Chapter 7

Logical Positivism

> I want neither that plutocracy grasping and mean, nor that democracy goody and mediocre, occupied solely in turning the other cheek, where would dwell sages without curiosity, who, shunning excess, would not die of disease, but would surely die of ennui.
>
> — Poincaré (quoted in Runes, *ToP*, p. 966)

> Science itself, therefore, may be regarded as a minimal problem, consisting of the completest possible presentment of facts with the *least possible expenditure of thought.*
>
> — Mach (Newman, *WM*, Vol. 3, p. 1792)

7.1 Historical Background

In this chapter we will look at *logical positivism*, the most influential philosophy of science in the twentieth century. In spite of the fact that logical positivism has been abandoned by most philosophers of science, its influence continues in many disciplines, including physics, linguistics and psychology. We will be especially concerned with logical positivism's view of knowledge, which is, roughly: (1) the only real knowledge is scientific knowledge; (2) by a process of logical analysis scientific knowledge can be reduced to symbolic formulas constructed from "atomic facts." Certainly assertion (1) is nothing new; Socrates said as much when he distinguished "scientific knowledge" (*episteme*) from a "practice" (*empeiria*); see Section 2.4.3. Furthermore, assertion (2) is implicit in Pythagorianism and is a continuous theme in most Western epistemology, from Plato and Aristotle, through Hobbes and Leibnitz, to Boole and Hilbert. In this sense logical positivism is just the continuation of this long tradition.

The major innovation of logical positivism follows from a new understanding of scientific knowledge, and in the resulting view of the atomic constituents of knowledge. Throughout most of these 2500 years scientific knowledge was viewed rationalistically, and it was assumed that the atomic constituents were some kind of self-evident axioms involving basic categories that required no definition. However, beginning in the Renaissance there was a growing recognition of the value of observation and experiment (active intervention in nature) and a corresponding increase in scepticism about the "self evidence" of any proposition. Indeed, if empiricist philosophers were willing to grant self-evidence to anything, it was to sense data, rather than to the metaphysical propositions favored by the rationalists. In the past the ideal of knowledge had been Euclidean geometry, but the new empiricism took physics as its ideal.

Although logical positivism originated in Germany in the 1920s, many of its roots are Anglo-American. First there is *empiricism*, a strong theme in British philosophy back to David Hume (1711–1776), Thomas Hobbes (1588–1679) and Francis Bacon (1561–1626). Second, there is American *pragmatism*, originated by C. S. Peirce (1839–1914), William James (1842–1910) and John Dewey (1859–1962), with its emphasis on the observable consequences of actions. Finally, there was *logical analysis*, strongly represented in the Continental idealist tradition, but turned into a technical tool by the British philosophers G. E. Moore (1873–1958) and Bertrand Russell (1872–1970).

Logical positivism combined these Anglo-American developments with the existing positivist tradition on the Continent, which originated with the French philosopher Auguste Comte (1798–1857). He argued that each branch of human understanding went through three stages:

in the *theological* stage, explanations are based on the volition of gods; in the *metaphysical* stage, explanations are based on abstract forces; in the *positive* (or scientific) stage, phenomena are not explained at all, but are simply connected by laws. Comte says,

> Finally, in the Positive state, the human mind, recognizing the impossibility of obtaining absolute truth, gives up the search after the origin and destination of the universe and a knowledge of the final causes of phenomena. It only endeavors now to discover, by a well-combined use of reasoning and observation, the actual *laws* of phenomena — that is to say, their invariable relations of succession and likeness. (quoted in Runes, *ToP*, p. 262)

The famous French mathematician and philosopher Jules Henri Poincaré (1854–1912) applied positivist ideas to physics and was concerned with the construction of basic physical concepts out of our sensations and perceptions. In this way he prepared the way for Einstein's reconstruction of space, time and gravity in his special and general relativity theories (see p. 340).

The Austrian physicist Ernst Mach (1838–1916) took a very similar view, and argued that the laws of physics, as of all the sciences, are just shorthand summaries of relationships between the observer's experiences:[1]

> It is the object of science to replace, or *save*, experiences, by the reproduction and anticipation of facts in thought. … This economical office of science, which fills its whole life, is apparent at first glance; and with its full recognition all mysticism in science disappears.

Every scientific law and concept — mass, energy, atoms — must be reduced to "relations between observable quantities." These in turn are relationships among sense data.

> Properly speaking the world is not composed of "things" as its elements, but of colors, tones, pressures, spaces, times, in short what we ordinarily call individual sensations.

[1] A relevant selection from Mach's *Science of Mechanics* (1883), from which these quotations are taken, is reprinted in Newman (*WM*, Vol. 3, pp. 1787–1795).

This view led Mach to detailed investigations of sensation and perception; for example in his *Space and Geometry* (1906) he carefully distinguishes the space of physics from the physiological space upon which it's based, and in the latter category he analyzes the space of vision and the space of touch (which, of course, are not the same). These analyses formed a starting point for Einstein's relativity work (p. 340).

Much like Comte, Mach saw science as an advance over metaphysics. "Where neither confirmation nor refutation is possible, science is not concerned." He rejected anything not reducible to experience as not true knowledge — a characteristic attitude of positivism — and by reducing statements to experience, he hoped "to expose the real significance of the matter, and get rid of metaphysical obscurities." As Hume said long before,

> If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, *Does is contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning, concerning matter of fact and existence?* No. Commit it then to the flames: for it can contain nothing but sophistry and illusion. (*Enq. Conc. Human Underst.*, sec. 12, pt. 3)

In 1895 Mach became a professor of physics at the University of Vienna, and with him we come to the doorstep of the Vienna Circle, the fountainhead of the logical positivist movement. However, before we discuss it, we must consider important contributions from the analytic tradition, upon which the logical positivists also depended.

7.2 Logical Atomism

7.2.1 Russell: Knowledge by Acquaintance and Description

In many respects logical positivism was motivated by the same desires for perfect clarity and absolute certainty that have driven much of the progress of epistemology from the time of Pythagoras. The particular form that this quest has taken in the *analytic tradition*, which has dominated Anglo-American philosophy in the twentieth century and which includes logical positivism, is the belief that analysis can be pursued down to certain indivisible elements, which are in some way incorrigible, and hence justify the intellectual edifice constructed from them.

One form of this is the theory of *logical atomism* developed by Bertrand Russell (1872–1970) in the first decades of the twentieth century.[2] He distinguished *knowledge by acquaintance*, which is indubitable, from *knowledge by description*, which may be in error. Examples of knowledge by acquaintance are sense data and the contents of our own memory. So, for example, if I were perceiving a patch of yellow color in a certain place in my visual field, Russell would take that fact to be unassailable, though I could certainly be incorrect in assuming that I'm seeing a yellow object, since it could be a hallucination, I might have jaundice, or be wearing yellow sunglasses, etc. etc. Similarly, my memory that a certain person attended my fifth birthday party might be mistaken, but I cannot be mistaken in the fact of having that recollection.

A common logical fallacy is the use of descriptions to which nothing answers. The classic example is "the present King of France," since France does not have a king. Therefore, when I make an assertion, such as "the present King of France is bald," it is neither true nor false, since it is not an assertion about anything. Such knowledge by description is fallible, since it contains descriptions that may fail in their reference, that is, they do not refer to anything.[3] In contrast, an object of acquaintance acts like a *logically proper name* and cannot fail in its reference; by virtue of my perceiving it, the spot of yellow I'm

[2]The logical atomism of Russell differs from that of Leibniz (p. 114) in that the former is empirical whereas the latter is rationalistic, though, interestingly, both took the *self* to be an elementary given. Sources for this section include Russell (LA) and Russell (*PLA*).

[3]The pitfalls of reference are illustrated by the footnoted sentence, for had I said "they refer to nothing," it might have implied that there is a thing — Nothing — to which descriptions refer when nothing else answers the description. We could then make a career out of investigating the properties of this Nothing. Indeed, Alexis Meinong (1853–1921) did precisely that, since he gave a kind of logical reality to any *intentional object*, that is, any object of consciousness. Consideration of Meinong's work led Russell to his theory of descriptions.

perceiving refers to itself. For example, I may be incorrect in thinking that I am seeing a dog (I may be hallucinating etc. etc.), but I cannot be incorrect in my belief that I'm seeing a certain spatial arrangement of patches of color and texture ("canoid color patches," as Russell calls them), which I have come to associate with dogs.

The way to certainty, then, lies in the grounding of all descriptions in objects of acquaintance. In the same way that he defined numbers in terms of more basic logical concepts, the usual objects of science would be defined in terms of sense data.[4] For example a "canoid perception" might be defined as an extremely complex logical construction of elementary propositions referring to canoid color patches. In this way we might be absolutely certain about whether we are having a "canoid perception" (though we might be mistaken about seeing a dog). Russell was convinced that every meaningful proposition could be analyzed into a description involving objects of acquaintance; in his words:

> Thus in every proposition that we can apprehend (i.e. not only in those whose truth or falsehood we can judge of, but in all that we can think about), all the constituents are really entities with which we have immediate acquaintance. (Russell, OD, p. 55)

7.2.2 Wittgenstein: The Tractatus

> *The limits of my language* mean the limits of my world.
>
> — Wittgenstein (*TLP*, ¶5.6)

> We feel that even when *all possible* scientific questions have been answered, the problems of life remain completely untouched. Of course there are then no questions left, and this itself is the answer.

[4] Or whatever the elementary terms might be; Russell changed his mind more the once in his long career. The nature of the "atomic facts" was also a perennial problem for the logical positivists. I may add in passing that the whole notion, that sense data — such as canoid color patches — are perceptually simple, is open to criticism, and is in fact rejected by the theories advocated in the second half of this book.

— Wittgenstein (*TLP*, ¶6.52)

Wovon man nicht sprechen kann, darüber muss man schweigen.
(Whereof one cannot speak, thereon one must remain silent.)

— Wittgenstein (*TLP*, ¶7)

It is rare enough when someone revolutionizes philosophy in their own lifetime; Ludwig Wittgenstein (1889–1951) has the distinction of having accomplished it twice. Indeed his views changed so completely that it is common to treat "early Wittgenstein" and "late Wittgenstein" almost like two different philosophers. In this chapter the topic is early Wittgenstein, late Wittgenstein will be considered in Section **??**.

Wittgenstein's career was anything but ordinary. Educated as an engineer, he became interested in mathematics and logic and studied under Russell at Cambridge. He retreated to a primitive home in Norway to think about philosophy, and during the First World War he completed the *Tractatus*, which is the subject of this section. Then he retired from philosophy, since he thought he had solved its principal problems, and held various jobs, including village school-master and gardener in a monastery. However, he began to question his conclusions and eventually rejected most of them. Therefore in 1929 he returned to Cambridge University and philosophy. However, "He believed that being a professor jeopardized the intellectual integrity of a philosopher" (Hartnack, *W&MP*, p. 7), so in 1947 he retired to a cabin on the west coast of Ireland. He returned to Cambridge in 1949 when he was diagnosed with cancer, and died in 1951. Although he published only the *Tractatus*, after his death his students edited and published his manuscripts and the notes he had dictated to his classes.[5]

Wittgenstein's only published work, the *Tractatus Logico-Philosophicus* (Wittgenstein, *TLP*), had great influence on Russell after World War I, and was seminal to the logical positivist movement. It's style is terse and dogmatic; for example, it begins (Wittgenstein, *TLP*, p. 7):

[5]Hartnack (*W&MP*) is a good, brief introduction to Wittgenstein's thought (both early and late).

1 The world is all that is the case.

1.1 The world is the totality of facts, not of things.

1.11 The world is determined by the facts, and by their being *all* the facts.

1.12 For the totality of facts determines what is the case, and also whatever is not the case.

1.13 The facts in logical space are the world.

1.2 The world divides into facts.

Wittgenstein's own one-sentence summary of the *Tractatus* is the oft-quoted:

> What can be said at all can be said clearly, and what we cannot talk about we must pass over in silence.
>
> *Was sich überhaupt sagen lässt, lässt sich klar sagen; und wovon man nicht reden kann, darüber muss man schweigen.*
>
> (Wittgenstein, *TLP*, p. 3)

Wittgenstein believed that many philosophical problems are a result of misunderstanding language and the way it works (an opinion he did not reject later). Language is only capable of expressing certain ideas, and for these we should use a language ideally suited to accuracy of expression. Those things about which we cannot speak, which Wittgenstein called "the mystical" (*das Mystische*), must be passed over in silence, because it is a philosophical error to try to express the inexpressible. He classed ethics and aesthetics in "the mystical." However, Wittgenstein's insistence on the existence of important, inexpressible problems was ignored by the logical positivists.

The greater part of the *Tractatus* is devoted to the expressible and its clear expression, which is based on two important theses. The *atomistic thesis* says that analysis terminates in elementary facts; though Wittgenstein's version of this thesis is not the same as Russell's or the logical positivists' I will pass over the details. The *picturing thesis*, which is based on the work of Frege and Russell, says that language, when correctly analyzed, is seen to be "isomorphic" to the world.

2.1 We picture facts to ourselves.

2.11 A picture presents a situation in logical space, the existence and non-existence of states of affairs.

2.12 A picture is a model of reality.

...

2.16 If a fact is to be a picture, it must have something in common with what it depicts.

Russell, in his introduction to the *Tractatus*, explains the picturing thesis as follows:

> In order that a certain sentence should assert a certain fact there must, however the language may be constructed, be something in common between the structure of the sentence and the structure of the fact. (Wittgenstein, *TLP*, p. x)

Thus the structure of the world may be discovered by analyzing the possible logical structure of language that depicts, that is, language that does not attempt to express the inexpressible.

7.3 The Vienna Circle and Verifiability

7.3.1 Background

Logical positivism was born in the 1920s with the formation of the *Vienna Circle*, a group of physicists, mathematicians and social scientists, who met every week in Vienna under Moritz Schlick (1892–1936), a philosopher at the University of Vienna.[6] The philosophical movement that they started was later known as *logical positivism*, *logical empiricism* and *scientific empiricism*. In part because of the flight of

[6] Among the members of the Vienna Circle were Rudolf Carnap, Otto Neurath, Friedrich Waismann, Kurt Gödel, Phillip Frank, Karl Menger, Hans Hahn and A. J. Ayer.

philosophers and scientists from Nazi Germany, logical positivism became the dominant philosophy of science in the Anglo-American world, often more implicitly than explicitly.

Although there were disagreements from the beginning in logical positivism, and they multiplied as the movement progressed, there are several themes that are characteristic. First, it is *empirical* in its requirement that all knowledge (except for the "analytic" truths of mathematics and logic, cf. p. 122) be derived from experience. It is *positivist* in its rejection of "metaphysical" claims that cannot be verified by appeal to the givens (literally, the *data*) of experience. It's *scientific* in holding that the methods of the sciences — especially physics — are the only way to true knowledge. Finally, it's *logical* in recognizing the important role that logical constructions play in relating basic data (sensations, measurements, etc.) to the higher order objects of scientific theories (atoms, waves, energy, etc.). In this way the positivists tried to augment Mach's empiricism with the more mathematical approach of Poincaré. We've seen that Russell and Wittgenstein advocated a similar viewpoint, so it's hardly surprising that the *Tractatus* was treated almost as sacred scripture, and was read out loud at Vienna Circle meetings.[7]

7.3.2 Verifiability and Meaning

One of the central tenets of logical positivism was the *verifiability principle*, which says that the meaning of a proposition lies in its mode of verification. In other words, its meaning consists in the measurements we would have to make to decide whether it is true or false. As Schlick (P&R, p. 87) said:

> The criterion of the truth or falsity of the proposition then lies in the fact that under definite conditions (given in the definition) certain data are present, or not present. If this is determined then everything asserted by the proposition is determined, and I know its meaning.

[7]For a time the prophet attended the meetings in person, but in the end he was less welcome than his revelations.

For example, consider the proposition that the temperature of a certain volume of water is 90°C. What does it mean? The logical positivist answer is that if you put a thermometer into the water and read it, then it will show 90°C. However, "reading a thermometer" is still a rather vague description, so it is more precise to say that we place a Celsius thermometer in the water, wait for its reading to stabilize, and then observe that it's opposite the '90' mark. This is still somewhat far from sense data, however, so a further explication might be: "When the meniscus of the mercury column stops moving, it is closer to line marked '90' than to the lines marked '89' or '91'." In general, the idea is that all meaningful factual statements can be reduced to measurements, and measurements are ultimately simple perceptual judgements, such as determining which mark on a dial is the closest to a pointer.

A corollary of this reduction of meaning to verification conditions is the conclusion that any proposition that cannot be verified by appeal to data is *literally meaningless*. In Schlick's words (P&R, p. 88),

> A proposition which is such that the world remains the same whether it be true or false simply says nothing about the world; it is empty and communicates nothing; I can give it no meaning.

Since traditionally *metaphysics* is the study of the basic grounds of existence, which is taken to be prior to empirical verification, its fails the verifiability test, and among the positivists "metaphysics" became a term of derision for meaningless mumbo-jumbo. In this way they saw the verifiability principle as a razor that would cut away all the unanswerable — because meaningless — questions that had vexed philosophers for ages, such as the existence of the external world. It would not *solve* metaphysical problems, it would *dissolve* them.

For a specific example, in the early days of atomic theory, when the existence of atoms was inferred from chemical laws, there were vigorous debates about the reality of atoms. Were there really indivisible bits of matter, or were they simply a convenient fiction for calculation?[8] Though many of the senior scientists at the time were against the reality

[8] In more recent times there have been similar debates about the reality of quarks.

of atoms, the tide eventually turned against them, and modern imaging techniques make it nearly impossible to doubt their existence. The positivist answer would be: "Tell me what you mean by 'existence' by reducing it to measurement. If you do so, then we can make the measurements and answer your question. If you can't point to any observable differences resulting from the existence or nonexistence of atoms, then you are just making meaningless sounds. The solution to your problem is for you to see the emptiness of your question."

Some logical positivists thought that ethical and aesthetic judgements have no more meaning than emotional ejaculations. Thus an aesthetic judgement such as "That's beautiful" has the same content as "Wow!" or "Nice!" An ethical judgement, such as "That's wrong," is really just an expression of personal feeling, like a snarl of anger, a hurt cry, or a sympathetic moan. If these have any meaning at all, it is as reflections of the speaker's emotional state, which is to be reduced to physiological measurements. Thus A. J. Ayer (1910–1989) says:

> For we have seen that, as ethical judgements are mere expressions of feeling, there can be no way of determining the validity of any ethical system, and, indeed, no sense in asking whether any such system is true. All that one may legitimately enquire in this connection is, What are the moral habits of a given person or group of people, and what causes them to have precisely those habits and feelings? (Ayer, *LTL*, p. 112)

> Such aesthetic words as "beautiful" and "hideous" are employed, as ethical words are employed, not to make statements of fact, but simply to express certain feelings and evoke a certain response. It follows, as in ethics, that there is no sense in attributing objective validity to aesthetic judgements, and no possibility of arguing about questions of value in aesthetics, but only about questions of fact. A scientific treatment of aesthetics would show us what in general were the causes of aesthetic feeling, why various societies produced and admired the works of art they did, why taste varies as it does within a given society, and so forth. (Ayer, *LTL*, p. 113)

7.3.3 Reductionism and the Unity of Science

Another important component of logical positivism was the *unity of science movement*.[9] Carnap gave a systematic explanation of how, in general, propositions expressed in the terms of one science, say biology, could be reformulated into equivalent propositions in the terms of another, say physics. Although the propositions of physics could conceivably be reduced to those of biology as well as the other way, in practice it was assumed that physics would be the ultimate goal of all reductions:

> The thesis of *physicalism* maintains that the physical language is a universal language of science — that is to say, that every language of any sub-domain of science can be equipollently translated into the physical language. From this it follows that science is unitary system within which there are no fundamentally diverse object-domains, and consequently no gulf, for example, between natural and psychological sciences. This is the thesis of the *unity of science*. (Carnap, *LSL*, p. 320)

Although the logical positivists were never able to carry out this program, their legacy lingers on in many sciences in the form of a desire to explain their phenomena in physical terms, and of an acceptance of the language and methods of physics as the standards of "real science" (an attitude sometimes called "physics envy" — with acknowledged Freudian allusions).

[9]Carnap (LFUS) is a clear explanation of the unity of science movement and the methods of reductionism.

7.4 The Collapse of Logical Positivism

Already by the 1930s the logical positivist movement had begun to fragment. Although this was the beginning of the end, the movement continued for several decades, and its attitudes and methods linger to this day in many disciplines. The causes of the collapse of logical positivism can be put in two classes, *internal weakness* and *external criticism*. I will begin with the internal causes.

7.4.1 Nature of Atomic Facts

There were problems in the logical positivist program from the beginning, as there are in all new paradigms, but they were expected to be easy to solve. As it turned out, they were fatal flaws. The first of these problems was the exact nature of the "atomic facts," which were supposed to be the indubitable raw material of scientific theories. I've mentioned that Russell changed his mind on this issue; the logical positivists were also unable to reach a consensus.

At first Schlick took sense data to be the atoms, but he recognized that sensory experiences are private — there is no way to tell if the yellow I see is the same yellow that you see — so subjective sense data seemed a bad foundation on which to build a supposedly public, objective science. Instead he decided to start from *relations* among sensory experiences; though our subjective experiences of colors might differ, at least we might be expected to agree about whether two patches have the same color or not. In this way the *order relations* among (private) sense data became the raw material of theories; as Schlick observed, you might even perceive as pitches what I perceive as colors, but that wouldn't matter so long as the relations among your perceptions corresponded to those among mine.

However, other members of the Vienna Circle were not comfortable with the abstractness of Schlick's solution, since they wanted empirical science to be based on concrete observations. Otto Neurath (1882–1945) proposed *protocol sentences* as the atomic constituents of knowledge. These were intended as incorrigible statements of facts which would form the basis of theory construction. This is one of his examples:

> Otto's protocol at 3:17 o'clock: [At 3:16 o'clock Otto said to himself: (at 3:15 o'clock there was a table in the room perceived by Otto)]. (Neurath, PS, p. 202)

Protocol sentences such as this seem too complex to be the "atomic constituents of knowledge." Nevertheless, Neurath admitted that protocol sentences are far from unambiguous. He went so far as to suggest that a term such as "Otto" could be defined as the man "whose carefully taken photograph is listed no. 16 in the file"! Of course, though this may reduce the ambiguity, it doesn't eliminate it, and in the end Neurath had to admit that his protocol sentences are not incorrigible. He thought the truth of a protocol sentence could be judged only by its coherence with other protocol sentences and with the theories constructed from them. Such a *coherence theory of truth* was anathema to the Vienna Circle.[10] Therefore protocol sentences were judged insufficient for the rock-solid foundation desired by the positivists.

I'll mention just one more stage in this development, to impress on you the elusiveness of "atomic facts." Schlick countered Neurath's proposal with one of his own. We have seen an incompatibility between incorrigibility and public verifiability. On one hand, we may accept that personal sensory experience is indubitable, but it's absolutely private. On the other hand, protocol statements are publicly verifiable, but are inherently ambiguous and potentially in error. Schlick (FK) tried to combine the two by saying that a protocol sentence, such as

> M.S. perceived blue on the nth of April 1934 at such and such a time and such and such a place,

is just a *hypothesis*, that cannot be counted as knowledge unless it has a corresponding *confirmation sentence*, such as "Here now blue." However, as Schlick himself observed, a confirmation statement cannot be written down, since "token-reflexive" words such as "here" and "now"

[10] In roughest terms, a coherence theory of truth says that a system of laws, facts, etc. are true if they hang together well. Crudely, if it's a good story then it's true. Scientists as a rule are *realists*, i.e., they believe there is a real world independent of us as observers, and therefore a statement should be judged true only if it *corresponds* to reality. Crudely, in a *correspondence theory of truth*, a true sentence says what's so.

lose there meaning. But filling in a description of the time and place converts it into a protocol sentence and incorrigibility is lost. Thus Schlick's analysis permits the individual scientist to have his protocol sentences confirmed (by *private* affirmations such as "Here now blue"), but this is not a satisfactory basis for *publicly* verifiable science.

7.4.2 Verifiability Problems

Logical positivism's second major internal problem was the status of the verifiability principle. The positivists held that there were only two classes of meaningful statements. On the one hand were the analytic statements, which express the truths of logic and mathematics. Since they follow necessarily from the axioms and definitions, they are indubitable, but factually empty, for they are consequences of the axioms and definitions, which may be chosen at will. On the other hand are synthetic statements, whose truth depends on their verification. In rough terms we have the truths of mathematics and the truths of science. Anything that could not be put into either of these categories was necessarily metaphysical mumbo-jumbo.

The trouble with the positivists' two-way classification of meaningful statements was that it seemed to leave no place for the verifiability principle itself! On one hand, it didn't seem to be analytic, and in any case it wouldn't be very convincing as a prescription if it were merely a consequence of arbitrarily chosen axioms and definitions. On the other hand, it could be considered synthetic only if its meaning could be explicated in terms of verification conditions. What sort of measurements or observations could confirm the verifiability principle. What if the observations, when made, *disconfirmed* the principle? The positivists were also unhappy with this possibility.

One solution would be to conclude that the verifiability principle is a meaningful statement that is neither analytic nor synthetic. But to admit one meaningful statement that's neither analytic nor synthetic is tantamount to admitting the meaningfulness of all the banished claims of metaphysics. The only alternative was to admit that the principle is factually meaningless and simply "expresses certain feelings and evokes a certain response."

For example, Rudolf Carnap (1891–1970), one of the major figures of logical positivism (see Carnap, *LSL*, §§64, 74–79), distinguished statements that are in the *material mode of speech*, that is, about the world, from those in the *formal mode of speech*, that is, about language; the distinction is essentially the same as that between *object language* and *metalanguage* (cf. medieval ideas of *intention* and *supposition*, p. 79). The resolution of the problem of the status of the verifiability principle then lay in recognizing that it's a statement in the formal mode of speech, specifically, it is a *recommendation* about how to use the words 'meaningful' and 'meaningless'. If you accept this recommendation, then you are bound by the verifiability principle and the rest of the positivist view. On the other hand, if you do not accept it, then you have simply adopted another idea of meaningfulness — you have chosen to use 'meaningful' and 'meaningless' in a different way from the positivists. But this is no excuse for them to assert that you are speaking nonsense. Carnap expressed this in his *Principle of Tolerance*: "It is not our business to set up prohibitions, but to arrive at conventions" (Carnap, *LSL*, p. 51). In the end the aggressive "If you can't measure it then you don't know what you're talking about" had been replaced by the wishy-washy "We recommend that you always base your definitions on observables."

Another problem with the verifiability principle is that its strict application would imply that *no scientific law is meaningful!* For example, we may verify that Angus is mortal, that Bridget is mortal and that Camille is mortal, but verification of 'all people are mortal' is impossible, since it would require observation of an infinite number of cases. The major value of scientific laws lies in their applicability to an infinite number of situations, yet it is precisely that property that makes them strictly unverifiable. The logical positivists tried to escape this predicament in many ways, but none were satisfactory. For example some (e.g. Schlick at one point) said that in fact scientific laws are technically *nonsense*, though "important nonsense." This was not a popular position, however, and other positivists distinguished confirmation (or weak verification) from (strong) verification, the idea being that the atomic facts can be strongly verified, and so are incorrigible; whereas general laws can be confirmed by supporting observations, but are not beyond doubt and are always subject to empirical refutation. Unfortunately this position required giving up the certainty that positivism had promised. Indeed Ayer (*LTL*, p. 38) went so far as to declare in 1936 that "no proposition, other than a tautology, can be anything more than a probable hypothesis." Logical positivism had come a long way![11]

Another problem with the verifiability principle was its exact interpretation. 'Verifiable' means 'possible to verify', but what is the appropriate sense of possibility? Logical possibility? Physical possibility? Economic possibility? For example, Schlick raised the question of the verifiability of the proposition that there are mountains on the far side of the moon. Although at that time there were no rockets capable of circumnavigating the moon, most positivists agreed that the proposition was verifiable, since they could see that it was verifiable *in principle*. That is, the necessary observations are "theoretically conceivable," but the question remains of how far this theoretical conceivability can go. For example, I can conceive of devices that use no energy (such as "Maxwell's demon"), and therefore are physically impossible. Can my verification conditions make use of "theoretically conceivable" procedures that violate the laws of physics?

If our verification procedures are restricted to physically possible, then we have the peculiar situation that the meaningfulness of a sentence depends on the state of physical knowledge. For example, before 1927 (when Heisenberg's Uncertainty Principle was published) the proposition that a particular particle has a certain specific position and momentum would have been meaningful, since in principle position and momentum could be measured to arbitrary accuracy. However, in 1927 the sentence became meaningless, since the Uncertainty Principle says that the supposed verification procedure is physically impossible.[12]

Whenever one sees the suffix '-able' (or '-ability') it's worthwhile to ask, "What is the relevant sense of possibility?"

[11] See Ayer (*LTL*, pp. 36–39) for further discussion of these issues.

[12] One also wonders about the precise way in which the meaning vanishes. Does it disappear as soon as the Uncertainty Principle is formulated, or only when it becomes widely accepted? Or does it vanish for each physicist as they accept the principle (which would make 'meaningful' subjective)? Or do we discover that the proposition was *never* meaningful (which would mean we can rarely be sure of meaningfulness, since we may revise at any time our beliefs about physical possibility).

7.4.3 External Criticism

One must acknowledge the intellectual integrity and honesty of the logical positivists and their allies, for it suffered as much from their criticism as from that of its enemies. We've seen that from the beginning there was disagreement about what should be accepted as the incorrigible givens — the *data* — that were intended to be the atomic facts from which true knowledge would be constructed. In addition to the continuing investigations of Russell, Carnap and others, the idea of atomic facts was scrutinized in the 1930s and '40s by such sympathetic philosophers as Tarski, W. V. O. Quine (1908–), Nelson Goodman (1906–) and Hilary Putnam (1926–). However, we pass over these criticisms, since they are subsumed by the more fundamental critique originating in the phenomenological tradition, which will be considered in Chapter **??**.

An even more damaging assault came from the "late Wittgenstein," J. L. Austin (1911–1960), and other "ordinary language philosophers." Since they will be taken up in detail later (Ch. **??**), it will suffice here to say that they called into question the view of language that had been accepted through most of the Western philosophical tradition. First, they pointed out that the words of ordinary language do not have definitions in terms of essential characteristics, as was generally assumed, and further that their meaning could not be captured by such definitions. Therefore, the method of logical construction was fundamentally inadequate as a means of explicating "metaphysical" questions relating to the mind, consciousness, perception, and so forth. Second, they showed that the meaning of a statement in ordinary language is not a simple function of the things denoted by its elementary terms (as, for example, in Tarski's semantic theory, Sec. 5.2). Although each statement fulfills a function for the community that uses it, that function might not be the simple "picturing" of a state of affairs (as "early Wittgenstein" had held). Although these conclusions followed from an analysis of ordinary language, it was apparent that they applied equally well to much of scientific language (see Ch. **??**), so whatever logical positivism might be doing, it was *not* explaining the *actual* practice of science or extending it to other disciplines. Finally, the deepened understanding of *meaning* that came from ordinary language philosophy showed that the much-maligned "metaphysical" statements are far from meaningless. As Putnam (*MLR*, Vol. 2, p. 20) sadly remarked,

> Not a single one of the great positive theses of Logical Empiricism (that Meaning is Method of Verification; that metaphysical propositions are literally without sense; that Mathematics is True by Convention) has turned out to be correct.

7.4.4 Summary

So we may say that logical positivism came in with the bang of the *Tractatus*, but went out with the whimper of increasingly rarefied debates about atomic facts and the status of the verifiability principle. Perhaps because its quick birth was more visible than its slow death, remnants of logical positivism have lingered on in the sciences long after most philosophers abandoned it.

7.5 Influence of Logical Positivism

7.5.1 Quantum Mechanics

> The Pythagorean school was an offshoot of Orphism, which goes back to the worship of Dionysus. Here has been established the connection between religion and mathematics which ever since has exerted the strongest influence on human thought. The Pythagoreans seem to have been the first to realize the creative force inherent in mathematical formulations.
>
> — Heisenberg (*P&P*, p. 67–68)

The influence of logical positivist ideas is apparent in the *Copenhagen Interpretation* of quantum mechanics, named for Bohr's Copenhagen Institute of Theoretical Physics, where it was developed in the mid-1920s, mostly by Niels Bohr (1885–1962) and Werner Heisenberg (1901–1976). The Heisenberg Uncertainty Principle, one of the pillars of quantum mechanics, says that there is an unavoidable uncertainty in the measurement of certain "conjugate variables," such as position and momentum, or time and energy.[13] Specifically, if Δx is the uncertainty in the position of a particle and Δp is the uncertainty in its momentum, then[14]

$$\Delta x \, \Delta p \geq h.$$

Therefore, if we increase the accuracy of our momentum measurement, we must "pay for it" with decreased accuracy in the position measurement and vice versa.[15]

Although the Uncertainty Principle has been very well confirmed since it was first proposed in 1927, physicists still disagree about how it is to be understood. The common-sense view, which we might call "naive realist," is that a particle actually has some specific position and momentum, but that nature places limits on their joint measurement. This, however, is not the view of most physicists, who endorse instead the Copenhagen Interpretation, which says that since it is *in principle* impossible to measure an exact position and momentum, the particle does not in fact have them. This can be understood as a direct application of the Verifiability Principle. According to the laws of physics (i.e. Heisenberg's principle), it is impossible to verify a particle's exact position and momentum, so it is literally *meaningless* to speak of it having an exact position and momentum. We can speak meaningfully only about what we can measure. Since we can measure only an approximate position and momentum, it only makes sense to speak of

[13]There is of course an enormous literature on the Uncertainty Principle, both popular and technical, by both physicists and philosophers. My goal here is limited to illustrating the ubiquity of logical positivist thinking in science. Although quantum mechanics is not within the scope of this book, it's perhaps worth remarking in passing that the uncertainty relation can be traced to the desire to have consistent discrete (particle) and continuous (wave) descriptions of physical phenomena. See Heisenberg (*P&P*, Ch. 3) for a readable discussion of the Copenhagen Interpretation.

[14]The exact constant, Planck's constant h here, depends on the way the measurement process is defined.

[15]It's often thought that this uncertainty results from the measuring device "disturbing the system," but this is not the case, for the uncertainty relation has been shown to hold even when the measurement is made by the *absence* of an interaction (so-called Renninger-style measurements). In fact, the uncertainty relationship is an inevitable consequence of the mathematics of quantum mechanics, since it is a theorem of Fourier analysis that any Fourier-transform pair of variables (e.g. time and frequency) will satisfy such a relationship (Gabor, TC).

an approximate position and momentum (as determined by the laws of quantum mechanics).

By taking positivism to its logical — if absurd — conclusion, respected physicists have gone so far as to claim that it's meaningless to say that the moon is still there when you are not looking at it. (How could you observe that the moon is there when it's not being observed?)[16]

Positivism in Relativity Theory

Although Albert Einstein (1879–1955) disagreed with logical positivism, and he published his first papers on special and general relativity (1905, 1916) before the formation of the Vienna Circle, nevertheless we can see in them applications of the same

[16]The difficulty physicists have accounting for the "collapse of the wavefunction" is also a consequence of their positivist approach with its dualist perspective. For logical positivism separates the subject from the object, the observer from what is observed. As Heisenberg (*P&P*, p. 55) states explicitly, quantum mechanics "starts from the division of the world into the 'object' and the rest of the world, and from the fact that at least for the rest of the world we use the classical concepts in our description."

Since by the Copenhagen Interpretation a particle cannot be said to have a definite state until its *observed* to have a definite state, it is said that before the observation the particle exists as a "superposition" of possible states, but that after the observation this superposition collapses into a specific state (corresponding to what was actually observed). It must be emphasized that this collapse is required only to account for the definiteness of observations. The standard dogma is that so long as a physical system is unobserved, it continues to evolve as a superposition of possible histories. On the other hand, since the laws of physics are supposed to apply to everything in the universe, including observers and their observations, one might expect there to be a physical process corresponding to the collapse of a superposition of potential observations into a single actual observation.

This view generates a host of problems. What is the nature of this collapse? If it is a physical process, what causes it? If it's caused by the act of observation, what constitutes an observation? Must the observation be made by a human? Or might an animal's awareness be adequate to cause the collapse? Could a machine make the observation? This line of reasoning has led to incredible conclusions, such as that consciousness had to evolve in the universe so that it would have a definite state! It also leads to a number of paradoxes, of which there are many popular accounts. These paradoxes vanish once one completely discards the dualism implicit in a fundamental distinction between the observer and the observed (MacLennan, DD).

idea, that physical concepts are constructions of observations and that unverifiable differences are not real differences. In 1916 Einstein directly acknowledged his debt to Mach, saying "the study of Mach has been directly and indirectly a great help in my work," and "Mach recognized the weak spots in classical mechanics and was not very far from requiring a general theory of relativity half a century ago" (quoted in Newman, *WM*, Vol. 3, p. 1785). For example, the postulate of relativity states there is no experiment that we can perform to distinguish one reference frame from another that is moving at a constant velocity with respect to the first. That is, the terms 'absolutely at rest' and 'absolutely in motion' are unverifiable and hence meaningless; all that can be verified is relative motion. Similarly, general relativity is based on the postulate that an accelerating reference frame is experimentally indistinguishable from a reference frame in a gravitational field. This opens the way for a geometrical description of gravity in terms of the curvature of space.

7.5.2 Behaviorism

> Behaviour is simply part of the biology of the organism and can be integrated with the rest of the field when described in appropriate physical dimensions.
>
> — Skinner (BSO, p. 75)

Further evidence of the influence of logical positivist thinking is apparent in *behaviorism*, the philosophy of psychology that dominated that field through the first half of the twentieth century, and still exerts a strong influence. Although the first "behaviorist manifesto" (Watson, 1913) predates the Vienna Circle, B. F. Skinner (1904–1992?), one of the principal exponents of behaviorism, traces its ideas to Mach, Poincaré and Comte — the same progenitors claimed by the logical positivists (Skinner, BSO, p. 74). Certainly behaviorism and logical positivism both reflect ideas "in the air" at the time.

The founder of behaviorism was John B. Watson (1878–1958), who became dissatisfied with psychology's "introspective" methods while he was a doctoral student in the first decade of the twentieth century. At that time psychology, as an experimental science distinct from philosophy, had existed for only 25 years, and its principal method was to ask observers to report on their mental states, which they had "observed introspectively." Watson thought that psychology could achieve its goals better if it studied people the same way it studied animals: by observing overt behavior. In this way psychology would be more scientific, since it would make publicly testable predictions of behavior, and it would be more practical, since it would produce means for controlling behavior. Watson described his vision for a new psychology in summer lectures at Columbia in 1912; they were published the following year (Watson, 1913). Although there were strong objections from some quarters, behaviorism advanced quickly. Its hegemony over psychology from the 1920s to the 1950s can be attributed in part to its conformity with the contemporary positivist philosophy of science, but also to it's arrival on the scene just in time to stock the rapidly growing psychology departments of the '20s and '30s.[17]

Behaviorism's emphasis on publicly observable behavior and its rejection of introspection of mental states has much in common with logical positivism's rejection of "metaphysics" in favor of measurement. For example, Skinner (BSO, p. 75) says,

> By dismissing mental states and processes as metaphors or fictions, [behaviorism] directs attention to the genetic and personal histories of the individual and to the current environment, where the real causes of behavior are to be found.

[17]Watson was left out of much of behaviorism's success. As a result of a divorce scandal, he was shunned by academia and forced to earn a living selling rubber boots. Eventually he was hired by an advertising firm, where he applied his knowledge of behavior to the development of many of the techniques of modern advertising. Behaviorism's advocacy of and technology for behavior control has inspired at least three novels: Huxley's *Brave New World*, Orwell's *1984* and Skinner's *Walden Two*. (See *OCM*, s.v. Behaviorism, and Cohen, *JBW*.)

Mental experiences, such as a feeling of purpose, are *epiphenomena* with no causal efficacy, and the cause of our actions is to be found in the environment, past or present:

> We do not act because we have a purpose, we act because of past consequences which generate the condition of our bodies which we observe introspectively and call felt purpose. (Skinner, BSO, p. 74)

"Physics envy" brings with it the assumption that everything of importance can be measured, so it is no surprise that Edward Lee Thorndike (1874–1949), who published his *Measurement of Intelligence* in 1926, was a leading behaviorist. Of course, there is nothing wrong with trying to measure phenomena. The problems arise when measurement is combined with the positivist outlook, which tends to reject the unmeasurable (or even the unmeasured) as meaningless and unimportant. Then, the measured fragments of the phenomenon come to be viewed as the whole of the phenomenon. For example, creativity seems to have little correlation with the components of intelligence measured by IQ tests (*OCM*, s.v. Creativity), but IQ is frequently treated as an accurate measure of intelligence.[18]

The positivist's emphasis on logical construction, for example in Carnap's "logical syntax," is also manifest in behaviorist psychology. For example, Clark Leonard Hull (1884-1952), the leading behaviorist of the 1940s,

> wanted a theory of behaviour as formal as Euclid's theory of geometry, and he introduced theorems and postulates which could account for all behaviour. (*OCM*, s.v. Behaviorism, p. 73)

(His intended "behavior theory" was not successful.) Debate continues about whether behaviorism improved psychology or merely delayed its progress. Be that as it may, in the next chapter we will consider *cognitive science*, a more sophisticated application of atomism and logical construction in psychology.

[18] See Gould (*MM*, esp. Chs. 5, 6) for a discussion of the abuse of intelligence measurements.

7.5.3 The Turing Test

> I believe that in about fifty years' time it will be possible to programme computers, with a storage capacity of about 10^9, to make them play the imitation game so well that an average interrogator will not have more than 70 per cent. chance of making the right identification after five minutes of questioning.
>
> — A. M. Turing (CM&I, 1950)

Debate continues about whether a computer could think or have a mind, and conversely about whether the brain or mind is in some sense a computer. Often the discussion revolves around the *Turing Test*, which Turing called the *imitation game* (Turing, CM&I). The topic here is limited to the Turing Test as a reflection of logical positivism; more general considerations will be taken up later (**??**).

Can machines think? This is the question with which Turing begins, but he observes that the terms are not clearly defined. He entertains the possibility of capturing the everyday use of these terms in definitions — essentially the method of ordinary language philosophy — but concludes that the result would have no more significance than a public opinion poll. Turing concludes:

> But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous terms.

The new question is based on the imitation game: First consider a game played by a man, a woman, and an interrogator of either sex. The "contestants" are concealed from the interrogator, who can communicate with them only by typed messages. The object of the game for the interrogator to guess which contestant is the woman; the man's object is to fool the interrogator into thinking he is the woman; the woman's object is to convince the interrogator that she is in fact the woman. We can expect the interrogator to reach the correct conclusion a certain fraction of the time (probably more than half). Now, Turing says, suppose we replace the male contestant by a computer, so that both the computer and the woman are trying to convince the interrogator that they are the woman. Turing says the original question, "Can machines think?" can be replaced by the question, "Can a machine fool the interrogator at least as often as a human male contestant?"[19]

As evident in the quotation that begins this section, Turing thought that by the beginning of the Twenty-first Century a computer would pass the Turing test, but we disregard that for now. Here our concern is not the *answer* to the question, but how logical positivism influenced the *formulation* of the question.

First observe that the Turing Test is completely behavioristic, replacing the mental predicate "think" by a verifiable behavioral predicate, "able to win the imitation game at least as often as a human male."

Turing acknowledges that passing the Turing test does not prove that the machine is conscious, but he counters this with the well-known claim that we do not know if other *people* are conscious. He observes that "Instead of arguing continually over this point it is usual to have the polite convention that everyone thinks." He anticipates that, rather than retreating to a solipsistic position, most people would be willing to extend this polite convention to a Turing Test-passing machine.

In other words, Turing takes consciousness to be a property that is not publicly verifiable and that is accessible only through introspection. Thus it has no role in his verifiable surrogate for "Can machines think?"[20]

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[19]Popular accounts of the Turing Test often have a person and a machine both trying to convince the interrogator that they are the person; the sexual component is omitted. Though Turing does not explain the purpose for this extra complication, and most descriptions of the Turing test simply ignore it, presumably it is to make the test more fair by comparing the intelligence of two agents in comparable tasks — imitating what they are not. That is, the goal is for the machine to know as much about being a woman as a man knows about being a woman, but not necessarily as much as a woman knows about being a woman.

[20]Turing's original paper (Turing, CM&I) addresses many (though not all) of the objections that have been made against the Turing Test and machine intelligence over the years, and anyone interested in the topic would be well advised to read it, and not depend on this or any other second-hand account.

7.5.4 Conclusions

The basic goals of logical positivism are laudable. "What we can say we should say clearly" — who would argue with this?[21] Likewise, a question can often be clarified by asking: How would you know? Or: What difference would it make? And shouldn't we try to relate our knowledge in one discipline to that in another, and ferret out any inconsistencies? These are common values in all intellectual activities, but especially in science.

The problems arise when these goals are pursued to extremes — one consequence of the quest for certainty. For the logical positivists wanted was an absolute, context-free foundation for knowledge. In this they were no different from the rationalists of earlier times. As empiricists, they differed in taking the objects of sense as their starting point, rather than the objects of the intellect. They were alike in supposing they knew where to find absolute certainties, but when they tried to sieze them, they slipped through their fingers.

The logical positivists ignored that fact that observation takes places in a context, a dense web of common practices (e.g. measurement) and unstated assumptions (e.g. causality). As a consequence, there are no context-independent sense data, nor are there observations unbiased by preconceived ideas. Further, most significant concepts are not logically reducible to necessary and sufficient properties equivalent, in turn, to their verification conditions.[22] Science progresses in spite of these difficulties, but they undermined the foundations of logical positivism. Though they ridiculed philosophy's quest for metaphysical truth, the logical positivists fell prey to an equally alluring idea and naively assumed the existence of context-free, atomic facts. Nietzsche foresaw the trap:

> One must, however, go still further, and also declare war, relentless war unto death, against the "atomistic need" which still leads a dangerous afterlife in places where no one sus-

[21] In fact there are situations, both social and legal, in which intentional ambiguity is desirable. We ignore this for now, and restrict our attention to scientific and philosophical discourse, where presumably clarity is always desirable.

[22] These issues will be discussed in more detail in Chap. ??.

> pects it, just like the more celebrated "metaphysical need"... (Nietzsche, *BG&E*, §12)

One unfortunate consequence of logical positivism, which still infects those disciplines where it has been influential, is the dogmatic, intolerant, arrogant and closed-minded attitude that it encourages. For when people are certain they are correct, they tend to be intolerant of other points of view. Why compromise with falsehood? And so we often find physics envy reinforced by *physics arrogance*: If you don't do things like we physicists (say we) do things, then you aren't a real scientist.[23]

One common form taken by this arrogance is the dogmatic limitation of phenomena to the measurable. Certainly, there is no inherent harm in trying to measure things; the mistake comes in the assumption that such observational or pragmatic correlates exhaust the phenomena. Thus we hear, "Intelligence is what IQ measures." Other important but unmeasured components of intelligence are simply defined out of existence, and therefore disvalued.

In conclusion, the major value of logical positivism, as of rationalism, formalism, and other single-minded views, may be that it exposed its own limitations. Now that we have thoroughly explored *that* path, we can turn our attention to others.

[23]As a consequence, many "soft sciences" and would-be sciences try to emulate the methods of physics to excess. For example, computer science has engendered the (largely unfruitful) "software physics" and "software science."