CONTRADICTION AND DIALECTIC IN THE DEVELOPMENT OF SCIENCE*

SEAN SAYERS

*Everything is inherently contradictory. . . . This law . . . expresses . . . the truth and the essential nature of things. . . . Contradiction is the root of all movement and vitality; it is only in so far as something has a contradiction within it that it moves, has an urge and activity.*

I

THE NOTION OF CONTRADICTION is fundamental to the philosophy of dialectic, the philosophy of Hegel and of Marxism. At the basis of this philosophy is the view that all things are in a process of change and development, and that the motion and change of things is the outcome of the contradictions which are inherent in them.

I am well aware that to many people such talk of contradiction will seem unacceptable and even absurd, for it appears to violate the most elementary and obvious principles of philosophy, logic and common sense. In particular, contradiction is commonly regarded as a synonym for absurdity and irrationality; and adherence to the logical law of non-contradiction is held to be a necessary precondition for all rational and scientific thought. And so the philosophy of dialectic is often dismissed and rejected out of hand as involving the simplest sort of logical fallacies.

Even philosophers sympathetic to the dialectical outlook have often found its notion of contradiction hard to understand and hard to accept. Consequently they have tried to reinterpret this philosophy so as to render it compatible with the law of

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non-contradiction and the other traditional laws of logic. Schaff, for example, argues that

"There is no disagreement between the dialectical principle of the unity and struggle of opposites, as the source of movement and development, and the principle of logical non-contradiction."²

Many other writers have argued in a similar fashion that the dialectical outlook can be reconciled with traditional logic.³

Tempting as it is to follow this path in giving an account of dialectical philosophy (for it is certainly the line of least resistance), I do not think that it is either a viable or a correct interpretation. The philosophy of dialectic, as it is explained by Hegel and by the major writers of Marxism, is quite explicitly and deliberately a philosophy of contradiction. It is impossible to remove this notion from dialectics without distorting and revising it beyond recognition. Nor is it necessary to do so. This is what I shall argue in this paper. My first purpose will thus be to try to show that the traditional logical law of non-contradiction is not a necessary principle of rational and scientific thought, and consequently that it does not constitute an insuperable objection to dialectics. In order to show this I shall focus particularly on recent work in the philosophy of science. In the latter part of the paper my argument will take a more positive form. I will try to indicate how dialectics, although it does indeed involve a questioning of the traditional principles of logic as usually understood, neither embraces irrationalism nor involves any elementary logical errors; on the contrary, it offers the basis for a much more adequate and illuminating account of the processes of rational and scientific thought than any view based on the law of non-contradiction.

At the outset, however, I must stress that my arguments in this paper cover only a limited ground. I will be concerned exclusively with the way in which contradiction functions in the development of thought and the way in which dialectics can illuminate this process. Although it is my conviction that the philosophy of dialectic involves the view that everything concrete


is contradictory — and it is in these terms that I outline this philosophy in Section II below — questions about contradiction in other spheres (e.g., nature or society) are not discussed here. I am aware that this leaves the argument for the dialectical outlook incomplete, and I have no doubt that the skeptical reader will find as many questions raised as answered by what I have to say. Yet perhaps this is not such a bad thing. If the only result of my arguments is to make the reader think more critically about the validity of traditional logic, I shall be satisfied. For an unthinking and unquestioning acceptance of traditional logic may be the greatest obstacle to an appreciation of the dialectical outlook. If, in addition, the reader is persuaded by the dialectical account of the process of scientific thought outlined at the end of this paper and is interested to pursue these ideas further, then I shall have achieved all that I set out to do.

II

Dialectics, then, is quite deliberately a philosophy of contradiction, by which is meant a unity or conjunction of opposites. Hegel’s philosophy is founded on this notion and so is the philosophy of Marxism. Thus in his Logic Hegel argues that everything concrete is in a process of motion, development and change, a process of “becoming,” which he analyzes as a unity of being and nothing. He argues that it is in the nature of concrete things to be both particular and general, to contain both identity and difference, to have both quantitative and qualitative, positive and negative, aspects, and so on. All concrete things are the unity of such opposites. This is what Hegel means when he says, "Everything is inherently contradictory. . . . This law expresses the truth and the essential nature of things."⁴

This law of contradiction, the fundamental principle of dialectical thought, is repeatedly stated and defended not only by Hegel, but by all other major dialectical philosophers as well. Moreover, there can be no doubt that when Hegel says “contradiction,” he does indeed mean contradiction and not some other notion. Dialectical philosophy does, therefore, involve a questioning of the idea that the law of non-contradiction and the

other traditional laws of logic constitute necessary principles of
reason and laws of thought.

Dialectical logic, with its law of contradiction, is intended to
provide a framework for describing the concrete reality of
things. The principles of traditional logic may well give an ade-
quate picture of purely abstract and formal reasoning, where the
only concern is for formal consistency and formal validity. But
concrete thought — thought which has a content and which at-
ttempts to grasp truth, whether in the form of science, mathemat-
ics, philosophy, logic or whatever — is never solely or simply
determined by the principles of traditional logic. This is what
Hegel argues. Indeed, he is positively scathing about the claims
made by traditional logic for what he calls "these so-called laws of
thought." He ridicules the claim that these laws are self-evident
and unquestionable principles of reason. For example, about the
"law of identity" (that everything is identical with itself, \( A = A \)) he
says:

It is asserted that the maxim of identity, though it cannot be proved,
regulates the procedure of every consciousness, and that experience
shows it to be accepted as soon as its terms are apprehended. To this
alleged experience of the logic-books may be opposed the universal
experience that no mind thinks or forms conceptions or speaks in
accordance with this law, and that no existence of any kind whatever
conforms to it. Utterances after the fashion of this pretended law (a
planet is a planet; magnetism is magnetism; mind is mind) are, as they
deserve to be, reputed silly. That is certainly a matter of general expe-
rience. The logic which seriously propounds such laws and the scholastic
world in which alone they are valid have long been discredited with
practical common sense as well as with the philosophy of reason.\(^5\)

And Hegel proceeds to make similar criticisms of the other tradi-
tional laws of logic as well:

Instead of speaking by the maxim of Excluded Middle (which is the
maxim of abstract understanding) we should rather say: Everything is
opposite. Neither in heaven nor in earth, neither in the world of mind
nor of nature, is there anywhere such an abstract "either-or" as the
understanding maintains. Whatever exists is concrete, with difference
and opposition in itself. . . . Contradiction is the very moving principle
of the world: and it is ridiculous to say that contradiction is unthink-

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214 (sec. 115).

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However, as Hegel goes on to say, the result of a concrete
and dialectical contradiction is never mere self-annulment; and
Hegel here is far from endorsing the common view that con-
tradictions are self-cancelling statements which state nothing. On
the contrary, the result of a concrete and dialectical contradic-
tion, the product of a real conflict of opposed ideas, aspects or
tendencies, the outcome of a real process, is always something
determinate, a result, a new thing, which is equally contradictory
and hence equally subject to change and development. "In gen-
eral," writes Hegel in summing up his views,

our consideration of the nature of contradiction has shown that it is
not, so to speak, a blemish, an imperfection or a defect in something if
a contradiction can be pointed out in it. On the contrary, every deter-
mination, every concrete thing, every Notion, is essentially a unity of
. . . contradictory moments.\(^7\)

III

This is the dialectical account of contradiction; it is clearly in
conflict with more traditional logical ideas, according to which
contradictions are unacceptable and incompatible with rational
and scientific thought. The law of non-contradiction is com-
monly regarded as such a self-evident and unquestionable prin-
ciple that it needs only to be stated in order to be universally
accepted as an obvious truth. But as soon as one looks in detail at
the history of logic and at the accounts of this law that are given
in the contemporary literature one finds abundant evidence to
contradict this specious claim. For instead of universal agree-
ment, what one discovers is a history of argument and contro-
versy about the meaning and status of this law, even among its
defenders.

Some philosophers argue that contradictory statements are
meaningless and that nothing can be stated in the form of a
contradiction. Others put forward the law of non-contradiction
in its Aristotelian form: self-contradictory statements, it is

\(^6\) Ibid., p. 223 (sec. 1192).
\(^7\) G.W.F. Hegel, Science of Logic, p. 442.
claimed, cannot be true, and to assert them is irrational. However, no serious account of the history or present state of logic can long sustain the view that it is a body of absolute, self-evident and universally agreed upon truths and principles. On the contrary, Engels has a more realistic and, indeed, a more dialectical view of the matter when he writes:

The science of logic is, ... like every other, an historical science, the science of the historical development of thought. ... The theory of the Laws of Thought is by no means an "eternal truth" established once and for all, as philistine reasoning imagines to be the case with the word "logic." Formal logic itself has been the arena of violent controversy from the time of Aristotle to the present day.8

The extreme view, that self-contradictory statements are meaningless, seems so clearly untenable that I shall not dwell long on it. It is put forward in familiar terms by Strawson, for example, who writes:

The standard purpose of speech, the intention to communicate something, is frustrated by self-contradiction. Contradicting oneself is like writing something down and then erasing it, or putting a line through it. A contradiction cancels itself and leaves nothing.9

This sounds plausible enough in the abstract, until one recalls that many writers have put forward their views in a contradictory and inconsistent fashion, sometimes quite deliberately. For paradox is a well-recognized technique of literary style. Heraclitus's famous river paradox or Zeno's paradoxes of motion are well-known philosophical examples. One may feel that these paradoxes are mere paradoxes, and that the problems they indicate in our understanding of motion and change can be otherwise stated and resolved in a non-contradictory manner. One may therefore wish to argue that the form of contradiction and paradox here serves merely as a dramatic device by means of which these problems can be presented in a striking fashion.10

But one can hardly maintain that such statements are meaningless, self-cancelling assertions, which fail to communicate anything at all. For then it would be incomprehensible how it has been that philosophers have been puzzled and exercised by these paradoxes for the last 2000 years and continue to be so today.

Other writers have produced self-contradictory statements or theories without intending to do so. Indeed, it is widely acknowledged that there is hardly a philosopher in whose work one cannot point to contradictions and inconsistencies. In Locke's philosophy, for example, there is a well-recognized contradiction (first pointed out by Berkeley) between his basic account of experience, the theory of ideas, on the one hand, and the realism and materialism of his causal and representative theory of perception, on the other. But this by no means implies that Locke failed to communicate anything in his great Essay. Quite the contrary, as the historical record shows, his work provided a philosophical framework which was enormously influential in guiding scientific work for over a century, and which is still at the center of discussion in the field of the theory of knowledge to this day. Furthermore, the suggestiveness and significance of Locke's philosophy is closely connected with this fundamental contradiction in it. For Locke thereby gives expression to the realist and materialist tendency of the empiricist tradition, and rejects the idealism and solipsism inherent in the theory of ideas developed in the superficially more consistent philosophy of Berkeley and in the phenomenalist tradition. I am not here arguing that there is virtue in inconsistency, but I am trying to show that inconsistent and self-contradictory theories can, and often do, communicate something; and that they cannot simply be dismissed as meaningless and self-cancelling statements which do not succeed in stating anything.

IV

The extreme view, that contradictory statements are meaningless and fail to express anything, seems clearly untenable. The more traditional version of the law of non-contradiction, that self-contradictory propositions are false, is less easily disposed of. For, it will be argued, to show that a statement or a theory is contradictory is to demonstrate at least that it is false and that there is something incorrect in it. Contradiction in a theory, it is said, is a fatal defect; and when a contradiction in a theory is discovered to exist, the theory must be abandoned on pain of

10 This is not my own view, however; see my book with Richard Norman cited above.
irrationality. For example, in response to Zeno’s paradoxes, one must either accept Zeno’s conclusion, that the very idea of motion is incoherent and impossible, or one must try to show that the concept of motion does not in fact involve the contradictions which Zeno thought it did. Or, in the case of Locke’s philosophy, one must either acknowledge that the contradiction which Berkeley pointed out in it shows it to be a false and defective philosophy, or one must show some fallacy in Berkeley’s argument. In other words, it is argued, we must reject contradictory assertions as false; for to accept a contradictory theory and to abandon the principle of non-contradiction is to abandon one of the fundamental principles of rational thought. Such contradictory assertions as Zeno’s paradoxes or Locke’s philosophy can be said to be fruitful and suggestive only because a recognition of the contradictions they involve leads us to critically reconsider the issues with which they deal.

This is Popper’s argument. It is precisely because of the law of non-contradiction, he argues, and the impossibility of accepting contradictory statements, that, for example, Zeno’s paradoxes lead us to reassess the concept of motion.

Dialecticians say that contradictions are fruitful, or fertile, or productive of progress, and . . . this is, in a sense, true. It is true, however, only so long as we are determined not to put up with contradictions and to change any theory which involves contradictions; in other words never to accept a contradiction.11

And Popper argues that the law of non-contradiction, in this form, is at the basis of all rational and scientific thought.

For . . . if one were to accept contradictions then one would have to give up any kind of scientific activity; it would mean a complete breakdown of science.12

Popper’s whole account of scientific method, which he also calls the “critical method,” is based upon the law of non-contradiction. According to him, scientific method is a process of “trial and error,” “conjecture and refutation,” guided and controlled by the principle of non-contradiction. Scientific theories,

12 Ibid., p. 316.

he argues, have the character of conjectures, “unjustified and unjustifiable” “guesses”13 or hypotheses which are put forward by scientists. The process of science then consists of subjecting these “conjectures” to empirical test and trying to criticize and refute them. According to this view, when a theory, a conjecture, a hypothesis, has been contradicted by evidence, it has been refuted — contradicted and falsified — and it must be abandoned and a new conjecture proposed.

This is Popper’s account of scientific method and it is based, as I have tried to emphasize, on his view that reason and criticism depend on the law of non-contradiction. However, as Kuhn has so well argued, scientific method, as it is actually used by practicing scientists, does not correspond to this picture. For, as Kuhn shows, no scientific theory is simply refuted by confrontation with contradictory facts. Scientists do not simply abandon their theories in the face of counter-instances. On the basis of a study of the history of science, Kuhn effectively argues that “refutation” in the Popperian sense simply does not occur in the development of science. “No process yet disclosed by the historical study of scientific development at all resembles the methodological stereotype of falsification by direct comparison with nature.”14 Of course this is not to deny that scientists are led to abandon one theory when experimental investigation reveals problems and difficulties for it and to develop a new theory. However, as Kuhn stresses, this is not merely a matter of rejecting a theory in the face of counter-evidence. For theory — or rather that complex of theory and methods which Kuhn refers to as a “paradigm” — is an essential working tool of science which serves a purpose: namely, to explain and make sense of a certain area of reality. If it is shown to be defective, it must be superseded and replaced by a new theory which is more adequate to that task; and until such a more adequate theory is available, a scientist will not simply abandon his theory, even in the face of counter-instances and contradictions.

Falsification, though it surely occurs, does not happen with, or simply because of, the emergence of an anomaly or falsifying instant. Instead,
it is a subsequent and separate process that might equally well be called verification since it consists in the triumph of a new paradigm over the old one.\textsuperscript{15}

Until a particular paradigm is superseded, according to Kuhn, a scientist will hold on to it, even while recognizing and acknowledging certain counter-instances. Such counter-instances are precisely what Popper describes as "refuting" instances; that is, cases where there is a contradiction between the theory and the evidence as so far understood. However, they are not regarded as fatal to the theory, as they should be according to Popper. They are not treated as "refutations," but rather as "problems" and "anomalies" – that is to say, as contradictions which are accepted within the theory.

It is certainly true that the presence of such contradictions or "anomalies" within a theory are a source of tension and a motive for development and change. This is precisely the role given to contradiction by Hegel and by other dialectical thinkers. However, such contradictions do not lead the scientist to reject his theory on these grounds alone, as the law of non-contradiction suggests he should. On the contrary, if a scientist really behaved as the law of non-contradiction says he should, and rejected his theory (or his observations) at the first sight of contradiction, so far from being in accordance with the laws of logic and the necessary principles of reason and so on, this behavior would be the very epitome of irrationality and the abandonment of science. For no scientific theory provides a perfect account of reality, free of all problems and discrepancies; and thus, as Kuhn says, "all [scientifc] theories confront counter-instances at all times."\textsuperscript{16}

According to Popper, "the acceptance of contradictions must lead here as everywhere to the end of criticism, and thus to the collapse of science."\textsuperscript{17} However, despite Popper's confident assertions, such purely logical and formal criticism plays only a subsidiary role in scientific method and is never the whole of it. If the sole aim of science were formal consistency and the avoidance of contradiction, then Popper's account of science would have its justification. However, science is the attempt to understand and explain the nature of reality, and so consistency is never its sole or primary aim. For all concrete scientific theories have their problems and contradictions and, in Kuhn's words, "there is no such thing as research without counter-instances."\textsuperscript{18}

All scientific theories have their counter-instances and these constitute contradictions for them. This is what I have so far argued; but before going on there is an objection that should be considered. For there are those who would argue that it is incorrect to speak of "contradiction" in this context and that, in Lakatos's words, "No experimental result may be interpreted directly as counter-evidence."\textsuperscript{19} According to Lakatos a well-established scientific theory can never be contradicted or refuted by empirical evidence, since the theory makes a definite prediction only on the assumption that all the causal influences operating are known and have been taken into account. However, instead of making such an assumption, and regarding anomalous observations as contradictory to his theory, the scientist may equally well take them as indicating some new and previously unsuspected influence. Thus:

No experimental result can ever kill a theory; any theory can be saved from counter-instances either by some auxiliary hypothesis or by a suitable re-interpretation of its terms.\textsuperscript{20}

To illustrate this argument, Lakatos gives "an imaginary case of planetary misbehavior" in the Newtonian era. In this example, the scientist uses Newtonian mechanics, \(N\), to calculate the path of a newly discovered small planet, \(p\). But observation shows that the planet deviates from the calculated path.

Does our Newtonian physicist consider that the deviation was forbidden by Newton's theory and therefore that, once established, it refutes the theory, \(N'\)? No. He suggests that there must be a hitherto unknown planet, \(p'\), which perturbs the path of \(p\). . . . Were the unknown planet \(p'\) to be discovered, it would be hailed as a new victory of Newtonian science. But it is not. . . . Does our scientist abandon Newton's theory?

\textsuperscript{15} Ibid., p. 147.
\textsuperscript{16} Ibid., p. 80.
\textsuperscript{17} K.R. Popper, Conjectures and Refutations, p. 322.
\textsuperscript{18} T.S. Kuhn, The Structure of Scientific Revolutions, p. 79.
\textsuperscript{20} Ibid., p. 32.
... No, either yet another auxiliary hypothesis is proposed or ... the whole story is buried in the dusty volumes of periodicals and the story is never mentioned again.21

One may grant Lakatos's account of how a scientist would probably proceed in such a case without conceding the conclusion he wants to draw. Initially the scientist works on the assumption that he has discovered the significant causal influences at work and that he has taken them into account in his calculations. If observations deviate from predictions then the scientist may be led to call this assumption into question. He may speculate about further causal factors and suggest various additional hypotheses to resolve the contradiction; and would, no doubt, do so as Lakatos suggests. However, such auxiliary hypotheses represent, initially, no more than a hope on the part of the scientist that the contradiction can be resolved in this way and a faith in the theory. They remain mere hypotheses and speculations at this stage, with as yet no empirical basis of support. Such auxiliary hypotheses must be tested experimentally; and until some grounds for accepting them are discovered, the problem is unresolved and the contradiction remains. And this is a contradiction in the full logical sense. There are well-established observations which stand in logical contradiction to the predictions of a theory on the basis of current empirical knowledge. For, as far as scientists are at this stage aware, there are no perturbing influences which would account for the anomalous results. This is the only correct description of the state of scientific knowledge at this stage. And so the contradiction remains unresolved at this stage and is accepted by the scientist in his work — even if he has various ways in mind by means of which he might hope to resolve it in the future.

In other parts of his work Lakatos is well aware of the fact that scientists can, and often do, tolerate and work with inconsistencies. He gives many examples of this and has much that is interesting and suggestive to say on the subject.22 But ultimately, it seems to me, he is unwilling to face up to the full logical implications of his own examples and arguments. Ultimately he wants to have it both ways: he recognizes that it is often rational to tolerate inconsistencies and yet he cannot bring himself (perhaps because of his antipathy to Hegelian and Marxist thought?) to call the logical principle of non-contradiction into question. Consistency, for Lakatos, remains an essential precondition for truth.

Consistency — in a strong sense of the term — must remain an important regulative principle; ... and inconsistencies (including anomalies) must be seen as problems. The reason is simple. If science aims at truth it must aim at consistency; if it resigns consistency it resigns truth.23

However, if inconsistency is a vice in Lakatos's book it is by no means such a serious one that it cannot and should not be tolerated for pragmatic reasons, and he goes on to say that this does not mean that the discovery of an inconsistency — or of an anomaly — must immediately stop the development of a programme: it may be rational to put the inconsistency into some temporary, ad hoc quarantine, and carry on with the positive heuristic of the programme.24

Despite this pragmatic toleration of inconsistency, however, Lakatos brands any attempt to question the law of non-contradiction as "anarchistic," "irrational" and "obscure."25 At least in its Hegelian and Marxist form it is nothing of the sort; and such accusations against the philosophy of dialectic, common as they are, are a crude and inaccurate caricature. It is completely false to suggest that dialectics is an irrationalist philosophy or that it rejects scientific method. On the contrary, dialectics, by recognizing the crucial role that contradiction plays in the development of thought, is able to offer a much more adequate account of the way in which concrete scientific and rational thought actually proceeds.

Furthermore, it is not only in the area of science that it turns out to be a myth that the law of non-contradiction is a necessary law of thought. The same is true even of mathematics. For example, the theory of the calculus, as it was developed and used from the time of Newton and Leibnitz right into the nineteenth century, was based upon contradictory notions of the "infinities-

21 Ibid., p. 17.
22 Ibid., see especially pp. 58-68.
23 Ibid., pp. 57-8.
24 Ibid., p. 58.
ations; it is the attempt to comprehend the concrete nature of reality in the most general theoretical terms; and mere logical consistency and the avoidance of contradiction is not its sole and necessarily overriding aim. In other words, the law of non-contradiction is no more a law of philosophical thought than it is of scientific or mathematical thought. Moreover the attempt to treat philosophy as though it had to be governed by this law is undoubtedly the basis of the academicism and scholasticism of so much recent philosophical work. As Collingwood so well says:

To study a philosophy with the avowed intention, not of asking how adequately it deals with its subject-matter, but solely of looking for inconsistencies in its logical form, implies a withdrawal of interest from that which most interested the author, the subject-matter, and a consequent alienation of sympathy from him which makes it impossible to estimate his work fairly. Criticism of this kind will fall most hardly on writers who are genuinely grappling with the intricacies of a difficult problem; ... it will be most lenient to those who, abandoning all attempt at profound or close study of the matter in hand, content themselves with a one-sided account of some partial aspect.  

Dialectical philosophy rejects the idea that the laws of traditional logic are necessary principles of reasoning that must govern all thought. Real thought is not like this. The idea of a non-contradictory theory is an abstraction. All real theories — the real thoughts of real people — are imperfect, limited, finite, relative, and thus contradictory.

I am well aware of how paradoxical the argument I am presenting will still seem to many people. No doubt the following objection will have been taking shape in people's thoughts. To point to contradictions in a theory, it will be argued, is nonetheless to point to defects and mistakes in it. The very examples that I have myself cited seem to bear this out: anomalies show that a scientific theory is defective; contradictions in the notion of the infinitesimal mean that the old theory of the calculus is incoherent; and inconsistencies in a philosophy are unacceptable. Surely this shows that it is correct to maintain that contradictions indicate a defect in a theory and that they cannot be accepted as they stand.

Contradictions are indeed a "defect" in things, in the sense that they are a negative aspect which leads to change and development in things. Dialectics does not deny this. However, according to dialectics, contradiction is not a purely negative phenomenon, it also has a positive aspect. The metaphysical outlook that I have been criticizing and the traditional logic upon which it is based, sees contradiction as something merely negative. Dialectics, by contrast, recognizes both the positive and the negative side of contradiction, and denies neither.

In science, for example, new and anomalous observations appear initially as a negative force, which eventually negate, undermine and destroy an old theory. But equally, as Kuhn implies in his account of the mechanisms of scientific development, we must recognize the positive side of such developments. These new observations, and the inability of the old theory to accommodate them, provide the basis for a new theory, and give rise to progress and development in science. By contrast, Popper, in his account of scientific method, focuses almost exclusively on the negative aspect, on "refutation"; and he entirely isolates this from the positive aspect, which he calls "conjecture," and which he regards as a non-logical, merely "psychological," process. But these two aspects should not be separated in this way, for in reality they are united. New theories do not appear from nowhere, they are not the result of groundless "conjectures" — they arise from experience and the problems it engenders for the old theory.

So there is certainly a negative side to contradiction, and in this sense one may think of contradiction as a "defect." Because of their contradictions things are undermined and negated, they perish and are superseded. However, in this process the "defect" of contradiction is not overcome. On the contrary, it is preserved. For the new thing that arises with the supersession of the old is a concrete result, not the abstract ideal of non-contradiction. It too contains antagonisms and tensions within itself, it too is a unity of positive and negative aspects, contradictory and subject to development and change.

"The grasping of the positive in the negative," says Hegel, "is the most important aspect of dialectic." To see only a "de-

I have been arguing that dialectics is a philosophy of contradiction which rejects the claim that the traditional laws of logic are universal and necessary principles of thought. However, it should be stressed that dialectical philosophy does not simply dismiss these laws absolutely and completely, and deny all validity to them. Rather, what dialectical philosophy says of these laws is that their validity is genuine but limited.

The traditional laws of logic specify the principles of deductive and formal reasoning. The utility and value of such reasoning, in science, mathematics, philosophy and other spheres of thought is genuine and substantial; and dialectical philosophy does not deny this. In a proof or in a deductive argument, for example, a contradiction is a fault and an indication that the argument, as an argument, is invalid. However, the crucial point to see is that formal consistency is only one concern in an argument about a concrete subject matter. It is never the only concern. For concrete and practical thought seeks not just to be valid, but to be true. And mere formal validity is no guarantee of truth, nor is formal invalidity a guarantee of falsehood. Formal logic, just because it excludes all considerations of content, is indifferent to truth.

In a purely formal and deductive system or argument, where the only concern is for consistency and formal validity, the law of non-contradiction holds true. A contradiction, the assertion of P and not-P, the conjunction of opposites, in these circumstances, is invalid and cannot be accepted. But the minute the content of what is being said is also taken into account the situation changes. Now the contradiction becomes concrete: P and its opposite now stand for determinate propositions, propositions with a definite content. In the abstract, one can never have any good reason for asserting a contradiction; but in concrete circumstances one may well have good reasons for asserting both sides of a contradiction. I have already cited examples from science and mathematics which show this. Indeed, it is the most
common experience in the world, whatever the logic books say. Concrete situations continually arise in which one has reason to believe both $P$ and not-$P$. One is in a dilemma, one comes up against problems. In such cases, one has reason to believe a certain thing, $P$, and one also has reason to believe its opposite, not-$P$; and so one has reason to believe a contradiction, both $P$ and not-$P$, and it would be irrational to believe anything else.

At this point the following objection can be anticipated. If a situation arises in which we have reason to believe $P$ and also at the same time reason to believe its opposite, not-$P$, then it does not follow that we have reason to believe both $P$ and not-$P$. Rather, it will be said, what is rational in such circumstances is to suspend judgment, and to believe neither $P$ nor its opposite. It seems to me that this line of argument is resorted to simply in order to preserve the law of non-contradiction from any questioning, and that it has little else to recommend it. For example, if a scientist were to “suspend judgment” whenever he came upon an anomalous result, a contradiction between theory and practical observation, this would rapidly lead him to suspend judgment not only in all scientific theories whatever (for none are without their problems and anomalies), but also in his observations and empirical findings into the bargain. To follow the law of non-contradiction here, in whatever shape or form it is put forward, so far from giving a necessary principle of rational thought, would make scientific thinking impossible.

VI

So far my argument has been a mainly negative one. I have tried to show that, even though the law of non-contradiction has a limited sphere of validity and application, it is not the necessary principle of reason it is so often claimed to be. It is wrong, I have argued, to see the contradictions which arise in the development of scientific thought in a purely negative way, as mere defects to be eliminated. Contradictions are necessary and essential to the development of scientific thought, and they play a positive role in it which must also be recognized. It is one of the great strengths of the dialectical outlook to be aware of this.

However, the philosophy of dialectic goes further; it sees a much greater role for contradiction than my argument so far has suggested. For, as I have already stressed, it maintains that all concrete things are contradictory and a unity of opposites. And so a true and correct account of reality must portray it as contradictory. A dialectical account of reality will involve contradiction, not only negatively, in the form of the problems and anomalies with which it will inevitably be confronted; but also positively, in the very way in which it describes its object.

Contradictions are therefore involved in thought in two ways. First of all, contradictions in a theory may appear negatively, as problems and anomalies. I have focused upon this form exclusively because up to now I have been arguing against the traditional logical principle of non-contradiction; and a proper appreciation of the role which anomalies and problems play in the development of scientific thought seems to me perhaps the easiest way of seeing the defects of the traditional logic. However, according to dialectics, there is a second way in which contradiction is essentially involved in a scientific understanding of things. All things are contradictory, according to dialectics, and a true account of them must therefore reflect, recognize and depict these contradictions.

Contradictions in thought appear in a negative form, as problems and difficulties, only when the basis of these contradictions is not recognized or understood. What dialectics seeks to do is to comprehend the contradictions which really do exist in things and in the process of thought itself, so that these contradictions no longer appear in a negative form, but rather as positive additions to knowledge. To comprehend a contradiction involves understanding its basis, resolving it into its “ground.” This does not mean eliminating or eradicating the contradiction, but rather locating each of its antagonistic aspects as “moments” of a larger unity or totality, as moments of a process which includes them both and in which they are preserved.

The fundamental idea of dialectics is that all things are in a process of change and development and that contradiction is at the root of such change. I have already, I hope, sufficiently emphasized that dialectics rejects the traditional logical principle of non-contradiction; when dialectics talks of things as being contradictory it does not mean that they are impossible or nonexistent. To say that capitalism is a contradictory social form, for example, does not mean that it cannot or does not exist, but
rather that it is an historical and transitory form of society. Likewise, to point to contradictions in a scientific theory does not necessarily entail that it is meaningless or false, but it does mean that the theory contains within itself conflicts and tensions which will necessarily result in its further development and change. The philosophy of science must comprehend these contradictions if it is to be adequate to the reality of science; similarly the social sciences must comprehend the contradictions of capitalism, and the natural sciences the contradictions of nature.

The traditional logic of non-contradiction regards contradiction as repugnant to reality and to rational thought. Dialectics, by contrast, argues that contradictions must be acknowledged to exist as real features of nature, society and our thought. It represents the attempt to recognize and comprehend the contradictions which manifest themselves in things. An important implication of this is that the natural and social sciences must describe and comprehend the contradictions in nature and society. A full explanation of how the philosophy of dialectics applies to the natural and social sciences lies beyond the scope of the present paper, and at this point I must refer the reader elsewhere. However, in the specific area I am covering here (namely, the development of scientific thought and the account of it which is given in the philosophy of science) I must now try to indicate how the dialectical account may be justified. In other words, I must now try to show how an understanding of the development of scientific thought requires a comprehension of it in dialectical terms, in terms of contradiction.

VII

In criticizing Popper’s attempt to make the law of non-contradiction the basic principle of scientific method I have relied heavily on Kuhn’s arguments. Now I want to consider Kuhn’s own philosophy in a more critical light as a useful preliminary to the dialectical account. I suspect that Kuhn would not be entirely happy with the use that I have made of his arguments and still less with the conclusions I am trying to draw from them.

A full consideration of Kuhn’s account of the nature of science reveals that it too relies very heavily on the law of non-contradiction, and that Kuhn is very far from wishing to question and reject this as a necessary precondition of rational thought. According to Kuhn, all established scientific work essentially involves the use of a “paradigm,” by which he means the particular constellation of theories and methods which the scientist uses in his investigation and understanding of that area of reality with which he is concerned. Kuhn argues that all the empirical data of science must be interpreted and understood in the light of a paradigm; for there is no such thing as the direct and immediate experience of nature. A paradigm functions as a “world-view.” All the data of science are necessarily filtered through it and, in the process, affected and altered by it.

For Kuhn, a paradigm is not the product of experience. On the contrary, it is our paradigm which determines how we interpret our experience and what we see it as revealing of the world. The data of science are not, therefore, something given immediately in experience; they are something constructed, a product of the paradigm, the interpretation, the world-view we bring to bear on them. Thus scientists with different paradigms see the world differently, even when confronted with the same situation. The Ptolemaic astronomer sees the sun circling the earth, whereas the Copernican sees the earth revolving around the sun. And this is not just a matter of each seeing the same situation — that is, receiving the same data of experience — but interpreting it differently. In some sense, Kuhn wants to argue, scientists with different paradigms “live in” and see “different worlds.”

The proponents of competing paradigms practice their trades in different worlds. . . . Practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction.

Kuhn puts these ideas forward with a considerable amount of hesitation and uncertainty but at the end of the day we are left in little doubt that this is the direction in which the main line of his theory is tending. “After Copernicus,” he says, “astronomers lived in a different world.”


29 T.S. Kuhn, The Structure of Scientific Revolutions, p. 150.
30 Ibid., p. 117.
Here we have the picture of a paradigm functioning as a systematic set of assumptions about the nature of reality in accordance with which particular methods of investigation are devised and data interpreted. According to this view, no particular experience or experimental result, simply as such, has any automatic and infallible authority or claim to truth. Each experience, and the results of every experiment, must be interpreted before they can be accepted as data and indicative of fact. The criterion for such interpretation, according to Kuhn, is how well the putative data fit in with the paradigm or “world-view” with which we are operating. Experience which coheres is accepted as fact within our system; while experience and experimental results which are discrepant are regarded as “problematic” or “anomalous” and laid aside for further investigation: “anomaly appears only against the background provided by a paradigm.”

According to Kuhn, then, coherence and non-contradiction with the existing paradigm is the criterion by which data is accepted as data within a scientific system; and anomalous experience is identified as such by its non-coherence. The crucial role played by the principle of non-contradiction in Kuhn’s theory is now apparent. And it is also apparent that Kuhn’s account of science is in a familiar and well-established philosophical tradition, for it bears unmistakable similarity to accounts of knowledge based upon the coherence theory of truth as developed by the idealist philosophers of the nineteenth century. Indeed, one would be inclined to say that Kuhn’s account of scientific knowledge is based upon the coherence theory of truth except that he rejects all talk of truth as unnecessary and unhelpful, and opts instead for an agnostic relativism. Nevertheless, just like the traditional coherence theorists, Kuhn argues that knowledge cannot rest on a foundation of indubitable and immediately given experience, and that instead our experience is to be judged by its coherence with the rest of our picture of reality. Bradley, for example, an earlier philosopher, expresses strikingly similar ideas when he writes:

My experience is solid . . . so far as . . . it is a system. My object is to have a world as comprehensive and coherent as possible, and, in order to attain this object, I have not only to reflect but perpetually to have recourse to the materials of sense . . . . Now it is agreed that if I am to have an orderly world, I cannot possibly accept all “facts.” Some of these must be relegated, as they are, to the world of error, whether we succeed or fail in modifying and correcting them. And the view which I advocate takes them all as in principle fallible . . . . Facts for it are true, we may say, just so far as they work, just so far as they contribute to the order of experience.33

This account of scientific knowledge gives rise to a serious problem for Kuhn, of which he does not seem to be sufficiently aware. For these epistemological views are incompatible with the very interesting and suggestive accounts of the historical development of science which Kuhn also gives. According to the latter, scientific development occurs through the accumulation of anomalies, which are engendered in the course of normal scientific activity, and which eventually lead to a crisis for the theory and at last to scientific revolution. However, the account which Kuhn gives of the way in which a paradigm shapes and forms the data of science rules out the very possibility of “anomalous” experience and hence also the mechanism of scientific change which he describes.

For if our knowledge is a construct of our interpretation, if our data is a product of the paradigm we bring to bear on it, then the data of experience and the results of experiment must always and necessarily conform to our theory. If our “world-view” is a creation of our theory, the very possibility of discrepant or contradictory experience is excluded. If the Ptolemaic lives in a Ptolemaic world, how is he ever to escape from it? How can anomalous experience ever arise for him, and how can the Ptolemaic paradigm ever come into crisis? Given Kuhn’s own account of the matter, these things would seem to be impossible, and so too, therefore, the mechanism of scientific change which Kuhn describes.

In other words, Kuhn’s epistemological views lead to the conclusion that each period of science is hermetically sealed up in its own dogmatic and self-created universe, immune from any external counter-evidence or criticism; and the development of science is rendered into a series of incomprehensible, arbitrary, sudden and absolute changes of “world-view.”

31 Ibid., p. 65.
32 Ibid., Ch. XIII.
No doubt Kuhn’s account of the nature of science would be a more consistent one if he abandoned the notions of “anomalies” and “crises” and with them his account of the mechanism of scientific change. An account of this sort is, incidentally, proposed by Althusser,\(^{34}\) whose epistemological views strikingly resemble Kuhn’s in other respects. Althusser, unlike Kuhn, omits all consideration of the mechanism of scientific change from his account; his portrayal is simply a series of arbitrary and incomprehensible “epistemological breaks” or discontinuities. Althusser’s philosophy is certainly the more consistent in this respect, but it is also the poorer for it. For Kuhn’s account of anomalies and their role in the development of science is surely one of the most valuable and important aspects of his work; and this inconsistency in his philosophy is therefore a product, in part, of his good sense of the process of the historical development of science — a sense almost entirely lacking in Althusser.

VIII

The accounts of scientific knowledge given by Popper and by Kuhn shed light on the nature of science; yet each is ultimately unsatisfactory. Each, in its own way, gives a one-sided account of the scientific method.

The scientist works with a theory and with certain methods guided and determined by that theory. He puts the theory to work in practice and observes the results. On this much, Popper and Kuhn are agreed. According to Popper, if the results of experience contradict the theory, the theory is “refuted” and must be altered or abandoned. Kuhn, by contrast, rejects the one-sided emphasis of Popperian empiricism,\(^{35}\) which gives experience absolute authority over theory. The facts, according to

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\(^{34}\) L. Althusser and E. Balibar, Reading Capital (London, 1970), Part I.

\(^{35}\) I am aware that in my account of Popper’s philosophy I have stressed his empiricism and ignored another theme which is prominent in his work and which brings his ideas closer to those of Kuhn — viz., his stress on the need for all experience to be interpreted. In justification of this account of Popper’s philosophy there are two considerations: (1) the main line of Popper’s argument is strongly empiricist in character, and for all practical purposes this is an accurate picture of his thought; (2) any attempt to make the data of experience subject to interpretation undermines the main line of Popper’s philosophy, and gives rise to inconsistencies and contradictions exactly analogous to those I have pointed to in Kuhn’s philosophy.
tradition of these opposite aspects, and it is only in these terms that it can be properly understood.

It is a problem and an anomaly for Popper's account that theory can be, and is, used to contradict experience in science. For Kuhn's account, conversely, it is a problem and an anomaly that experience can and does contradict even well-established theories. The mutual interaction and conflict between theory and experience which is the process of knowledge is not adequately comprehended in either of these accounts, but rather manifests itself in a negative form, as problems and difficulties for them. The dialectical account, by contrast, recognizes that this contradiction is essential to knowledge and attempts to comprehend knowledge as the process of this contradiction. The contradiction is acknowledged and preserved in the dialectical account because there is explicit emphasis on the conflict which continues to exist between theory and the results of experiment and their interaction. But the contradiction is comprehended; it no longer manifests itself as an anomaly. These contradictory aspects are seen to be moments in the development of knowledge. It is only when knowledge is seen as a process and as a development that its contradictory aspects can be comprehended in a satisfactory manner.

In reality contradictions cannot stand permanently. They lead to development and change. They must be resolved — or rather, they resolve themselves. But the resolution is not the elimination of contradiction. Instead it is a result, a development, a new thing, which is equally contradictory, and hence one in which contradiction is preserved. This is what characterizes the development of knowledge. The resolution of the contradictory aspects of knowledge occurs only through the development of knowledge. However, the contradiction, in being resolved in one form, is only reinstated in another, and hence preserved. For example, the contradiction between theory and experience at a particular stage in the development of knowledge may be resolved ultimately by the development of a new theory which comprehends previously anomalous experience within a new theoretical framework. But the new theory, though no doubt

36 For an excellent account of the theory of knowledge along these lines, see Mao Zedong, "On Practice" and "Where Do Correct Ideas Come From?" Four Essays on Philosophy (Peking, 1966).

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more adequate than the old, will in its turn involve anomalies and contradictions. Thus the resolution of the contradiction between experience and the old theory does not lead to the elimination of the contradiction between theory and experience. On the contrary, it merely reestablishes the contradiction on a new and different basis. The contradiction is thus both resolved and preserved, and continues to be so as long as knowledge continues to develop. The resolution that I am here talking about is not a merely theoretical resolution, but the practical result and outcome of contradiction. The contradiction between theory and experience exists as a fact in all scientific knowledge. It cannot be resolved merely conceptually, by thinking about these matters in other terms. It must be acknowledged to exist in any adequate account of scientific knowledge.

The dialectical account of knowledge which I have been outlining here is sometimes summed up in the slogan that knowledge is the "unity of theory and experience" (or, more familiarly, the "unity of theory and practice"). However, in the light of what I have been saying, it may be seen that this formulation is one-sided and unsatisfactory. Hegel makes this point in connection with the relation of Being and Nothing as follows:

Such phrases as "Being and Nothing are the same" or "The unity of Being and Nothing" — like all other such unities, that of subject and object, and others — give rise to [a] reasonable objection. They misrepresent the facts, by giving an exclusive prominence to the unity, and leaving the difference which undoubtedly exists in it ... without any express mention or notice. ... The fact is, no speculative [i.e., dialectical — S.S.] principle can be correctly expressed by any such propositional form, for the unity has to be conceived in the diversity, which is all the while present and explicit.

Knowledge is not merely the unity of theory and experience, since it is equally the case that knowledge involves the conflict, the difference and disunity, of theory and experience, their mutual antagonism. It is only by recognizing both aspects — unity and diversity — and seeing the process of knowledge as a contradictory one that it can be properly understood.

To conclude, then: scientific knowledge is a process involving a continual conflict, interaction and dialogue between expe-

37 G.W.F. Hegel, The Logic of Hegel, p. 166 (Sec. 88).
rience and theory. Knowledge, in other words, is a process based (like all other concrete processes) upon contradiction. This is the dialectical account of knowledge; and it is in conflict with the traditional logic of non-contradiction. However, as I have tried to show, there is no good reason for dialectical philosophy to abandon its theory on this account. On the contrary, although the law of non-contradiction has a limited validity, in specifying the principles of purely formal reasoning, the moment the attempt is made — as it invariably is in traditional logic and in the metaphysical philosophy to which it gives rise — to portray this law as a necessary principle of all rational and scientific thought, then it becomes misleading and false. Dialectics, by contrast, with its correct appreciation of the significance of contradiction, offers a logic of content — a method of thinking which grasps things in their concreteness, and therein lies its power and value.