it as a synthetic statement. They may have adopted the statement by legislation; but

they continued to accept it on the basis of experience.

Since this distinction can apply to statements other than those of logic and mathematics, we cannot use the legislative/discursive distinction to justify a sharp demarcation between those statements that we wish to describe as analytic and those that we wish to describe as synthetic. We want to argue that analytic statements are true by convention while synthetic statements are not. The problem, as Quine points out, is that this notion of convention only explains how we came to adopt a statement as true. It does not explain why we continue to accept that statement as true. In fact, we may use convention to adopt a scientific law as well as a logical or mathematical axiom or definition. But if we wish to use the notion of convention to argue that the latter are analytic while the former is not, then we have already decided which statements are analytic and which are synthetic.

Although the network theorists reject the logical positivists' version of the analytic/synthetic distinction, a few, following in the footsteps of Putnam, accept a pragmatic version of the distinction. Consider the following three statements:

(i) Bachelors are unmarried men.
(ii) Vixens are female foxes.
(iii) Brothers are male siblings.

We tend to feel that these statements are analytic while the following statements are synthetic:

(iv) Bachelors are neurotic.
(v) Vixens are carnivores.
(vi) Brothers are obnoxious.

Even with Quine's arguments against the analytic/synthetic distinction, it still seems as though the statements in the first group owe their truth value to the meaning of the terms that are used within those statements while the statements in the second class do not owe their truth value to the meaning of their terms.

Putnam agrees with the logical positivists that statements (i)-(iii) are analytic while statements (iv)-(vi) are synthetic. He even agrees with the logical positivists that statements (i)-(iii) are true by linquistic convention. Putnam wants to argue that analytic statements are those statements that have one-criterion words as their subjects and the criterion for those words as their predicates. One-criterion words are those terms that are defined by means of a single law or a single characteristic. Analytic statements are those statements that connect a one-criterion word with its criterion. Putnam argues that such statements meet four criteria (which I have paraphrased):

(1) The statement can be rewritten in the form 'Something (someone) is an A if and only if it (he, she) is a B' where 'A' is a single word.

(2) The statement holds without exception; and it provides us with the criterion for something to be the sort of thing to which the term 'A' applies.

> (3) This criterion is the only one which is accepted and employed in connection with the term 'A'.
>
> (4) 'A' is not a law-cluster term. [8]

These four criteria enable us to know when a statement is analytic.

Statements (i)-(iii) meet these four criteria. Consider (i). When it comes to the first criterion, (i) can be rewritten as 'Someone is a bachelor if and only he is an unmarried man'. When it comes to the second criterion, (i) holds without exception. When it comes to the third criterion, being an unmarried male is the only criterion that is accepted for being a bachelor. When it comes to the fourth criterion, 'bachelor' is not a law-cluster term. The only role it plays in explanations is through its tie with 'unmarried man'. This is a point that even Quine recognizes when he writes

> One looks to 'unmarried man' as semantically anchoring 'bachelor' ... sever its tie with 'unmarried man' and you leave it ['bachelor'] with no very evident social determination, hence no utility in communication. [9]
>
> 'Brother', in its synonymy with 'male sibling' is essentially like 'bachelor' with its synonymy with 'unmarried man'. ...it is only the few verbal links that give the terms the fixity needed in communication. [10]

While statements (i)-(iii) meet these four conditions, statements (iv)-(vi), in contrast, do not.

But while Putnam resurrects the analytic/synthetic

distinction, he only resurrects it as a pragmatic distinction. It is no longer the distinction that it was with the logical positivists. Putnam's version of this distinction is rather limited. For one thing, he only resurrects the linquistic notion of analyticity. This means that while we can describe the statement 'Bachelors are unmarried men' as analytic, we cannot describe 'P v -P' as analytic. For another thing, Putnam's version depends upon one-criterion words; and by Putnam's own estimate, there are only a few hundred such words in English.[11] Moreover, a term that is a one-criterion word at one time may no longer be a one-critrion word at another time. Putnam argues that 'atom' is an example of a term that was once a one-criterion word that has now become a law-cluster term. So, the statement 'Atoms are indivisible', which philosophers once argued to be analytically true is now empirically false.[12]

Nor does Putnam believe that his version of the analytic/synthetic distinction is exclusive and exhaustive. Although he believes that some statements are most definitely analytic and other statements are most definitely synthetic, most statements are neither. Rather, analyticity can be a matter of degree. Putnam writes

> What these statements [the law of conservation of energy, 'there is a past', and 'bachelors are unmarried men'] reveal are different degrees of something like convention and different degrees of systematic import. [13]

Quine makes a similar point when he writes that

> There can be no doubt that sheer verbal usage is in general a major determinant of truth. Even so factual a sentence as 'Brutus killed Caesar' owes its truth not only to the killing but equally to our using the component words as we do. [14]

These passages suggest that the analytic/synthetic distinction falls along some sort of continuum. Those statements, which are clearly analytic, fall at one end of this continuum while those statements, which are clearly synthetic, fall at the other end of the continuum. But most statements fall somewhere in between these two extremes. Thus, we cannot use the analytic/synthetic distinction to divide all our statements into two exclusive and exhaustive classes.

What Happens to the A Priori/A Posteriori Distinction?

Putnam believes that this attack on the analytic/synthetic distinction is important primarily because it simultaneously does away with the a priori/a posteriori distinction.[15] Since the logical positivists equate a priori statements with analytic statements and a posteriori statements with synthetic statements, it should not surprise us that the collapse of one distinction leads to the collapse of the other. But should we be so quick to dismiss the a priori/a posteriori distinction? After all, the logical positivists drew this distinction in terms of experience.

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(LT) A statement is a posteriori if and only if its truth value is determined by experience.

Now it seems as though we could accept this distinction whether or not we accept the analytic/synthetic distinction. Even if we reject the analytic/synthetic distinction, it seems as though we could still argue that certain classes of statements, say those of logic and mathematics, are a priori while other classes of statements, say those of the empirical sciences, are a posteriori. Perhaps the logical positivists' mistake was not that they accepted the a priori/a posteriori distinction but that they based it on the analytic/synthetic distinction. But it is not quite so easy to divorce the a priori/ a posteriori distinction from the analytic/synthetic distinction as we might think.

The truth value of every a posteriori statement is determined by experience. The problem, however, is that while every a posteriori statement depends upon experience to some degree or other, not every a posteriori statement has quite the same relationship with experience. It is fairly easy to see how we use experience to verify the truth value of the statement 'The pen is in my hand'. It is not quite so easy to see how we use experience to verify the truth value of the statement 'Electrons circle the nucleus of the atom'. The logical positivists believed that a posteriori statements fell into one of two classes.

An a posteriori statement is either an observation statement or a theoretical statement. While we verify or falsify an observation statement directly by experience, we can verify or falsify a theoretical statement only indirectly by experience. The logical positivists argue that when it comes to theoretical statements, we can only determine their truth value once we "reduce", or translate, them to some set of observation statements. We can use experience to determine the truth value of a theoretical statement only because every a posteriori statement "is equivalent to some logical construct based upon terms which refer to immediate experience."[16]

But such a reduction proved difficult to carry out. In fact, as we know, the logical positivists were unable to reduce theoretical statements to some set of observation statements. The failure to effect this reduction is sketched by Hempel in "Empiricist Criteria of Cognitive Significance". Hempel traces the failure to reduce theoretical statements to observation statements by means of complete falsifiability, complete verifiability, and partial verifiability. He traces the failure to reduce the theoretical terms within a theoretical statement to a set of observation terms by means of explicit definitions and reduction rules. He traces the failure to tie theoretical terms within a scientific theory to experience by means of reconstructing that theory into a formal

axiomatic system. In each case, Hempel shows that this attempted reduction not only failed to exclude "metaphysical" nonsense but also failed to include various sorts of a posteriori statements.

What is interesting, though, is that once the logical positivists began to reconstruct scientific theories into formal axiomatic structures, they adopted a holistic position. They conceded that we cannot talk about the "experiential meaning" of a given statement in isolation. As Hempel points out

> A single sentence in a scientific theory does not, as a rule, entail any observation sentences; consequences asserting the occurrence of certain observable phenomena can be derived from it only by conjoining it with a set of other, subsidiary hypotheses. Of the latter, some will usually be observation sentences, others will be previously accepted theoretical sentences. [17]

In order to know the empirical implications of a particular statement, Hempel points out that we not only need to know other theoretical and observation statements, but we also need to know the logical and mathematical apparatus of the theory in which that sentence occurs.

But this holism means that we can no longer talk about verifying or falsifying an individual statement. If a theoretical statement entails an empirical consequence only with the addition of subsidiary statements, then we cannot conclude that this statement is false if the empirical consequence fails to occur. Perhaps the theoretical statement

is false; but perhaps it is a subsidiary statement that is false instead. Quine argues that since all the statements that express our knowledge are related to one another by various logical and causal relations, we cannot verify or falsify individual statements. Rather, "our statements about the external world face the tribunal of sense experience not individually but only as a corporate body."[18] Quine argues that every statement within our network is ultimately justified by the fit of the entire network with experience. And if a revision needs to be made, it can occur anywhere within that network.

But without the analytic/synthetic distinction, this holism also undermines the a priori/a posteriori distinction. Although they conceded that we use logic and mathematics to derive the empirical consequences of a scientific theory, the logical positivists believed that logic and mathematics could not be falsified by an empirical consequence. If any revision needed to be made, it would occur elsewhere in the theory. This is because they believed that the statements of logic and mathematics, as analytic statements, had no empirical content. These statements were a priori. But once we do away with the analytic/ synthetic distinction, we have no justification for claiming that the statements of logic and mathematics have any sort of special status within our network.

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and synthetic statements, we cannot justify the claim that logic and mathematics are independent of experience. Many philosophers believe that just as there is no sharp distinction between logic and mathematics, there is no sharp distinction between mathematics and physics. Putnam, for example, points out that

> It is worthwhile pausing to remark just how much of classical mathematics has been developed for physical application (the calculus, variational methods, the current intensive work on nonlinear differential equations for a start) and what a surprising amount has found physical application. [19]

The boundary between mathematics and physics becomes even more blurred if we examine the work of two of the most recent Fields Medalists. Ostensibly, the Fields Medal is awarded for original work in mathematics. But Vaughan F.R. Jones won his award for connecting Von Neumann algebras (which are used in quantum mechanics) with knot theory (a branch of topology). Edward Witten, who is actually a physicist rather than a mathematician, won his award for his work in string theory. Although string theory is a branch of physics, Witten argues that it will ultimately flourish as a branch in geometry; and he provides a hint at what this geometrical foundation will look like with his topological field theories.[20] This suggests that the boundary between mathematics and physics is rather more blurred than the logical positivists thought. But since this boundary is blurred, we cannot justify the claim that

one discipline is a priori while the other is a posteriori.

Quine believes that all our knowledge, including that of logic and mathematics, forms one overall theoretical network. He writes that

> The totality of our so-called knowledge or beliefs, from the most casual matters of geography and history to the profoundest laws of atomic physics or even of pure mathematics and logic, is a man-made fabric which impinges upon experience.[21]

Quine believes that every statement within our theoretical network is ultimately justified by the fit of the entire network to experience. This means that every statement within our network is, to some degree or other, a posteriori. We cannot argue that some statements within our network are somehow independent of experience. And this holds for the statements of logic and mathematics as well as for the statements of empirical science.

While we can distinguish logic and mathematics from the rest of our knowledge, we cannot make a sharp distinction. Quine believes that all our knowledge is bound into some overall theoretical network. At the center of this network, Quine places logic. Moving away from the center, Quine argues that we come to mathematics. While logicians need not rely on mathematics, mathematicians rely on logic. Quine argues that mathematicians add their distinctive terms and objects to logic. From mathematics, Quine argues we move to physics. While logicians and mathematicians need not rely on physics, physicists need both logic and

mathematmatics. Physicists add their distinctive terms and objects to mathematics. From physics, we move to chemistry. While logicians, mathematicians, and physicists need not rely on chemistry, chemists presuppose logic, mathematics, and physics. Chemists add their distinctive terms and objects to that of mathematics and physics. From chemistry, we move to biology and so on.[22] As we can see from Quine's picture, although we can distinguish logic and mathematics from the rest of our knowledge, this is not a sharp distinction. Logic and mathematics differ in degree from the rest of our knowledge, not in kind.

Just as the network theorists resurrect a pragmatic version of the analytic/synthetic distinction so do they also resurrect a pragmatic version of the a priori/a posteriori distinction. While every statement within our theoretical network is ultimately justified by the fit of the entire network with experience, not every statement within the network is equally related to experience. Some statements, say the axiom of extensionality, are farther removed from experience while other statements, say 'The pen is in my hand', are relatively close to experience. In general, the statements of logic and mathematics tend to be among the statements that are the farthest removed from experience. In this respect, we can describe them as a priori. Compared to the other statements within our network, they are relatively a priori. But this is only

a matter of degree and not of kind.

What Happens to the Necessary/Contingent Distinction?

In Chapter One, we learned that the logical positivists draw the necessary/contingent distinction as:

> (LN) A statement is necessary if and only if it must be true--it is impossible for it to be false.
>
> (LC) A statement is contingent if and only if it can be false--it is possible for it to be false.

Considering that the network theorists reject the logical positivists' versions of both the analytic/synthetic and the a priori/a posteriori distnctions, it is not surprising that they reject this version of the necessary/contingent distinction as well. The network theorists reject the claim that it is impossible for any statement to be false. They believe that it is possible, in principle, for any statement within our network to be revised or dropped. And this does not exclude the statements of logic and mathematics.

But just as the network theorists resurrect pragmatic versions of both the analytic/synthetic distinction and the a priori/a posteriori distinction, they also resurrect a pragmatic version of the necessary/contingent distinction as well. While no statement within our theoretical network is immune from revision, not every statement is equally likely to be revised. We protect certain statements from

revision. Quine suggests that we could describe these statements as "necessary". In effect, this is a new notion of necessity--a notion that is based upon the likelihood of revision. The more likely a statement is to be revised, the less necessary it is; and the less likely a statement is to be revised, the more necessary.

But why would we protect certain statements from revision? Quine argues that we tend to protect those statements that are central to our network. The statements of logic and mathematics are central to our network in that any revision of logic or mathematics also affects physics, chemistry, and so on. Thus, in the interests of minimal mutilation, we protect logic and mathematics. Quine writes

> ...the more fundamental a law is to our conceptual scheme [theoretical network], the less likely we are to choose it for revision. When some revision of our system of statements is called for, we prefer, other things being equal, a revision which disturbs the system least. ...Conjectures of history and economics will be revised more willingly than laws of physics, and these more willingly than laws of mathematics and logic. Our system of statements has such a thick cushion of indeterminacy, in relation to experience, that vast domains of law can easily be held immune to revision on principle. We can always turn to other quarters of the system when revisions are called for by unexpected experiences. Mathematics and logic, central as they are to the conceptual scheme, tend to be accorded such immunity, in view of our conservative preference for revisions which disturb the system least; and herein, perhaps, lies the "necessity" which the laws of mathematics and logic are felt to enjoy. [23]

But this same point can apply to statements other than

those of logic and mathematics. Lakatos points out that we also protect certain statements in science. According to Lakatos, the history of science is actually the history of scientific research programmes [sic], where each programme consists of a succession of related theories. Within each programme, there are certain statements that we protect from revision. Lakatos describes these statements as the "hardcore" of the research programme. Whatever changes need to be made within a programme, these statements will be held immune. Consider the following three statements:

(1) Heisenberg's Uncertainty Principle: We cannot measure the position and the momentum of a particle simultaneously with precision.
(2) Evolution occurs by the mechanism of natural selection.
(3) To every action, there is an equal and opposite reaction.

(1) belongs to the hardcore of quantum mechanics. (2) belongs to the hardcore of Darwinian theory. And (3) belongs to the hardcore of Newtonian mechanics. Whatever changes need to be made in quantum mechanics, Darwinian theory, and Newtonian mechanics, these statements will be held immune. If we revise these statements, or give them up, we have, in effect, moved to a new research programme.

While we may view the statements of logic and mathematics as central to our overall theoretical network, we may view the hardcore of a research programme as central to that programme. If we were to revise the statements of logic and mathematics, then we end up by revising our

entire network. Similarly, although on a smaller scale, if we revise the statements that make up the hardcore of a research programme, then we end up revising the discipline in which that programme occurs. If we give up certain principles in logic and mathematics, we have, in effect, moved to a new network. Similarly, if we give up the hardcore of a programme, then we have moved to a new programme. The role of a hardcore is analogous to the role of logic and mathematics within our overall theoretical network. It is only the relevant body of knowledge that is different. In the case of logic and mathematics, the relevant body of knowledge is our entire network while in the case of a hardcore, the relevant body of knowledge may be only a particular discipline.

But this means that we can describe certain statements from science as necessary. Quine, at any rate, is willing to grant scientific statements the status of necessity when he writes

> In principle, therefore, I see no higher or more austere necessity than natural necessity; and in natural necessity, or our attributions of it, I see only Hume's regularities, culminating here and there in what passes as an explanatory trait or the promise of it. [24]

We may be more willing to revise or give up the hardcore of a particular research programme than we are willing to revise or give up the statements of logic and mathematics. We may even concede that the statements of logic and

mathematics are more necessary than the statements that make up the hardcore of a particular research programme. But once again, this is a difference of degree and not of kind. Logic and mathematics are necessary for the same kind of reason as certain scientific statements are necessary.

Chapter Four

The network theory and the causal theory are both plausible. Yet, as I have presented them, they are incompatible. According to the network theory, every term obtains its meaning from its sense (which is given by its role and position within a theoretical network); but according to the causal theory, some terms obtain their meaning from their reference. Despite this apparent contradiction, many philosophers seek to combine the two theories. This is not surprising since each theory, to a certain extent, complements the other.

It would be quite convenient if we could place the causal theory within some sort of theoretical network. In chapter two, we learned that the causal theory presupposes essentialism when it comes to statements such as

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

But essences and essential properties are essential only within some sort of theoretical context. Without this context, we have no reason to suspect that certain properties are more important than other properties. Statements (1)-(3), for example, provide the essence of their subjects only within a theoretical context where we are interested in the internal structure of heat, gold, and water. Without a particular theoretical network in place, we have no

reason to claim that the internal structure of heat, gold, and water is more important than their other properties.

It would also be convenient if we could incorporate features from the causal theory into the network theory. If we accept the network theory, as I have presented it in Chapter Three, then every time we make an adjustment within our network, we change the meaning of every term within that network. Since every term is related, directly or indirectly, to every other term within its network, if we change the meaning of one term, we change the meaning of all. But this is preposterous. Most of us tend to believe that certain terms retain their meaning throughout changes within our network.

In "The Meaning of Meaning", Putnam argues that 'χρυσὸs', which occurs in Archimedes's dialect of Greek, and 'gold', which occurs in our dialect of English, have the same meaning. We certainly translate 'χρυσὸs' as 'gold'. But Archimedes's scientific beliefs are not ours. As Putnam points out, 'χρυσὸs' and 'gold' not only belong to different languages but to different networks. If the network theorists are correct and every term obtains its meaning from its role and position within a theoretical network, then 'χρυσὸs' and 'gold' should not have the same meaning. But we think that they do. While we admit that Archimedes's beliefs about χρυσὸs differ from our beliefs about gold, we, or, at least most of us, do not

admit that Archimedes means something different by 'χρυσὸs' than we mean by 'gold'. Putnam states that this is because 'χρυσὸs' and 'gold' are both natural kind terms; and as such, they obtain their meaning from their reference. And so long as 'χρυσὸs' and 'gold' have the same reference, they have the same meaning.[1]

If certain terms within our theoretical network obtained their meaning from their reference, then these terms would not only retain their meaning throughout changes within our network but they would also retain their meaning as we move from one network to another. Thus, it would be quite convenient if reference had some sort of role within the network theory.

Føllesdal: How to Synthesize the Causal Theory and the Network Theory

Although the causal theory and the network theory are incompatible as I have presented them, offhand, it does not seem as though they must be incompatible. After all, the main point to the network theory is that every term obtains its meaning from its role and position within a theoretical network. But this point does not imply that every term must have the same role. Perhaps our network has different classes of terms. Perhaps these different classes play different roles. And perhaps the role that certain classes play is referential.

In Chapter Three, we examined the epistemological and

semantical aspects of the network theory. But there is an ontological aspect as well. Our theoretical network, after all, provides us with our ontology. It is our theoretical network that tells us what exists and what does not. And among the things that exist, according to our network, are objects. We analyze the world in terms of objects. Our knowledge, from ordinary beliefs to scientific theories, concerns objects of one sort or another.

Objects are rather interesting entities. Føllesdal, in "Essentialism and Reference", argues that objects have three features that are particularly pertinent to reference. First, objects have a great many properties, some of which we know and others of which we do not. Second, many objects change through time--an object may have a property at one time that it lacks at another. Third, objects are the sorts of things about which we can have false beliefs--we may believe something of an object at one time that we dismiss as false at another. Given the importance of objects within our ontology and given the fact that objects have these features, Føllesdal argues that "we should expect a language to have a category of expressions that is especially designed to refer to these objects and to stay with them through all these changes that they and our beliefs about them undergo."[2] In effect, Føllesdal is claiming that within our theoretical network we want certain terms to serve as rigid designators. We want certain

terms to obtain their meaning from their reference.

But Føllesdal is no orthodox proponent of the causal theory. According to Føllesdal, the causal theorists discern two questions. There is an ontological question: How does a term obtain its meaning? And there is an epistemological question: How do we come to know the object designated by a given term? Føllesdal believes that the causal theorists are principally concerned with the ontological question. They wish to explain how certain terms obtain their meaning. Or to be more precise, they wish to explain the connection between certain referential terms and their objects. And they explain this connection by means of the causal theory.[3] An object undergoes a baptism--we decide that a particular name or term will designate a particular object or a particular kind of object. After this baptism, the name is spread throughout the linquistic community. But, as Føllesdal points out, this account only settles the ontological question.[4] It explains how I use the term 'Kripke' to refer to Kripke, for example; but it does not explain how I came by my knowledge of Kripke.

One problem pops up immediately. While this account seems to work for proper names, where there is usually some sort of naming ceremony, it does not work quite so well for natural kind terms. As Zemach states

> ... no one knows, nor can ever hope to know, on what occasions and with res-

> pect to what objects our ordinary English substance-terms were first uttered. We do not even know whether the substance that was originally referred to as "water" was indeed water (i.e., was the substance we call "water"). According to this version of Putnam's theory, it is possible that we, all of us are utterly mistaken, and what we call "water" is simply not water. It is possible that only, say, spittle, or milk, is water, and nothing else is. [5]

Zemach's point does not necessarily undermine the rigidity of the term 'water'. Perhaps Zemach is correct that while we use 'water' to refer rigidly to water, the originators of the term used 'water' to refer rigidly to spittle or milk; but in either case, 'water' is a rigid designator. His point does raise a problem, however, if we are trying to explain how 'water' came to refer to water. His point intimates that perhaps the ontological and epistemological issues of the causal theory are not as distinct as the causal theorists have presented them.

Føllesdal collapses the causal theorist's distinction between ontological and epistemological questions. He believes that how we learn to connect a particular term with a particular object may also explain how that term is related to the object. He argues that this is because language is a social institution. "What our names refer to--and not only how we find out what they refer to--depends upon evidence that is publicly available in situations where people learn and use language."[6] He continues

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to stress this point when he writes

> For both what a term refers to and how we find out what it refers to depend on a complex interplay of several factors: assent to and dissent from sentences is just one; ostension is another; actions, including non-linquistic actions, are a third; and above all, our theories of how people are likely to go wrong in their perception and their reasoning are a fourth. Here interaction within the whole speech community comes in. Some people are less likely to go wrong in certain matters, because they are better located for perception and observation, because they are better trained and perhaps specialists on these matters, etc. This "linquistic division of labor" was first observed by Putnam. However, neither he nor Kripke will probably accept my view that it actually contributes to determining the reference and not just to finding out what the reference is. [7]

This suggests that our theoretical network may not only have a class of terms that play a referential role within the network; but it also suggests that our theoretical network may, in turn, play a role in determining the reference of these terms. Unfortunately, Føllesdal, in "Essentialism and Reference", does not follow up on this suggestion.

Referential Terms

Føllesdal's point is this: Within our network, we want a class of terms that refer to objects; and we want these terms to retain their meaning not only throughout the changes that objects may undergo but also throughout the changes that our beliefs about these objects may undergo.

But Føllesdal does not insist that these terms obtain their meaning from their reference. And for good reason. We can use a term referentially even if that term does not obtain its meaning from its reference. In reality, the terms that we use referentially fall upon a continuum where sense, which is ultimately tied to our network, gradually takes a larger and larger component of meaning. Examine the following classes of terms:

(i) Currer Bell, Charlotte Bronte, Jolmo Lunmga, Mt. Everest, Malvinas Islands, Falkland Islands.
(ii) Mallard, garlic, snow rose, gold, water, elephant, caribou, reindeer.
(iii) Anas platyrhynchas, Allium sativum, Hellaborus niger, Rangifer tarandus, Elephas maximus, Loxodonta elephanta.
(iv) atom, electron, quark, gene.
(v) group, ring, triangle, square.
(vi) vertebrate, marsupial, mammal, coelenterate, chordata.
(vii) bachelor, vixen, brother.

Each class consists of terms that we use referentially. But not every class consists of terms that obtain their meaning from their reference. While the terms in class (i) obtain their meaning from their reference, the terms in class (vii) do not. In fact, as we move from class (i) to class (vii), we gradually move from terms that obtain their meaning from their reference to terms that obtain their meaning from their sense. As we move from one class to the next, sense gradually becomes more important.

Class (i) consists of proper names. And when it comes to proper names, the causal theory is quite plausible.

Thanks to Føllesdal, we can now show this account of proper names is not incompatible with the network theory. We can argue that proper names play a particular role within our network. They are those terms that rigidly designate their objects; and since they are rigid designators, they obtain their meaning from their reference. But even when it comes to proper names, we cannot ignore our theoretical network entirely. When we use proper names, we implicitly rely on various metaphysical assumptions--for example, we assume that the objects we have named endure through space and time; we assume that these objects are identical to themselves; we assume that these objects cannot be in two places at the same time; and so on. Indeed, unless we rely upon these sorts of assumptions, we have little reason to adopt proper names.

Class (ii) consists of natural kind terms. These terms, according to the causal theory, also obtain their meaning from their reference; and we may, in fact, find the causal theory quite persuasive on this fact. Yet when we try to explain exactly what constitutes a natural kind, we begin to see just how difficult it is to divorce natural kinds from the background knowledge that is provided by our theoretical network. This is because a kind is made up of things that we find similar. But the fact that we find certain things similar suggests that we have some reason to find them so.

Initially, it may seem as though we do not need any background knowledge to divide up the world into natural kinds. Many philosophers and scientists believe that certain similarity relations, in particular the similarity relations that cause us to perceive the members of a natural kind as similar, are innate. Quine, for example, writes that

> A standard of similarity is in some sense innate. This point is not against empiricism; it is a commonplace of behavioral psychology. ... Without some such prior spacing of qualities, we should never acquire a habit; all stimuli would be equally alike and equally different. [8]

This claim becomes more plausible once we realize that even small children and animals divide the world into many of the same natural kinds as adult humans. Now surely small children and animals are not relying upon a full blown theoretical network to divide the world up into these natural kinds. Rather, it seems more plausible that there is some sort of innate mechanism that causes even small children and animals to perceive some things as similar and others as not.

But this innate mechanism only takes us so far. Perhaps the similarities that are due to this innate mechanism are only superficial. Mayr points out that

> The history of taxonomy decisively refutes the assumption that similarity is self-evident and not in need of careful evaluation. It requires a great deal of knowledge to be able to look through superficial similarities and to discount

> superficial dissimilarities. [9]

Viceroy and Monarch butterflies appear remarkably similar; yet once we know something about butterflies, we distinguish between the two. Male and female mallards appear quite dissimilar; yet once we know something about birds, we place them in the same kind. While we may begin with innate notions of similarity, we also rely upon our theoretical network to help us sort things into kinds.

But we are also realists when it comes to natural kinds. We do not think that they are simply creations of our minds. Rather, we believe that there is a reason why things belong to the natural kind that they do; and this reason is something other than the fact that we perceive them as similar. Putnam writes that natural kinds are "classes of things that we regard as of explanatory importance; classes whose normal distinguishing characteristics are 'held together' or even explained by deep-lying mechanisms."[10] In yet another article, Putnam writes that

> To belong to a natural kind, something must have the same composition, or obey the same laws--indeed, what makes composition important, when it is, is its connection with laws of behavior.--as model members of the class, and this composition or these laws are not usually known when the natural kind term is introduced, but requires an inordinate amount of investigation to discover. [11]

It may be true that we initially perceive natural kinds on the basis of some innate mechanism. But it is also true

that we believe that these natural kinds play an explanatory role within our network. And we then use our network to help us place things into kinds. For example, we use our knowledge of evolution and reproduction to place male and female mallards within the same kind; and we use the same sort of knowledge to separate Viceroy and Monarch butterflies into two different kinds.

The fact that our theoretical network comes into play for natural kind terms is not surprising if we remember the discussion on paradigms in Chapter Two. Although natural kind terms obtain their meaning from their reference, their reference is not fixed beforehand. Thus, we choose paradigmatic examples of the kind, and by characterizing that example, we can find other members of that kind. But in characterizing our example, we rely upon our overall knowledge. We use our theoretical network. This is not to deny that reference is the principle component of meaning for natural kind terms. We may be willing to make minor adjustments in the reference of a natural kind term on the basis of our theoretical network; but we would reject major adjustments.

Class (iii) consists of taxonomic names for biological species. While biological species match up, for the most part, with biological kinds, this match up is not perfect. We often divide a natural kind into two or more species. This is the case with elephants. We divided elephants, the

kind, into two species: African elephants, or elephas maximus, and Indian elephants, or loxodonta elephas. We may also combine two natural kinds into one species. While we may originally have thought that reindeer and caribou, for example, constituted two kinds, we now count them as one species--Rangifer tarandus. But these cases are relatively minor. For the most part, biological kinds and biological species match up fairly well.

And this is what we should expect. Quine points out that "we revise our standards of similarity or of natural kinds on the basis of second-hand inductions."[12] He argues that we rise above our innate notions of similarity by

> ...developing modified systems of kinds; hence modified similarity standards for scientific purposes. By the trial-and-error process of theorizing [we have] regrouped things into new kinds which prove to lend themselves to many inductions better than the old. [13]

Taxonomy, at the level of species, is intended to be an improvement over natural kinds. In sorting out the world, we begin with natural kinds. But we do not stop with this initial sorting. We try to make our notion of natural kinds more precise. And to do this, we rely more upon our background knowledge.

When we divide things into biological species, we definitely rely upon scientific knowledge. We make use of genetic testing and evolutionary history. We examine the morphological characteristics of the entities in question

and their life-cycle. We study their reproductive techniques. And this knowledge is reflected as we place things into species. But still, throughout this process, we are not so much rejecting natural kinds as we are refining those kinds. And thus, we can argue that the meanings of the terms in this class are primarily due to reference.

Class (iv) consists of the names for theoretical kinds. Obviously these terms depend upon our theoretical network in one respect. Before we accept the existence of the entities named by these terms, we must first accept certain theories. Yet once we adopt these entities within our ontology, the terms that name them function much like natural kind terms. These terms are rigid designators. Although our beliefs about atoms, electrons, quarks, and genes are continually changing, we use the terms 'atom', 'electron', 'quark', and 'gene' to refer to atoms, electrons, quarks, and genes respectively. The meaning of these terms is given by their reference.

But while reference may provide the major component of meaning for these terms, sense also provides a component. Consider the following passage from Putnam:

> ... I do not see much point, for example, in saying that someone is referring to Quine when he uses the name 'Quine' if he thinks 'Quine is a Roman emperor' and that is all he "knows" about Quine; unless one has some beliefs which are true or approximately true, then it is at best idle to consider that the name refers to the bearer of one's idiolect. [14]

When it comes to proper names, my intuitions are not the same as Putnam's. My intuition is that the person who mistakenly believes that Quine is a Roman emperor still refers to Quine when he uses the name 'Quine'. The reason why the statement 'Quine is a Roman emperor' is false is because 'Quine' refers to Quine; and governing the Roman empire is not one of Quine's accomplishments. But when it comes to the terms for theoretical kinds, my intuitions are with Putnam. When it comes to theoretical kinds, we had better have some beliefs that are approximately true.

Consider the Greek term 'ατομος' and the English term 'atom'. We certainly translate 'ατομος' as 'atom'; but do these two terms have the same meaning? Do Leucippus and Democritus mean the same thing by 'ατομος' that we mean by 'atom'? My intuition is that they do not. This intuition may seem rather strange considering that I agreed with Putnam that 'χρυσὸς' and 'gold' have the same meaning. And I agreed with Putnam that these two terms have the same meaning even though Archimedes's beliefs about χρυσὸς may differ from our beliefs about gold. Thus, it seems rather strange that I willing to argue that 'χρυσὸς' and 'gold' designate the same natural kind but 'ατομος' and 'atom' designate two different theoretical kinds.

Yet once we accept Føllesdal's claim that how we learn to connect a particular term with a particular object also explains how that term is related to this object, this

intuition becomes less strange. Our ontology includes both natural and theoretical kinds. But a theoretical kind does not enter within our ontology in quite the same way as a natural kind does. Natural kinds precede theory. We accept the existence of the kind first and then develop a theory about that natural kind. But theory precedes theoretical kinds. We usually add theoretical kinds to our ontology as hypothetical entities. We accept their existence before we prove their existence. Yet how do we prove the existence of a theoretical kind? We prove the existence of a theoretical kind once we find an entity that fits the description given by our theories. Perhaps a term for a theoretical kind functions as a rigid designator; but it can only serve as a rigid designator once we fix its reference. And we do this by means of the theories within our theoretical network.

This seems to suggest that 'ατομος' and 'atom' designate different theoretical entities. Leucippus and Democritus argued for the existence of a particular kind of entity. This entity came in various sizes and shapes. It was indivisible. It was the smallest unit of matter. And it built up everything else in the world. Yet while Leucippus and Democritus posited the existence of this entity, they never found a referent. They never found an indivisible unit of matter that came in various sizes and shapes. In contrast, modern proponents of the atomic theory not

only posited the existence of a particular kind of entity but they also found the referent.

This point, by itself, is not sufficient to prove that 'ατομος' and 'atom' designate two different kinds. After all, we may be inclined to argue that Boyle, Newton, and Dalton meant the same thing by 'atom' that we do although they too failed to find a referent. But when we compare our atomic theory with the atomic theory associated with Leucippus and Democritus with our atomic theory, it seems as though we have two different research programmes. Consider the following statement:

(4) An atom is an indivisible unit of matter.

If we compare atomic theories, this statement belongs to the hardcore of Leucippus's and Democritus's research programme. Moreover, within their programme, this statement is not only true, it is analytically true. In their programme, the term 'ατομος' was a one-criterion word.[15] Now in our version of the atomic theory, (4) hardly constitutes part of our programme's hardcore. We not only believe that this statement is synthetic, we believe that it is false. Given that we have two different research programmes, and given that our research programmes determine our ontology, it does not seem unreasonable to argue that 'ατομος' and 'atom' designate two different theoretical kinds.

The terms in group (v) designate mathematical objects and structures. These terms are particularly interesting

in that they straddle Putnam's distinction between one-criterion words and law-cluster words. Consider the terms 'triangle' and 'group'. Each term has a definition.

> (a) A triangle is a plane figure with an area enclosed by three straight lines.
> (b) A group is a non-empty set that is closed under a binary operation that meets the following conditions:
> (i) The associative law holds.
> (ii) There is a unit element.
> (iii) Every element has an inverse.

These terms resemble one-criterion words in that their reference is determined fully by their sense; and this sense is given by these definitions. But these terms resemble law-cluster terms in that they take part in a great many mathematical and physical laws.

The terms in group (vi) designate taxonomic entities other than species. There are two activities associated with taxonomy: microtaxonomy and macrotaxonomy. In micro-taxonomy, taxonomists distinguish one species from another while in macrotaxonomy, they group species together into higher taxa. Mayr argues that

> ... there is a drastic difference between the species taxon and the higher taxa. Higer taxa are defined by intrinsic characteristics. Birds is the class of feathered vertebrates. Any and all species that satisfy the definition of "feathered vertebrates" belong to the class of birds. An essentialist (typological) definition is satisfactory and sufficient at the level of the higher taxa. [16]

While at the species level, reference is the primary component of meaning, at the leve of the higher taxa, sense

becomes the primary component of meaning. The reference of these terms can change without affecting their meaning. Consider the term 'coelenterate'. The usual definition of 'coelenterate' is the following:

> The phylum of coelenterates are those invertebrates that possess a radially symmetrical body with a saclike internal cavity.

Twenty years ago, this phylum included combjellies. These days, it does not. Yet while the reference of 'coelenterate' has changed, its meaning has not. This is what we should expect when sense provides the predominant component of meaning.

The terms in class (vii) are one-criterion words. We use these terms to refer to whatever objects satisfy their criterion. So, the sense of these terms determines the reference. After all, the meaning of 'bachelor' does not change one whit as various bachelors marry. While the reference of 'bachelor' is continuously changing, its meaning does not. And this is because its meaning is determined by its sense.

What Does This Do To The Traditional Distinctions?

Although we can now argue that reference provides the meaning for certain classes of terms within our network, this has little impact on either the analytic/synthetic distinction or the a priori/a posteriori distinction. These distinctions remain much as they have been drawn by

the network theorists. We can continue to argue that certain statements within our network, those that meet Putnam's four criteria, are analytic. And we can continue to argue that certain statements within our network are a priori relative to other statements within our network. So long as we continue to treat the analytic/synthetic distinction and the a priori/a posteriori distinction as pragmatic distinctions, this synthesis has no impact.

But this synthesis has a major impact on the necessary/contingent distinction. The advantage of this synthesis is that it allows us to keep the more plausible features of the various accounts of necessity that we have examined up until now. The disadvantage of this synthesis is that our notion of necessity becomes more complex. We can no longer produce one overall all-encompassing account of necessity.

Types of Necessity

We would like to have one all-encompassing account of necessity. But consider the following statements:

(a) A bachelor is an unmarried male.
(b) A vertebrate is an animal with a backbone.
(c) A triangle is a plane figure with an area enclosed by three straight lines.
(d) f=ma.
(e) The snow rose is the Hellaborus niger.
(f) Currer Bell is Charlotte Bronte.
(g) Gold is the element with atomic number 79.

While we can argue convincingly that each statement is necessary, we cannot use the same argument to justify the necessity of each statement. Each statement may be necessary; but they are necessary for different reasons.

But this does not mean that we need seven accounts of necessity. Consider statements (a) and (b). Statement (a) belongs to the class of "analytic" statements, a class that includes statements such as:

(a) A bachelor is an unmarried male.
(a_1) Vixens are female foxes.
(a_2) A brother is a male sibling.

Statement (b) belongs to the class of taxonomic identities for higher taxa, a class that includes statements such as:

(b) A vertebrate is an animal with a backbone.
(b_1) Marsupials are mammals with external abdominal pouches.
(b_2) The phylum of coelenterates are those invertebrates that possess a radially symmetrical body with a saclike internal cavity.

Now while these statements belong to different classes, I believe that they are necessary for much the same reason.

While there are certain differences between these two classes, there are also similarities. These similarities become apparent once we examine the chart on the following page:

	(a)	(b)
analytic	A bachelor is an unmarried male.	A vertebrate is an animal with a backbone.
	one-criterion	law-cluster

figure 2

In chapter three, we learned that 'bachelor' is a one-criterion word. We also learned that (a) is analytic because its subject is a one-criterion word and its predicate gives that criterion. It would be convenient if we could argue that 'vertebrate' is also a one-criterion word. Unfortunately, it is not. Just consider the following statements:

(b_3) Vertebrates have gill slits in their pharnyx at some stage in their life-cycle.
(b_4) Vertebrates have a digestive tract.
(b_5) Vertebrates reproduce sexually.
(b_6) Vertebrates share a common evolutionary history.

As we can see, 'vertebrate' occurs time after time in biological theories. But while we cannot argue that 'vertebrate' is a one-criterion word, statement (b) seemingly resembles (a)-(a_2) more than it resembles (b_3)-(b_6).

The fact that (b) resembles (a) is not surprising. This is because 'vertebrate', while it is not a one-criterion word, resembles 'bachelor'. We use both terms to designate certain classes of objects. Within our network, it is convenient to have a term that refers to unmarried males; and within our network, it is convenient to have a term that refers to animals with a backbone. But while

'bachelor' and 'vertebrate' have a referential use within our network, they obtain their meaning from their sense. Before we categorize something as a bachelor or as a vertebrate, that thing must first meet certain conditions. To be a bachelor, it must be an unmarried male; and to be a vertebrate, it must be an animal with a backbone. Although 'vertebrate' may not be a one-criterion word, there is one criterion that something must meet before we categorize it as a vertebrate. And in that respect, 'vertebrate' resembles 'bachelor'.

When it comes to statements (a) and (b), the logical positivists give the correct analysis for their necessity. Statements (a) and (b) are analytic. And because they are analytic, they are necessary. Borrowing Aristotelian terminology, we can argue that (a) and (b) express the nominal essence of their subjects. They express the "essence" of their subjects in that they give the meaning of the terms 'bachelor' and 'vertebrate'. And so long as these terms are defined in terms of a single criterion, and so long as (a) and (b) state this criterion, (a) and (b) will be true. They can only be false if we change the meaning of 'bachelor' and 'vertebrate'. Thus, their analyticity not only proves their necessity but gives the explanation for their necessity.

It is tempting to make the same argument for statements (c) and (d). It is tempting to argue (c) and

(d), along with (a) and (b), express the nominal essence of their subjects--while (c) gives the meaning for 'triangle', (d) gives the meaning for 'force'. It is tempting to argue that (c) and (d), along with (a) and (b), are analytic. And it is tempting to argue that (c) and (d) are necessary in virtue of this analyticity.

This is certainly the sort of argument that the logical positivists would make. And in the case of (c) and (d), such an argument is plausible. In reference to (c), we already know that the logical positivists believe that the statements of logic and mathematics are all analytic. And while we have yet to note it, any quick perusal through a physics textbook quickly reveals that definitions have a role in science. Quine remarks that

> The less a science has advanced, the more its terminology tends to rest upon an uncritical assumption of mutual understanding. With increase of rigor this basis is replaced piecemeal by the introduction of definitions. The interrelationships recruited for these definitions gain the status of analytic principles, what was once regarded as a theory about the world is reconstructed as a convention of language. [17]

It is true that when the logical positivists reconstructed scientific theories into axiomatic structures, they argued that certain statements were analytic--certain statements within the structure were true by definition. And such statements, according to the logical positivists, would be necessary in virtue of this fact.

But if we wish to make this argument, we soon run into a problem. What happens when we change our theories? As we know from chapter three, statements within our scientific theories can change their status. A statement that we accept as a definition at one time, we can accept or reject on empirical grounds at another time. Putnam says that

> The distinction between statements necessary relative to a body of knowledge and statements contingent to that body of knowledge is an important methodological distinction and should not be jettisoned. But the traditional philosophical distinction between statements necessary in some eternal sense and statements contingent in some eternal sense is not workable. The rescuing move which consists in saying that if a statement which appears to be necessary relative to a body of knowledge at one time is not necessary relative to the body of knowledge at a later time, then it is not really the same statement that is involved, that words have changed their meaning, and that the old statement would still be a necessary truth if the meanings of the words had been kept unchanged, is unsuccessful. The rescuing move which consists in saying that such statements were only mistaken to be necessary truths, that they were contingent statements all along, and that their 'necessity' was merely 'psychological' is just the other side of the same blunder. For the difference between statements that can be overthrown by merely conceiving of suitable experiments and statements that can be overthrown only by conceiving of whole new theoretical structures--sometimes structures, like Relativity and Quantum Mechanics, that change our whole way of reasoning about nature--is of logical and methodological significance, and not just of psychological interest. [18]

Putnam is making at least two points. His first point is

that a statement may be necessary for some reason other than meaning. If we were to give up statement (a), for example, then 'bachelor' has changed its meaning; but if we were to give up (d), perhaps the meaning of 'force' has changed. But if we were to give up (d), we would also have modified our entire system of physics.

Putnam's second point is particularly pertinent for the network theory. If we reject (d), this does not mean that its necessity was only psychological. It could still be necessary relative to a certain body of knowledge. This is an important point. Compare (c) and (d) with (a) and (b). As we can see from the following, one difference is readily apparent.

Trivial	Central
(a) A bachelor is an unmarried male.	(c) A triangle is a plane figure with an area enclosed by three straight lines.
(b) A vertebrate is an animal with a backbone.	(d) f=ma.

figure 3

While (a) and (b) play only a trivial role within our theoretical network, (c) and (d) play a relatively important role. They are either central to our network as a whole or they are central to a particular research programme within

our network. And because they are central, the network theory gives the best account for their necessity.

Consider (d). Lakatos argues that (d), as one of Newton's three laws of dynamics, constitutes part of the hardcore of Newtonian gravitational theory.[19] Now while (d) appears to be a definition, not every statement that constitutes part of the hardcore of a research programme need be a definition. Consider the following:

(d_1) Evolution occurs by the mechanism of natural selection.

In chapter three, this statement was described as part of the hardcore of Darwinian theory. But this statement is not a definition. In fact, if we only accepted the logical postivists' account of necessity, we may even argue that this statement is contingent. But if we consider the importance of this statement for a particular theory of evolution, we can argue that it is necessary relative to that theory. And we can make the same argument for (d).

The network theorists also argue that the statements of logic and mathematics owe their necessity to the central role that they play within our network. But if we examine various statements from logic and mathematics, this claim is a little disingenuous. This is because the statements of logic and mathematics fall into various sub-divisions. There are definitions:

(c) A triangle is a plane figure with

an area enclosed by three straight lines.

(c_1) A group is a nonempty set of elements that is closed under a binary operation and that meets the following conditions:
(i) The associative law holds.
(ii) There is a unit element.
(iii) Every element has an inverse.

There are axioms:

(c_2) For all well-formed formulas, p and q, the following holds: $p \rightarrow (q \rightarrow p)$.
(c_3) The axiom of infinity.

There are theorems:

(c_4) 1+1=2.
(c_5) $(A \& B) \rightarrow A$.
(c_6) Every map on a flat surface or sphere can be colored with no more than four colors.

And there are metaphysical principles:

(c_7) The principle of identity.
(c_8) The principle of excluded middle.
(c_9) The principle of contradiction.
(c_{10}) The principle of self-identity.
(c_{11}) The principle that any statement that follows logically from necessary statements is itself necessary.

Now do we really want to argue that every single one of these statements owes its necessity to the central position that it holds within our theoretical network. After all, however useful (c_6) may be for map-makers, is it really central to our overall network? And while (c_3) is one of the axioms in Zermelo-Fraenkel's system, does it really play an important role in physics and chemistry?

One problem is that the notion of centrality is ambiguous when it comes to logic and mathematics. A statement

may be central to our overall network; or it may only be central to logic and mathematics as two of the disciplines within our theoretical network. Consider (c_3)--the axiom of infinity. This axiom, as one of the axioms in the Zermelo-Fraenkel axiom system, plays a central role in mathematics. In general, it is one of the axioms that we use to derive other mathematical truths. In particular, it is the axiom that guarantees the existence of infinite sets. If we consider mathematics solely as an intellectual discipline, then we could argue that (c_3) is necessary only because it constitutes part of the "hardcore" of mathematics. Now consider (c_4). Since this statement is derived from other truths of logic and mathematics, we cannot argue that it is part of the hardcore of mathematics. But if we consider our network as a whole, (c_4) plays a far more important role than (c_3). When it comes to balancing our checkbooks, which statement do we use? (c_3) or (c_4)? If we consider the role that mathematics plays within our network as a whole, then we can argue that (c_4) owes its necessity to its central position.

To further illustrate this point, consider the "metaphysical" principles. Where Quine places the truths of logic at the very center of our network, I would place these principles instead. But if we consider logic solely as an intellectual discipline, then these principles are no more important than any other statement of logic. Yet if

we consider logic as part of our overall network, these statements play a fundamental role. Consider statements (c_7)-(c_9)--the so-called laws of thought. Copi argues that while these laws, considered merely as logical tautologies, are no more important than any other tautology,

> ... the three laws of thought can be regarded as having a certain fundamental status in relation to truth tables. As we fill in subsequent columns by referring back to the initial columns, we are guided by the Principle of Identity: if a **T** has been placed under a symbol in a certain row, then in filling out other columns under expressions containing that symbol, when we come to that row we consider that symbol still to be assigned a **T**. In filling out the initial columns, we put either a **T** or an **F**, being guided by the Principle of Excluded Middle; and nowhere do we put both **T** and **F** together, being guided by the Principle of Contradiction. The three Laws of Thought can be regarded as the basic principles governing the construction of truth tables. [20]

The laws of thought can also be regarded as having a certain fundamental status in relation to proofs. Proofs by contradiction, for example, implicitly rely upon the Principle of Excluded Middle. If we reject the Principle of Excluded Middle, as certain intuitionistic mathematicians do, then we reject indirect proofs. Rejecting such proofs can have a ripple effect throughout our entire network. For example, the classical proof for the law of trichotomy (which states that every real number is either zero, positive, or negative) is an indirect proof. This particular law plays a fundamental role in calculus and analysis. But

calculus and analysis are important for physics as well as mathematics. Thus, we cannot reject the Principle of Excluded Middle without affecting a great deal of our overall network.

As a matter of fact, however, the statements that are central to logic and mathematics as particular disciplines within our network and the statements of logic and mathematics that are central to our overall network are related in a certain respect. The axioms of logic and mathematics are often discursive. We choose certain "truths" of logic and mathematics as a basis from which we can derive other "truths". These statements are central to logic and mathematics as disciplines. They constitute the "hardcore" of logic and mathematics. But we would not choose these particular statements as our basis if they did not enable us to derive truths that are central to our overall network. We are not likely to choose an axiom system in mathematics, for example, if it did not allow us to derive '1+1=2'.

While logical positivism best accounts for the necessity of statements (a) and (b), and while the network theory best accounts for the necessity of statements (c) and (d), the causal theory best accounts for the necessity of statements (e) and (f). Statement (e) belongs to a particular class of taxonomic statements--the class of taxonomic identities for species. This class consists of statements such as

(e) The snow rose is the Hellaborus niger.
(e_1) Mallards are members of the species Anas platyrhynchas.
(e_2) Garlic is Allium sativum.

Statement (f), too, belongs to a particular class of statements. It belongs to the class of singular statements that contain two rigid designators. This class consists of statements such as

(f) Currer Bell is Charlotte Bronte.
(f_1) Jolmo Lungma is Mt. Everest.
(f_2) The Malvinas Islands are the Falkland Islands.

In fact, if we do not accept the causal theory, we are not likely to describe these statements as necessary.

They certainly do not owe their necessity to the fact that they play a central role within our network. The statements in both classes are rather trivial. But these statements are not trivial in quite the same way as statements (a) and (b). Consider the following:

sense	reference
(a) A bachelor is an unmarried man.	(e) The snow rose is the Hellaborus niger.
(b) A vertebrate is an animal with a backbone.	(f) Currer Bell is Charlotte Bronte.

figure 4

In each case, where 'S' is a statement, we are committed to

the truth of the following: 'S→□S'. If S is true, then it is necessarily true. But in the case of (a) and (b), we are also committed to the truth of S. Statements (a) and (b) may be trivial; but we are firmly committed to their truth. But in the case of (c) and (d), we are not so committed to the truth of S. We are quite willing to concede that perhaps we made a mistake in identifying Currer Bell with Charlotte Bronte; and we are quite willing to allow botanists to change the taxonomic name of the snow rose. If (c) and (d) are true, they are necessarily true; but we are willing to admit that they could be false.

This comes back to the fact that while 'bachelor' and 'vertebrate' obtain their meaning from their sense, 'snow rose', 'Hellaborus niger', 'Currer Bell', and 'Charlotte Bronte' obtain their meaning primarily from their reference. We are committed to the truth of (a), for example, because we define 'bachelor' as 'unmarried man'. While we could make the case that (e) is the taxonomic definition of 'snow rose', the fact remains that 'snow rose' does not literally mean 'Hellaborus niger'. Nor does 'Currer Bell' literally mean 'Charlotte Bronte'. While 'bachelor' obtains its meaning by its verbal connection to 'unmarried man', 'snow rose' and 'Hellaborus niger' obtain their meaning by their connection to a particular kind of plant.

Surprisingly enough, while (e) and (f) are trivial, their necessity is ultimately tied to the account of

necessity given by the network theory. As we recall, the causal theorists admit that statements (e) and (f) ultimately owe their necessity to the principle of self-identity. Statements (e) and (f) are necessary only because the principle of self-identity is necessary. And why is this principle necessary. It owes its necessity to the fact that it is central to our network. Thus, while (e) and (f) are not central to our network, their necessity is linked to our network by our reliance upon a particular metaphysical principle.

Logical positivism accounts for the necessity of statements (a) and (b). The network theory accounts for the necessity of (c) and (d). The causal theory accounts for the necessity of (e) and (f). Which theory accounts for (g)? Intuitively, we believe that (g) owes its necessity to the fact that it is an Aristotelian essence. Now, of our three accounts of necessity, which accounts for Aristotelian essentialism. The problem is that while we may believe (g) is necessary, none of the accounts of necessity that we have examined explains Aristotelian essentialism. If we want to describe (g) as necessary, we need an additional account of necessity.

Chapter Five

In Chapter One, I began with a relatively modest goal. I only wanted to show that the traditional analysis of necessity, which equated necessary statements with a priori statements, was inadequate. This was because certain statements, namely,

(1) Heat is the form of energy constituted by the motion of atoms and molecules in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

are both necessary and a posteriori. By the end of Chapter One, my only goal was to modify this traditional analysis so that it could account for these statements. But if the discussion is chapter four is correct, which I believe it to be, then no slight modification will do.

In Chapter Four, I made two claims: First, I claimed that necessary statements fall into at least seven different classes:

(i) "Analytic" statements.
(ii) Taxonomic identities for the higher taxa.
(iii) Logical and mathematical truths.
(iv) The hardcore of a scientific research programme.
(v) Taxonomic identities for species.
(vi) Singular identity statements containing two rigid designators.
(vii) Aristotelian or "metaphysical" essences.

Second, I claimed that we cannot reduce these seven classes to just one epistemically or semantically homogeneous class of statements. If the statements in these various classes

are necessary, then they are necessary for different reasons. In Chapter Four, we accounted for the necessity of the statements that fell into the first six classes. But we have yet to account for the necessity of those statements that fall into the seventh class. In this chapter, we shall finally discover why statements (1)-(3) are necesary.

Why We Need An Additional Analysis of Necessity

Intuitively, we feel that statements (1)-(3) are necessary because they express some sort of Aristotelian essence--they express the "real" or "metaphysical" nature of their subjects. Yet none of the analyses of necessity that we have seen up until now accounts for Aristotelian essentialism. If we wish to argue that statements (1)-(3) owe their necessity to the fact that they express the essence of their subjects, then, as we shall see, we need an additional analysis of necessity.

Why is logical positivism inadequate? Consider the following two statements:

(2) Gold is the element with atomic number 79.
(4) A bachelor is an unmarried man.

These statements resemble each other in that each seemingly expresses the essence of its subject. Yet this resemblance is superficial. Statement (4) only expresses the nominal essence of its subject while (2) expresses the

"metaphysical" essence of of its subject. (4) only tells us what a bachelor is by stating the definition for the word 'bachelor'. (2), in contrast, tells us what gold is by giving us its internal constitution--it does not tell us what gold is by merely stating the definition of the word 'gold'. If it did, then someone who fails to know that gold is the element with atomic number 79 would also fail to know the meaning of 'gold' just as someone who fails to know that a bachelor is an unmarried male fails to know the meaning of 'bachelor'. But this is not so. And this suggests that while (4) owes its necessity to some sort of linquistic practice, (2) does not. Thus, any account of necessity that justifies necessity solely in terms of linquistic conventions and practices, such as logical positivism, will be inadequate.

Why is the causal theory inadequate? The causal theorists, at the very least, concede that statements (1)-(3) express Aristotelian essences. But this is only because the causal theory presupposes essentialism. Consider once more the discussion from Chapter Two. Since 'heat', 'gold', and 'water' obtain their meaning from their reference, they are rigid designators. As it so happens, certain definite descriptions, such as 'the form of energy constituted by the motion of atoms and molecules in solids', 'the element with atomic number 79', and 'H_2O', are also rigid designators. These particular descriptions

pick out the same kind or the same phenomena in every possible world. Yet these descriptions refer rigidly only because they happen to express the essence of their subjects. The causal theorists, in effect, are presupposing essentialism when they argue that statements (1)-(3) are necessary. But as Putnam points out, presupposing essentialism is not quite the same thing as justifying essentialism. If we examine the account in Chapter Two, Putnam writes that

> The difficulty is that Kripke individuates objects by their modal properties, by what they (essentially) could and could not be. Kripke's ontology presupposes essentialism; it cannot be used to ground it. [1]

Thus, if we wish to justify essentialism, we need some analysis of necessity in addition to the causal theory.

Why is the network theory inadequate? Offhand, it appears as though the network theory can fully account for Aristotelian essentialism. We certainly can use the network theory to argue that statements (1)-(3) are necessary. We can argue that thse statements either constitute part of the hardcore of a research programme or they follow logically or causally from some hardcore. Consider (2), for example. We know from the periodic table of elements that gold is the element with atomic number 79. And if anything counts as the hardcore in chemistry, surely it is the periodic table of elements. While neither (1) nor (3) constitute part of the hardcore of a research programme

in either physics or chemistry, they follow causally from a hardcore. The problem, however, is while this account can explain why statements (1)-(3) are necessary, it does not explain why they are essential. We have many research programmes in science, each of which has its own hardcore. But not every statement that makes up the hardcore of a particular programme expresses an essence. The network theory, by itself, does not distinguish between those statements within a hardcore that express an essence and those statements that do not. Thus, if we wish to argue that statements (1)-(3) are essential, we will need some analysis of necessity that goes beyond the network theory.

What Is An Essence?

How do we distinguish between statements that express only a nominal essence and statements that express an Aristotelian essence? Take the following two statements:

(2) Gold is the element with atomic number 79.
(4) A bachelor is an unmarried man.

Intuitively, we believe that these two statements are different. But as we noticed in the preceding section, we have yet to develop an analysis of necessity that justifies this intuition.

How should we develop an analysis that allows us to distinguish between statement (2), which we believe to be an Aristotelian essence, and statement (4), which we

believe to be a nominal essence? We could suggest, as we did in chapter two, that an Aristotelian essence is necessary de re while a nominal essence is only necessary de dicto. Yet many philosophers find fault with this suggestion. Marcus, one such philosopher, insists that

> ... what has gone wrong in recent discussions of essentialism is the assumption of surface synonymy between 'is essentially' and de re occurrences of 'is necessarily. [2]

And Marcus has good reason for finding fault with this assumption. While every essence or essential property is necessary de re, not every property that is necessary de re is essential.

There are all sorts of properties that are necessary de re. Just consider the following:

> (a) the property of being self-identical.
> (b) the property of being some thing.
> (c) the property of having some property.

Examine property (a). We may be tempted to argue that this property is necessary de dicto since it can be reformulated as a truth of logic, namely '(x)(x=x)'. But it is also necessary de re. For any object or any entity, it is the sort of thing that is necessarily self-identical. Yet while these properties are necessary de re, they hardly constitute the essence of anything. As a matter of fact, these properties are vacuous.

These properties are vacuous because they apply to everything. And properties that are true of everything

cannot be Aristotelian essences. Bennett writes that

> Being an entity is a necessary property of everything, i.e., a transcendental property. ... Essential properties sort the entities of which they are true in some fashion. [3]

Bennett's point becomes particularly apt once we realize that essences must meet two conditions: First, the essence of some thing must be what that thing is; and second, the essence of some thing must also distinguish that thing from everything else. If we know the essence of a particular thing or kind of thing, we not only know what that thing is but we also know how to distinguish that thing from everything else. Statements (1)-(3) meet both conditions. Statement (2), for example, expresses the essence of gold. Gold <u>is</u> the element with atomic number 79. And it is this fact, the fact that gold has a particular atomic number, that separates gold from everything else. Vacuous properties, such as (a)-(c), fail the second condition. If everything is necessarily self-identical, for example, we can hardly use this property to separate one thing from another.

If we cannot equate essentialism simply with de re necessity, couldn't we equate it with non-vacuous de re necessity? After all, we distinguish vacuous from non-vacuous properties all the time. But then we are faced with the following question: How do we distinguish non-vacuous properties from vacuous properties? It is one thing to say

that we make a distinction. It is another thing to explain how we make the distinction.

Some philosophers answer this question by arguing that there are certain conditions that an essential property must meet. Marcus, in "Essential Attribution", and Teller, in "Essential Properties: Some Problems and Conjectures", discuss two such conditions. Both Marcus and Teller situate their discussion within the context of modal logic. They carefully mention that their conditions occur within a particular system of modal logic (Marcus places her conditions within S_4 while Teller places his within S_5) as interpreted by Kripke semantics. Interestingly enough, both Marcus and Teller provide the same two conditions.[4] And interestingly enough, we can discuss these conditions apart from their modal context.

In their first condition, Marcus and Teller rule out certain vacuous properties. Marcus argues that "implicit in essentialism is that an object has attributes necessarily that are not necessary to other objects."[5] To capture this intuition, Marcus provides the following condition:

(i) $(\exists x)\Box Px \ \& \ (\exists x)\text{-}\Box Px$.

Teller, who also accepts this condition, argues that it prevents a trivialization of the notion of an essential property since it excludes those properties that hold necessarily of everything and those that hold necessarily of nothing.[6] In any event, it excludes vacuous properties

such as (a)-(c).

For their second condition, Marcus and Teller both wish to emphasize a particular feature about Aristotelian essentialism. According to Marcus,

> Aristotelian essentialism takes it that, if anything is a man or mammal, it is so necessarily. These are not properties that anything can have per accidens. The same strong conditions extends to properties (e.g., rational-animal) which are definitive of a kind (e.g., man). [7]

Marcus attempts to capture this feature about Aristotelian essentialism in the second condition which states:

(ii) $(x)(Px \rightarrow \Box Px)$.

Teller argues that this condition captures a generalized form of the idea that whether a thing has P or not makes a difference in the very identity of that thing.[8]

Statements (1)-(3) meet both conditions. Consider (2). There is something which necessarily has the property of being the element with atomic number 79, namely gold; and there is something which does not have this property necessarily, namely everything else. Thus, the first condition is met. And since the property of being an element with atomic number 79 constitutes the very identity of gold, anything that has this property has it necessarily. Thus, the second condition is met.

There are at least two problems with this account. Teller describes the first problem as the problem of boolean combinations. He believes that any property that

meets these two conditions can be described as a minimally essential property. But, as he points out,

> ... any union or complement, and so any boolean combination of minimally essential properties will again be a minimally essential property except for those properties which in some possible world hold of everything or hold of nothing. [9]

Why is this a problem? Teller notes that one purpose of essentialism is to characterize natural kinds. But while "the property of being a tiger picks out a natural kind, and so does the property of being an electron. But the property of being a tiger-or-an-electron does not pick out a natural kind."[10] Yet if we wish to argue that the property of being a tiger is a minimally essential property and the the property of an electron is another minimally essential property, then so is the property of being a tiger-or-an-electron. Our two conditions do not rule out these sorts of properties.

Nor do these two conditions rule out every vacuous property. While they may do away with properties (a)-(c), they do not do away with other sorts of vacuous properties. Compare the following two properties:

> (d) the property of being Charlotte Bronte.
> (e) the property of being the element with atomic number 79.

Although we may be willing to concede that the property of being the element with atomic number 79 is the essence of gold, we are not so willing to concede that the property of being Charlotte Bronte is the essence of anything. Yet

both properties meet Marcus's and Teller's two conditions. Consider property (d). This property certainly meets the first condition--there is something that is necessarily Charlotte Bronte, namely Charlotte Bronte; and there is something, namely the rest of us, that does not have this property necessarily. And this property meets the second condition--if something is Charlotte Bronte, then it is necessarily Charlotte Bronte. Yet this property, the property of being Charlotte Bronte, is vacuous. It is a vacuous property despite the fact that it only belongs to one entity. This is because an essence is supposed to meet two conditions. If we know the essence of something, then we not only know what that thing is but we also know how to distinguish it from everything else. Property (d) meets these two conditions only in the most trivial sense.

So, once more, we are left with the following question: How do we determine which properties are vacuous and which are not? If we compare vacuous properties with non-vacuous properties, one answer comes quickly to mind. Certain properties play a role within our theoretical network. Such properties include

(e) the property of being the element with atomic number 79.
(f) the property of being a tiger.

Other properties play only a trivial role, if even that, within our network. Such properties include

(g) the property of being a tiger-or-an-electron.

(d) the property of being Charlotte Bronte.

Despite the fact that Goodman is concerned with induction, this seems rather reminiscent of his distinction between the predicates 'green' and 'grue'. We accept 'green' as a predicate but we reject 'grue'. We believe that 'green' is projectible for inductive inferences while 'grue' is not. Goodman argues that this is because 'green' is entrenched.[11] 'Green' plays some sort of role within our network while 'Grue' does not. Much the same point can be made about properties (e) and (f). These properties, in contrast to properties (d) and (g), are entrenched within our network.

This suggests that while we cannot reduce essentialism to the hardcore of research programme within our theoretical network, neither can we ignore theoretical context. When we claim that statements (1)-(3) express the essence of their subjects, we are making a claim about the role that these statements play within our network. When we describe certain properties as essential, we are making a claim about the role that that these properties play within our theoretical network. Rather than attempting to characterize these properties in terms of some list of necessary and sufficient conditions, it is more useful to characterize these properties in terms of the role that they play within our network.

Essence and Explanation

We do not want to divorce essences and essential properties from our theoretical network. This is because essences and essential properties are essential insofar as they play a particular sort of role within our theoretical network. But what is this role? Teller suggests that they play an explanatory role. He writes that

> ... a natural kind is the extension of some property that plays a significant role (or a signficant explanatory role) within a true (general, explanatory, ...) theory. I will call such a property an explanatory essential property, or, more euphonically, an explanatory essence, the suggestion being that such a property plays a key role in explanations, or in an explanatory theory. [12]

The advantage of this move is that it enables us to distinguish vacuous properties, such as the property of being Charlotte Bronte, with non-vacuous properties, such as the property of being the element with atomic number 79. Non-vacuous properties have an explanatory role within our network while vacuous properties do not.

Teller is by no means the only philosopher who connects the notion of essences and essential properties to some sort of explanatory role. When it comes to gold, for example, Sober writes that

> ...we want to require that essences are necessary properties that play a certain causal (and hence explanatory) role. ... That an atom possess a given atomic number causes it to have numerous other properties. [13]

And Copi writes that

> ...within the context of [our scientific theories] that property [of being the element with atomic number 79] is fundamental. From its chemical formula more of its properties can be inferred than any other. ... To the extent to which one small group of properties of a substance can serve as a basis from which its other properties can be causally derived, to that extent we can be justified in identifying tha group of properties as its real essence. [14]

These passages reiterate Teller's point. We choose a particular property to serve as an essence if it plays an explanatory role within our theoretical network. The existence of this property explains the existence of other properties. An essence is a property that explains why a particular object or kind has the properties that it has. We can use the fact that gold has a particular atomic number, for example, to explain why gold has various other properties. In that sense, its atomic number serves as its essence.

But an explanatory essence need not be an Aristotelian essence. An explanatory essence is a property that allows us to explain the existence of other properties. But this property need not be an Aristotelian essence. It need not be an Aristotelian essence even when we discuss natural kinds. Natural kinds, as we know from Chapter Two, are not alike. This difference becomes quite pronounced once we compare biological species with physical elements. The explanatory essence for the latter is an Aristotelian

essence. The explanatory essence for the former is not. These days, scientists reject any role for Aristotelian essentialism in biology. This is ironic since, as Teller points out,

> Historically, one place where theorists tried to put doctrines of essential properties to work was in attempts to develop a theory of natural kinds, or real species, in application to biological classes. [15]

But whatever the historical record may be, biologists gave up essentialism. This is basically for two reasons. The first reason is that they have yet to find an essence for any biological species. And the second reason is that the theory of evolution does away with the need for essentialism.

Let's examine the first reason. Suppose a biological species has an Aristotelian essence. This means that there is some property that belongs to every member of that spespeies and only to the members of that species. This property will then be the defining characteristic of that species just as its atomic number is the defining characteristic of gold. Sober argues that this is a constituent definition--the essence of a species is defined in terms of the properties of its members.[16] But we have yet to find such a property for any species. Just think about the various sorts of candidates for such a property. The essence of a species cannot be a morphological property. For while members of a species are morphologically similar, we

may decide not to exclude entities from that species which lack that particular morphological property. The essence of a species cannot be a phenotypic property. For once again, we may decide not to exclude entities from that species which lack that property. And an essence of a species cannot be a genotypic property. This is because, as Sober points out, the genetic variation among a given population is prodigious; and it is highly unlikely that there is a particular gene that every member, and only the members, of a given species possesses.

The fact that biologists have failed to find essences for species is no problem considering that the theory of evolution does away with the need for essences in biology. There are various reasons cited for this. Some scientists, and philosophers, argue that this is because essentialism is committed to the view that species are static. Others argue that the essentialist is unable to account for the continuity of nature. For his part, Sober argues that

> ... evolutionary theory has removed the need for providing species with constituent definitions; population thinking provides another way of making species scientifically intelligible. This consideration, coupled with the principle of parsimony, providing an additional reason for thinking that species do not have essences. [18]

Sober goes on to argue that in evolutionary theory, the population is the unit of organization, not the organisms that make up that population. We then treat the population

as an entity in its own right, subject to its own forces and obeying its own laws. And we can do this without recourse to essentialism.

But while biological species may lack an Aristotelian essence, they do not lack an explanatory essence. But this explanatory essence, as Sober insists, is not in terms of a constituent definition. Rather, it is a historical explanation. In the case of species, explanatory essences concern historical lineages. Morphological, phenotypic, and genotypic properties of a species are all discussed within the framework of a historico-evolutionary explanation. This framework is sufficient to provide an explanatory essence; but it is not an Aristotelian essence.

What is an Aristotelian Essence?

What is our problem? We can distinguish essential properties from vacuous properties by their explanatory role; but how do we distinguish essential properties from explanatory essences? The problem is that when we describe some property as essential, it plays an explanatory role; but not every property that plays an explanatory role is an Aristotelian essence. So, what is unique about essential properties?

To answer this question, it is useful to examine statements (1)-(3) one more time.

(1) Heat is the form of energy constituted by the motion of atoms and molecules

in solids.
(2) Gold is the element with atomic number 79.
(3) Water is H_2O.

Apart from expressing an Aristotelian essence, what do these three statements have in common? One feature that they share is that they are all associated in one way or the other with the atomic theory. Thus, to understand why these statements express an Aristotelian essence, we need to first know something about atoms and molecules.

The atomic theory is a rather interesting theory. We can argue that ontologically and metaphysically it is our most fundamental theory. We can argue that it is our most basic theory. And this is because everything in the universe is made out of atoms. This is not a minor point. Feynman, one prominent physicist, emphasizes its importance when he wrote that

> If, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generations of creatures, what statement would contain the most information in the fewest words? I believe it is the atomic hypothesis ... that all things are made of atoms... [19]

The atomic theory provides the ontological building blocks for the entire universe. And thus, it is our basic theory.

This should give us some idea of what an essential property must be.

> (E_1) A property of an object or kind is essential if and only if it is an explanatory essence of that object or kind in our basic theory.

On our present view, the atomic structure (and by extension, the molecular structure) of something is its essence. Thus, heat is essentially the motion of atoms and molecules in solids; gold is essentially the element with atomic number 79; and water is essentially H_2O. But this notion of an essential property is not just any explanatory essence. It is the explanatory essence in our basic theory. The advantage of this move is that it not only explains how an essence is tied to our theoretical network; but it also shows why the more general criterion of being part of the hardcore of just any theory does not do. It must be the hardcore of our basic theory.

Yet we quickly run into the following problem. While we believe that everything in the universe is constructed from atoms, we also believe that atoms, in turn, are constructed from subatomic particles. But this seems to suggest that elementary particle theory and quantum mechanics are even more basic than atomic theory. After all, if everything in the universe is made from atoms, and atoms are made from elementary particles, then everything in the universe is made from elementary particles. Thus, it seems as though elementary particle theory and quantum mechanics are ontologically and metaphysically our most fundamental theories; and as such, these theories constitute our basic theory. Yet even so, we still believe that statements (1)-(3) express the essence of their subjects. But this means

that we do not equate essentialism with the explanatory essence of our most basic theory.

Perhaps we could argue that we have many basic theories. After all, elementary particle theory and quantum mechanics hardly do away with atomic theory. Feynman writes

> The theory of chemistry... was summarized to a great extent in the periodic chart of Mendeleev ... All these rules were ultimately explained in principle by quantum mechanics, so that theoretical chemistry is in fact physics. On the other hand, it must be emphasized that this explanation is in principle. ... It turns out to be very difficult to predict precisely what will happen in a given chemical reaction; nevertheless, the deepest part of theoretical chemistry must end up in quantum mechanics. [20]
>
> ...it is going too far to say that quantum mechanics has given a precise understanding of the periodic table. It is possible, however, even with a sloppy approximation--and some fixing--to understand, at least qualitatively, many chemical properties that show up in the periodic table. [21]

We can view quantum mechanics as a supplement to the periodic table of elements rather than as a replacement. It provides us with a "deeper" understanding of the periodic table of elements; but it does not replace it. In a certain respect, these theories do not compete with each other. It is just that one theory gives us a deeper understanding of the other. We still believe that everything in the universe is constructed from atoms. It is just that elementary particle theory and quantum mechanics give us a

better understanding of what atoms are. Thus, it seems as though we could argue that we have more than one basic theory.

In light of this, we may wish to modify our notion of an essential property.

> (E_2) A property of an object or kind is essential if and only if it is the explanatory essence of any basic theory.

We can argue that statements (1)-(3) still express the essence of their subjects so long as they belong to any basic theory--it need not be our "deepest" basic theory.

But this leads to another problem. Do we really want to argue that an explanatory essence in any basic theory is going to give us an essence? Perhaps not. Elementary particle theory and quantum mechanics can certainly provide an explanatory essence of physical elements; but it is not clear that they give an Aristotelian essence. Moreover, it seems as though we could also argue that certain theories in biology are also basic theories. Certainly some theories in biology are ontologically and metaphysically more fundamental than others. For example, we could make a serious case that genetic theory and evolutionary theory are, in some sense, more basic than other theories in biology. But we already know that biologists have rejected essentialism.

This suggests that we still need something more for a property to be an Aristotelian essence. But what could

this be? Rosenberg argues that

> ...calling all the entries in the periodic table "elements" is based on their all sharing a type of property; that is, they all have atomic structure. What distinguishes one element from another is the difference between their atomic structure, the number and arrangements of electrons, out of which their atoms are uniformly composed. Now it is because all the elements have a common type of structure and differ in the particular structures of this type that they manifest that can justify the taxonomy of the periodic table. ... If the elements did not have a common structure, then they would constitute a heterogeneous collection of items. [22]

Rosenberg's comments suggest that we believe that something has an Aristotelian essence if this essence concerns its inherent structure. We believe that

> (E_3) A property of an object or kind is an essential property if and only if it is the explanatory essence of any basic theory; and its explanatory role concerns the inherent structure of that object or kind.

An Aristotelian essence is a structural property that plays an explanatory role.

If something has an essence, then we are talking about the role that its structure or form plays in our theoretical network. In the case of physical elements, we not only can explain what these elements are in terms of their inherent structure but how to distinguish one element from another in terms of this structure. In the case of biological species, the structure or form of the kind is not relevant. Rather, we use a historical analysis to explain

what a species happens to be and how we can distinguish that species from any other species.

Perhaps, one day, physicists will develop theories in which the form or structure of physical elements are no longer relevant. At that time, we may give up essentialism even for physical elements. But for the time being, we believe that the explanatory essence of physical elements can be given in terms of Aristotelian essences.

Notes

Chapter One

1. Leibniz, "Monodology," in Leibniz Selections, edited by Philip P. Wiener. New York: Charles Scribner's Sons. pp. 539-540; Hume, "An Enquiry Concerning Human Understanding," in The Empiricists. Dolphin Books. Garden City: Doubleday and Company. p. 322.

2. Leibniz, New Essay Concerning Human Understanding, translated by Alfred Gibbon Langley. New York: The Macmillan Company. 1896. p. 143; Hume, A Treatise of Human Nature, edited by L.A. Selby-Bigge. Oxford: Clarendon Press. pp. 13, 15, 70. Leibniz believes that demonstrative knowledge ultimately originates from self-evident propositions while Hume argues that even these self-evident propositions (or intuitions) can be traced back to impressions.

3. Leibniz, New Essay Concerning Human Understanding, p. 14; Hume, "An Enquiry Concerning Human Understanding," pp. 322-323. Hume limits demonstrative knowledge to logic and mathematics while Leibniz expands it to include various truths from ethics, theology, and metaphysics.

4. Leibniz, "Monodology," p. 539.

5. Hume, "An Enquiry Concerning Human Understanding," pp. 322-323.

6. ibid. p. 322.

7. Leibniz, "Monodology," pp. 539, 540.

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23. ibid. p. 84.

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1. Putnam, "The Analytic and the Synthetic," in Mind, Language, and Reality. Cambridge: Cambridge University Press. 1975. p. 36.

2. Kripke, Naming and Necessity, Cambridge: Harvard University Press. 1972. pp. 37, 39.

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4. ibid. pp. 35, 36.

5. ibid. p. 143.

6. ibid. p. 140.

7. Hull, "A Matter of Individuality," in Conceptual Issues in Evolutionary Biology, edited by Elliott Sober, Bradford Books. Cambridge: M.I.T. Press. 1984. p. 640.

8. Putnam, "Why There Isn't A Ready-Made World," in Realism and Reason. Cambridge: Cambridge University Press. 1983. p. 220

9. Putnam, "Reference and Truth," in Realism and Reason.

Cambridge: Cambridge University Press. 1983. p. 71

10. ibid. p. 73.

11. Kripke, Naming and Necessity, p. 138.

12. Sober, The Nature of Selection. Bradford Books. Cambridge: M.I.T. Press. 1985. p. 164.

13. Aristotle, "Posterior Analytics," 97^{b} 5-15.

14. Hull, "A Matter of Individuality," p. 638.

15. ibid. p. 638.

16. ibid. p. 638.

17. ibid. p. 638.

18. Hahn, "Logic, Mathematics, and Knowledge of Nature," in Logical Positivism, edited by A.J. Ayer, New York: The Free Press. 1959. p. 152.

19. Quine, Word and Object, Cambridge: M.I.T. Press. 1960. p. 199

20. Mackie, "De What Re is De Re Modality," Journal of Philosophy (71) September 19, 1974, pp. 560-561.

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2. Putnam, "The Analytic and the Synthetic," p. 52.

3. Churchland, Scientific Realism and the Platicity of Mind, Cambridge: Cambridge University Press. p. 15.

4. Quine, "Carnap and Logical Truth," in The Ways of Paradox. Cambridge: Harvard University Press. 1975. p. 110.

5. ibid. p. 116.

6. ibid. p. 119.

7. Putnam, "The Analytic and the Synthetic," p. 45.

8. ibid. p. 65.

9. Quine, Word and Object, p. 56.

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12. Putnam, "The Analytic and the Synthetic," p. 68.

13. ibid. p. 35.

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2. Føllesdal, "Essentialism and Reference," in The Philosophy of W.V. Quine, edited by Hahn and Schlip. The Library of Living Philosophers. La Salle: Open Court. 1986. p. 107.

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11. Putnam, "Reference and Truth," p. 74.

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14. Putnam, "Explanation and Reference," Mind, Language, and Reality. Cambridge: Cambridge University Press. 1975. p. 203.

15. Putnam, "The Analytic and the Synthetic," p. 68.

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Chapter Five

1. Putnam, "Why There Isn't a Ready-Made World," p. 220.

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4. As a matter of fact, Teller acutally provides three conditions; but since his first two conditions are simply conjuncts of Marcus's first condition, I am going to treat his two conditions as one.

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6. Teller, "Essential Properties: Some Problems and Conjectures," Journal of Philosophy, Volume (72) May 8, 1975. p. 236.

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