

BERKELEY'S PHILOSOPHY OF SCIENCE

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by

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SCOPE AND CONTENTS:

This paper is an examination of Berkeley's philosophy of science, and the connections of his views on science with the rest of his metaphysics. Berkeley's ontology is outlined so as to provide a groundwork from which his arguments for his theory of science can be more easily seen. The distinction between real explanation and scientific explanation is drawn and examined. The possibility of having scientific knowledge is examined within the content of Berkeley's epistemology in general, and the consistency of Berkeley's view of science with his analysis of perception is considered. The question of Berkeley's instrumentalism and reductionism is examined in the context of his treatment of mathematical hypotheses (i.e., force, gravity, mass, etc.). Lastly, Berkeley's views on space, time, and motion are considered within the context of his views on science in general.

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List of Abbreviations

<u>Dialogues;</u>	<u>Three Dialogues Between Hylos and Philonous</u>
D.M.;	<u>De Motu</u>
N.T.V.;	<u>An Essay Towards a New Theory of Vision</u>
P.C.;	<u>Philosophical Commentaries</u>
Pr.;	<u>A Treatise Concerning the Principles of Human Knowledge</u>
Siris;	<u>Siris: A Chain of Philosophical Reflections and Inquiries</u>
T.V.V.;	<u>The Theory of Vision or Visual Language, shewing the immediate Presence and Providence of a Deity, Vindicated and Explained</u>

In the text and footnotes, the number after the above abbreviations indicates the number which Berkeley gave to the various sections of his works; except that Dialogues is followed by the number of the relevant page in volume II of Luce's and Jessop's edition of Berkeley's works.

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Chapter I

Introduction

The object of this paper is essentially twofold. First, I wish to examine Berkeley's philosophy of science; that is, to examine what he has to say about science, scientific explanation, and such scientific concepts as force and emotion. In particular, of interest are the limits he wished to establish for science, and the areas where he disagreed with and criticized his contemporaries. Berkeley, indeed criticized almost all his contemporaries on questions of science; he criticized the materialists, especially the corpuscular theorists, but even went on to criticize the great Newton himself. Berkeley's philosophy of science, from which such criticisms arose, is worthy of consideration if only because, as history progressed, both scientists and philosophers have come to agree with many of his criticisms.

The other question I wish to consider, and which will constitute the bulk of the paper, is the problem of the relationship between Berkeley's philosophy of science and the rest of his philosophy. Both his ontology and his epistemology play an integral role in his arguments for his philosophy of science, and hence, will be considered mainly in that aspect. Also to be considered is his analysis of perception, though that is not as closely related to his philosophy of science.

The second chapter will be devoted to outlining Berkeley's ontology and epistemology, and their inter-connection. This is an essential first step in understanding the framework in which Berkeley formulated his theory of science.

The next chapter will discuss Berkeley's two notions of cause; real cause and scientific cause. The latter part of the discussion will contain Berkeley's theory of scientific explanation which is the keynote of his philosophy of science.

Two problems arise out of Berkeley's theory of scientific explanation. There is the major epistemological problem of how scientific knowledge is possible; in pursuing this topic, one encounters many problems which arise from the more general question of how knowledge of any sort is possible in Berkeley's philosophy. God's role in the universe, and the relation of God to the objects of scientific study, also require consideration at this point.

It is not immediately obvious that Berkeley's restrictions on science have not excluded some concepts (such as force and gravity) which science cannot do without. To solve some problems in this area, Berkeley introduces the concept of mathematical hypotheses. The possibility of using these hypothetical entities is the topic of part two of Chapter IV.

The next chapter considers the relationship between Berkeley's philosophy of science and his analysis of perception. Is his analysis of perception consistent with his view of science; is it sufficient for his view of science; and, is it necessary

for his view of science? These are the main questions I attempt to answer.

Lastly, I briefly consider Berkeley's views on space, time and motion. These are mainly considered as further applications of the principles which underlie most of his theory of science.

As will be seen, Berkeley's theories have many inconsistencies, questionable portions, and omissions. But despite that, Berkeley on science can be insightful, enlightening, and generally deserving of admiration.

Chapter II

Berkeley's Ontology

Before considering Berkeley's views on the philosophy of science, I will devote this chapter to outlining his metaphysics. This discussion should not be viewed as complete or thorough; I present only Berkeley's conclusions, shorn of the arguments he presents for them and shorn of all criticism or development. This task is necessary if we are to be free in the ensuing chapter to discuss problems in Berkeley's philosophy of science without getting bogged down in all the problems of his metaphysics. I wish to establish an unquestioned starting point so as to provide a framework for the rest of the paper.

In this respect, two aspects of Berkeley's metaphysics are essential; namely, his ontology and his epistemology. His ontology is actually quite simple; there exist ideas, spirits, or minds, and relations. That is all. This is largely determined by his epistemology, which provides for the possibility of knowing these and only these entities. We know ideas by immediate perception;¹ we have notions of spirits and relations,² and know

¹ Pr. 1.

² Pr. 142.

of them either directly or by rational inference.³

We perceive ideas; we perceive only ideas; and all ideas are perceived. This philosophical position, in conjunction with Berkeley's theory of the nature of ideas, might be called 'perceptual atomism.' For Berkeley, ideas are discrete, simple and indivisible,⁴ and have no necessary connections with one another.⁵ They are, indeed, atoms in the historical sense of the word. The complex picture of the world as it is normally thought of, is built up combinations of ideas in various arrangements.

Ideas are of three types; namely, ideas of sense, ideas of the imagination, and ideas of memory.⁶ Ideas of the latter two sorts exist only in the mind which causes them.⁷ Ideas of sense exist only in minds, but they are presented to finite minds by God; or, in other words, God is the cause of our perceiving the ideas of sense. Memory and imagination contain only ideas formed out of and resembling ideas already perceived by the senses.⁸ The criterion used to distinguish ideas of sense from ideas of the imagination and memory seems to be the causal origin of them. This raises the

³ Pr. 89.

⁴ Cf. Ritchie, George Berkeley, A Reappraisal, pg. 50. See also the discussion of minima visibilia, N. T. V. 80 f.f., P.C. 439, and below p V-14; and Berkeley's discussion of objects as collections of ideas or qualities, Pr. 1-3, 38, 78.

⁵ N.T.V. 62,63; T.V.V. 22, 30; Pr. 31, 65.

⁶ Pr. 30; P.C. 823.

⁷ Berkeley's notion of cause will be discussed in depth in the next chapter.

⁸ Cf. Pr., 1.

problem of the degree to which I am aware of my own causing, or even controlling, my memory or imagination. This, of course, is an empirical question, but I think I am safe in claiming that my awareness is not sufficient for making the distinction. If awareness of causation (or the lack of it) is not the ground for this distinction, then Berkeley will be forced to base the distinction on some quality which is internal to the ideas, such as the feeling, vivacity, or distinctness of the idea, as Hume does.⁹ This will be equally unsatisfactory. The failure to provide an adequate criterion for distinguishing sense from memory and imagination is one of the weak points of Berkeley's theory of ideas.

All ideas perceived by the senses are perceived by one, and only one, of the senses.¹⁰ By sight we perceive light, colours, visible extension, visible figure, and visible position. By touch we perceive hardness and softness, heat and cold, motion and resistance, and tangible extension, tangible figure, and tangible position. It is to be noted that sight and touch can perceive no common ideas, tangible and visible extension, figure and position being different.¹¹ By the other senses we perceive sounds, tastes, and smells, as might be expected. Several things should be noted here. First, Berkeley is making an empirical claim; namely, that we can always classify our perceptions as being by one of several senses such that no sensed idea falls

⁹ Cf., Pr., 30.

¹⁰ Cf. Pr. 1; T.V.V. 10.

¹¹ P.C. 441; H.T.V. 49.

under two headings. He seems on safe ground here, with the possible exception of smells and tastes, which are sometimes so confused it would seem impossible to distinguish them. Second, although we seem to be able so to classify our ideas, Berkeley provides no criterion for the classification, and indeed, as a matter of empirical fact, there seems to be no such criterion possible. Lastly, Berkeley says in the New Theory of Vision that touch allows us to perceive what is real¹² but in his later works he withdraws this,¹³ and only says that touch is the most important sense for our survival; all senses and all sensible ideas are thus ontologically equal.

For Berkeley, there are no necessary connections between any of our ideas.¹⁴ Whether they be of the same sense or of different senses, two ideas can only be connected by relations learned by experience. It is both logically possible and conceivable that our sensible ideas should be related in a fashion different from the way they are in fact related.

But what precisely, one may well ask, is an idea? Berkeley never describes or attempts to define ideas. He only says that they are the "objects of human knowledge" (Pr. 1.). This is probably the weakest point of Berkeley's philosophy, and one which indeed may be fatal to it. The only consolation is that most of the British empiricists suffer from the same fault. I am

¹²N.T.V. throughout; especially those places where he says that sight suggests distance without the mind; eg., 41, 46, etc.

¹³Cf. Pr., 44.

¹⁴Pr. 31, 65; N.T.V. 62, 63; T.V.V. 22, 30.

like all other philosophers I know, powerless to elucidate the concept of ideas further.

Ideas are known immediately, which is to say we do not know them by inference. Berkeley never attempts to analyze or describe how we are conscious or aware of ideas; he considers the matter obvious. What is perplexing in this respect is whether or not the mind is active in its perception of ideas; or, as the question could be asked in Berkeley's terms, whether we have notions of ideas. Ritchie, for example, thinks Berkeley's theory requires passive receptivity of ideas by the mind,¹⁵ but there are advantages to claiming we have notions of ideas.¹⁶

Unlike Hume, Berkeley allows that there are spirits or minds. There must be Something, he says, (his capital letter) which perceives and acts upon ideas.¹⁷ The primary characteristic of spirits is that they are active; but it is not clear whether their being consists entirely in their acting, or whether there is an underlying substance which exists independently of the acting. Berkeley, on occasion, says the latter,¹⁸ but it does not seem that his philosophy derives any advantage from such a belief. (The possible advantage to Berkeley's theology is another question.)

¹⁵A. D. Ritchie, Berkeley: A Reappraisal, p. 50

¹⁶For the implication of this step on the theory of notions, Cf. S. Najm, "Knowledge of the Self in Berkeley's Philosophy,"

¹⁷Pr. 2.

¹⁸For example, Pr. 26.

Spirits are necessary in Berkeley's world because ideas are entirely passive and inactive,¹⁹ and Berkeley cannot see how to have a dynamic world (including such things as motions and causes) without some active agents.

We cannot have ideas of spirits; this is primarily because ideas are not of anything, they just are what they are and represent nothing else.²⁰ Besides, an idea is necessarily inactive, and a spirit is necessarily active.²¹ Hence, an idea cannot represent nor even resemble a spirit. Also, spirits are not perceivable by sense, as all ideas must be. Since spirits, unlike ideas, exist independently of their being known by a mind, Berkeley feels that he must provide something which is dependent on the mind and which allows us to know spirits. These he calls notions. Berkeley's theory of notions is far from clear, and I will not try to make complete sense out of it here. It would seem that notions are activities of the mind²² which allow us, in some way, to know spirits, the actions of spirits, and relations. The ambiguity of the concept of notions will be discussed in relation to several problems in the ensuing chapters.

We know of some (actually, only one; namely, ourselves) spirit

¹⁹P.C. 684, Pr. 25.

²⁰P.C. 660.

²¹Pr. 27.

²²Cf. Siris, 308. For a further discussion of notions, see chapter IV.

directly by inward reflection, and we know of others by inference.²³
By inference, we know that there are many other finite minds, and
that there is one infinite mind, God.²⁴

The final group of entities in Berkeley's ontology, and the one which is most poorly discussed, is relations. That Berkeley never develops an adequate theory of relations (or perhaps we should say that he never develops a theory at all) is one of the central causes of the problems in his philosophy of science. We know relations by way of notions; (Pr. 89, 142); the mind is active in knowing relations; (Pr. 142); and relations are distinct from the ideas related, (Pr. 89). This is all Berkeley tells us about our knowledge of relations. In particular, it is not clear whether such relations as time, space, and the rules of science (all of which are relational for Berkeley, as we shall see), are presented to us in the same fashion as ideas are, or whether the mental activity required to know relations to some extent determines the relations known.²⁵

Ideas, relations, and spirits (both finite and infinite), are all that exist in Berkeley's world. Furthermore, these are all that can ever be known. Knowledge is either by direct perception, as in the case of ideas, or it is by way of notions, as in the case with spirits and relations. Most finite spirits and the infinite spirit are known by inference; myself I know immediately. How we come to understand relations is never made clear.

²³ Cf. Pr. 89.

²⁴ Pr. 145-148.

²⁵ Cf. Below, Chapter IV.

Chapter III

Cause and Explanation

In the last chapter, the elements of Berkeley's ontology were described, and some indication was given as to how we can know ideas, spirits, and relations. Such an outline is an essential prerequisite to any discussion of Berkeley's ideas on cause and explanation, for Berkeley explains and defends his notion of explanation by referring to his ontology, and to a basic principle of explanation which refers to his ontology.

Berkeley argues that all explanations must be in terms of those entities to which his ontology grants existence; that is, all explanations must be in terms of only ideas, spirits, and relations.¹ For this principle, he advances two closely related arguments. First, he claims that we can never know about anything except ideas and spirits, and that it is useless to offer explanations in terms of entities which can never be known. In *De Motu*, for example, he says: "To throw light on nature it is idle to adduce things which are neither evident to the senses, intelligible to reason.....I speak of things known; for of the unknown it is profitless to speak." (D.M. 2). The second argument is in terms of Berkeley's theory of meaning; it is pointless

¹Berkeley's theory of relations causes special epistemological problems, which I will discuss later.

to use words which have no meaning. Since Berkeley grants meaning only to words which refer to existing entities (i.e., ideas or spirits), this criterion grants legitimacy only to those explanations which do not refer to anything outside his ontology.

Both these arguments are advanced often throughout Berkeley's works,² but both are essentially summed up in the principle that one must offer explanations only in terms of ideas, spirits, or relations. Throughout the rest of this paper, I will use this conclusion without presenting each time the argument for it from the possibility of meaning or knowing.

Granting Berkeley this principle, the central problem of this chapter now becomes: what scope is there for a notion of cause, and what sorts of explanations can be offered which do not refer beyond spirits or ideas? It should be noted here that the possibility of explanations in terms of hypothetical or mathematical entities which do not really exist, will be discussed in the next chapter. The problem here is to establish the nature of cause and to outline the logical structure of legitimate explanations within the confines of Berkeley's ontology.

Berkeley assumes that the meaning of the word "cause" is known, and that there are, in fact, causes, effects and causal relations in the world. What he precisely means by cause he never fully explains, nor does he argue for what he does say about cause. However, the following assumptions seem to underlie most.

²For example, Cf., D.M. 6, 21, 23, 40; Pr. 102 and especially T.V.V. 17, 18.

of what he says about cause:³ causing is an activity and only that which can be active can cause, passive entities cannot cause;⁴ all passive entities are caused by something else;⁵ and the action of an active entity need not be caused by anything outside the acting entity.⁶ The magnitude of these assumptions can easily be seen when one remembers that ideas are passive, spirits active, and that ideas and spirits are all that the world contains. That Berkeley does not present arguments for the above assumptions, therefore, seems to entail that he assumes almost everything he says about real causes. And this is, I think,⁶ the case.

¹ Perhaps the central problem with Berkeley's acceptance of there being causes in the world, is how we can come to know them. If cause necessarily involved activity, then we cannot possibly have an idea of cause, either in general or in any specific instance. Berkeley seems to have recognized this fact; he says in the Philosophical Commentaries, for example, "The simple idea called Power seems obscure or rather none at all." (P.C. 461; Cf. 493). Both times he says this in the Commentaries, he provides an alternative; causes are relations.⁷ This, if accepted, solves both the questions of what ontological status causes have, and of how we can know causes. Relations are real entities

³ Berkeley nowhere explicitly states these principles, but the following references give passages where each is obviously assumed.

⁴ Pr. 25, D.M. 26-29, P.C. 499.

⁵ Pr. 146.

⁶ Dialogues, p. 237.

⁷ Within the content of the rest of Berkeley's philosophy, there are ambiguities in seeing real cause as a relation; but these are beyond the scope of this paper.

for Berkeley; in precisely what sense is a problem, especially when dealing with cause. But the point that I want to raise here is that if causes are relations, then they are known by way of notions.⁸ So far as I know, Berkeley at no point explicitly says that we have notions of causes, but as mentioned above, he seems to be aware that we do not have ideas of them.

Both Berkeley's doctrines of relations and his concept of notions are engulfed in problems, and so I content myself with the following observations rather than advancing any definite conclusions.

First of all, it makes sense to see cause as involving relations. Most philosophers of the present century would admit that the logical structure of causal thinking is relational. And Berkeley at one point, (P.C. 461), attempts to make such a logical structure explicit.

Secondly, some⁹ hold that notions are for Berkeley activities of the mind. The grounds for such an opinion have to do with the role of mental activity in the process of knowing, a topic which will be discussed in the next chapter. For the moment, let me only note the following passage in Siris which supports this interpretation: "Some, perhaps, may think the truth to be this--that there are properly no ideas, or passive objects, in the mind, but were

⁸ Cf. Pr. 89--"In a like manner we know and have a notion of relations between things or ideas,..."

⁹ S. M. Najm, "Knowledge of the Self in Berkeley's Philosophy," p. 256.

derived from sense: but that there are also besides these her own acts or operations, such are notions." (Sirís, 308)

That notions are activities poses no problems for the doctrine that causes are known by way of notions. In fact, Berkeley's philosophy aside for a moment, it makes sense to say that the mind must be active in knowing causes; for such knowledge is obviously conceptual, and conceptual knowledge is not immediately perceived. In Berkeley's philosophy the possibility of mental activity is especially clear in the cases where Berkeley says causes are known by inferential reasoning, (eg., God causing our sensed ideas), but could also be the case where causes are known immediately¹⁰ if one allowed the perceiving of the mind's own activities to be an activity. (Only causes within our own minds are known immediately.)

Lastly, some also hold that only activities can be known by way of notions. This poses problems for Berkeley's claim that we have notions of relations, for it is not obvious that relations can be viewed as activities. But oddly enough, this problem does not arise with respect to cause; cause can easily be viewed as an action which relates two things.

I have tried so far to give some indication of how cause fits into Berkeley's ontology and epistemology; it is a relation known by way of notions. I would now like to examine how Berkeley uses the notion of cause, and how he argues from the assumptions he makes about it.

¹⁰ As in the case of my own will. How such immediate knowledge is possible Berkeley doesn't make clear, but it is characterized by being neither perceived by sense nor inferred.

All ideas are caused. The finite mind can cause ideas; such ideas are said to be in the imagination, and the activity of causing them is called willing. We are directly aware of, although we do not "perceive," the activities of our own mind, including willing and hence also including causing. But we are also aware that we do not cause the ideas of sense. Since these must by assumption be caused by something, we conclude that there is another spirit (God) causing them. From the nature of our ideas of sense, we can rationally determine the nature of God. (Cf. Pr. 30.) This is Berkeley's proof for the existence of God, and by far the most important use he makes of the notion of cause and the assumptions he makes about cause.

Cause, as mentioned above, is a relation; it relates the thing (or idea) caused with the causing agent. Thus, in the case of God causing our sensed ideas, there is a relation established between God and the caused idea. Similarly in the case where I cause an idea in my imagination; the causal relation relates a finite spirit with the caused idea.

We know, therefore, of two groups of causal relations; we cause the ideas of our imagination, and God causes the ideas of sense. We know of the first directly, though not by perception, and the second by reason. (The question of how we can know something directly which we cannot perceive, raises again all the problems surrounding the concept of notions.) This much, that all ideas are caused by some spirit, fits very nicely into both Berkeley's ontology and his epistemology (if one accepts notions).

But Berkeley is forced beyond this and into problems he must, in fact, extend the notion of cause to a wider use. The problem here is not with scientific causality; as we shall see in a moment, scientific cause is a pseudo-entity which poses few problems. The problem here is with the activity of human agents in the world; that is, with the activity of myself and of other minds. If God is the direct and immediate cause of all my sensed ideas, how is it possible for me to will (i.e., cause) changes in the world of sense? For example, I see a blank sheet of paper; I then will that I write on it, and thereupon perceive a page of writing. How is my causing the change in my perceptions consistent with the fact that God is the immediate cause of all that I perceive? Berkeley must allow the extension of the causal powers of finite minds into the world of sense for two reasons; first, his notion of free will, and hence his moral philosophy, depend on it; and second, his argument for the existence of other minds depends on it. (Cf. Pr. 145.) That Berkeley has a problem can be seen by comparing the passages in the discussion of other minds where he says that some ideas of sensation are "produced by, or dependent on, the wills of men" (Pr. 146. Berkeley's emphasis), with those passages where he says that God is the immediate cause of "all the sensible impressions I perceive." (Dialogues, p. 215). Berkeley addresses himself to the problem in two places. In Pr. 147, he points out that although men can act in the world, God must cause the ideas in other men to change in accordance with those actions. This complicates his proof for the existence of other minds, for he now must add

an assumption to the effect that God is not deceiving us about what appears to be the behaviour of other finite minds. Berkeley in places seems to recognize this fact; he concludes the above section by saying that God "maintains that intercourse between spirits whereby they are able to perceive the existence of each other." (Pr. 147.) But there are other places where he suggests that we know of the existence of other finite minds in the same way that we know of God's existence. (Cf. Pr. 147, Pr. 148, etc.)

In the Dialogues, (p. 237), he again addresses himself to this problem in a passage I quote in full; Philonous there says:

"Lastly, I have no where said that God is the only agent who produces all the motions in bodies. It is true, I have denied there are any other agents besides spirits: but this is very consistent with allowing to thinking rational beings, in the production of motions, the use of limited powers, ultimately derived from God, but immediately under the direction of their own wills, which is sufficient to entitle them to all the guilt of their actions."

Berkeley's concern for morals can be seen here, but more interesting is his attempted solution to the problem of both God and finite spirits causing the same thing. God, he says, is not the only cause of motions. This stress on the cause of motions is also noticeable in Pr. 147; it is almost as though Berkeley wants to distinguish between causing motions and causing ideas. Such a plan has a certain amount of plausibility; when I move my arm (Berkeley's example) I do not seem to produce any new ideas, but only to re-arrange ideas already present to my senses. But when we perceive motion, do we perceive a succession of new ideas, or do we perceive a succession of rearrangements of the

same ideas?¹¹ If Berkeley wants to hold the latter of these, then two points must be made. First, he has now expanded his notion of cause to include spirits causing changes in the relations of ideas as a causal act distinct from spirits causing ideas. And second, this is not going to solve the problem anyway, for if God is the immediate cause of all sensed ideas, how can man be the cause of their arrangement?

This whole problem is the resurrection of the age old problem of reconciling the evil in the world with God as the world's sole creator; Hylas makes this point very explicitly (Dialogues, p. 236). However, the point of discussing it in this paper is to determine the effect of Berkeley's struggle with it on his concept of cause.

One change in his original notion of cause which Berkeley must, and does,¹² allow, is that one spirit can cause activity in another; namely, we can cause God to make certain changes in the perception of other finite minds. Secondly, there is suggested a distinction between causing ideas and causing motions; accepting such a distinction will affect our interpretation of Berkeley's concept of motion and his notion of the succession of ideas.¹³

Thus far, this chapter has been devoted to Berkeley's view of cause; that is, real cause; cause which exists in the world.

¹¹ For a further discussion of motion; see below, Chapter V.

¹² Cf. above reference to Pr. 147.

¹³ Cf. below, chapter VI.

and hence has ontological status. Noticeably lacking in the discussion was any mention of how cause fits into Berkeley's theory of science. Such a lack is quite justified; for Berkeley, the notion of cause never appears in science. The kind of causes we have so far been discussing, which I will henceforth call real cause, is a subject for metaphysics, not science; scientific explanations are not causal, as we shall see.

Berkeley uses a great variety of phrases to describe the nature of scientific explanation. Essentially, a scientific explanation for a particular event consists in establishing a general rule or pattern amongst similar events and then showing that the event to be explained is consistent with such rules or patterns. Berkeley expresses this by saying:

"A thing can said to be explained mechanically¹⁴ then indeed when it is reduced to those most simple and universal principles, and shown by accurate reasoning to be in agreement and connection with them. For once the laws of nature have been found out, then it is the philosopher's task to show that each phenomenon is in constant conformity with those laws, that is, necessarily follows from those principles. In that consists the explanation and solution of phenomena and the assigning their cause, i.e., the reason why they take place." (D.M. 37)

Or again, later in the same work he says: "Physically, therefore, a thing is explained not by assigning its truly active and incorporeal (i.e., real, as described above) cause, but by showing its connection with mechanical principles, such as action and reaction

¹⁴This is Berkeley's notion of mechanical, or scientific, explanation. I will use the term 'mechanical' (when not directly quoting from Berkeley), to refer to the 'complete' (or real, as in Berkeley's philosophy described above) explanation which the materialists attempted to offer in terms of matter, (eg., explanation by corpuscles). Cf. below, p. IV-15-16.

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are always opposite and equal." (D.M. 69; Berkeley's emphasis.)

Berkeley uses a variety of expressions to refer to such principles. In Pr. 105 he uses the words "analogies, harmonies and agreements ... in the works of nature," as well as "largeness of comprehension," "analogy and uniformness ... in the production of natural effects," and what seems to be his most widely used expression, "general rules." He also talks of the "laws of nature," "general laws," "regularity," (Cf. Pr. 62) and many others.

I quote these references to the nature of scientific explanation to make clear how it differs from explanation by real or efficient causes. Berkeley is well aware that he has two distinct notions of cause; he explicitly says so as early as the Commentaries (Cf. P.C. 754, 855, 856) and repeatedly after that. Indeed he thinks that the study of the two types of cause is divided into two distinct and separate disciplines; first philosophy or metaphysics studies real causes, and experimental philosophy, natural philosophy, or mechanics studies scientific causes. "Only by meditation and reasoning can truly active causes be rescued from the surrounding darkness and be to some extent known. To deal with them is the business of first philosophy or metaphysics." (D.M. 72.) On the other hand, "the natural philosopher should concern himself entirely with experiments, laws of motion, mechanical principles, and reasonings thence deduced;..." (D.M. 42).

Berkeley considers metaphysics "the most excellent part of human knowledge" (D.M. 34), and a science much superior to physics (D.M. 34). Natural philosophy results in mere practical utility; from metaphysics, on the other hand, "the most excellent

considerations arise." (D.M. 42). That is to say, metaphysics leads to knowledge of great moral and social significance.

Berkeley's notion of real cause combined with his views about God's nature, could lead to an interesting theory of teleological explanation in terms of the good that God intends by causing a particular event. Berkeley only once suggests such a possibility; in Siris 260 he says: "All things are made for the supreme good, all things tend to that end: and we may be said to account for a thing when we shew that it is so best." Such a theory of explanation is a possibility within Berkeley's philosophy, but it would need considerably more development. For one thing, it would require a criterion for deciding what was good; this would be a major problem, for when talking of God, Berkeley wants the normal standards of good and evil discounted. (Cf. Pr. 152, 153). But though this line of thought might be interesting, it can never be of concern for science. Berkeley is quite explicit in discounting final causes from scientific consideration; "The laws of attraction and repulsion are to be regarded as laws of motion; and these only as rules or methods observed in the productions of natural effects, the efficient and final causes whereof are not of mechanical consideration." (Siris, 231.)

Berkeley's concept of scientific explanation as outlined above is philosophically inadequate. He cannot just say that the natural philosopher explains by showing the consistency of an event with general rules, but must go on to describe the nature of those rules within the context of his ontology, and to shew the limits

of scientific explanation within the context of his epistemology. In other words, he must relate his view of science more closely to the rest of his philosophy, especially to his analysis of perception. His attempts to do this contain several problems, and a complete discussion of these shall constitute Chapters IV and V. But before proceeding to those topics, I would like to make a few observations on scientific explanation as discussed so far.

First, Berkeley's distinction between physics and metaphysics allows one to use the distinction between explaining and describing. Metaphysics explains because it gives the real or efficient causes; physics only describes by giving general rules outlining observed events. Historically, this marks a change in the concept of science. Earlier philosophers of science, in particular the then recent materialists, had struggled to find a form of explanation which explained in some fundamental or absolute sense. Newton might be viewed as an exception to this, for he argues that his theories offered only mathematical descriptions and were not hypotheses of a more explanatory nature. But Newton always allowed for the possibility of explanations of what he described; he advanced elaborate hypotheses of his own, though he phrased them as queries.¹⁵ Eventually such explanation would reach a direct reference to God's actions, but herein lies the major difference in theory between Newton and Berkeley. Newton allowed the possibility of mechanical explanation, (though he advanced only

¹⁵Cf. Newton, Optics, Book III.

mathematical descriptions himself) which would eventually reach God. Berkeley, however, insisted that science could only describe, and that mechanical explanations were theoretically impossible because God caused everything directly. One cannot help thinking that scientists using these two philosophies would show little difference in their theories, but Berkeley is historically important for theoretically limiting science in a way that Newton only limited himself in practice.

Secondly, I mention in passing, that Berkeley seems to have had Newton's three laws of motion in mind when he described general laws. His examples (e.g., Pr. 104, D. M. 69) cite these laws, but also he constantly talks of the laws in connection with motion. He says such things as that it is "the business of physics or mechanics to establish...the rules of impulsion or attractions, and, in a word, the laws of motions, and from the established laws to assign the solution, not the efficient cause, of particular phenomena." (D.M. 35). It is not clear that this limitation on laws is necessary, nor even desired by Berkeley, but it puts his thinking into its historical context.

Lastly, as a prelude to the next two chapters, I emphasize the point that according to Berkeley, natural philosophy deals only with what is presented to the senses. It ignores spirits, both finite and God, and all that is known only by reason or inward reflection. In other words, natural philosophy discovers regularities in our perceptions as God chooses to present them to us.

Chapter IV

Epistemological Problems and the Problem of Hypothetical Entities

Given Berkeley's definition of scientific explanation as outlined above, there arise two areas of problems with which I will deal in this chapter. In the first section, I will consider the epistemological question of how we can have scientific knowledge, and the related problem of the role of God in those aspects of the world which are the object of scientific study. Berkeley seems to have involved himself in an inconsistency between his theory of scientific knowledge and his view of God's relation to it. In the second section, I will examine the possibility of using hypothetical entities in scientific explanation. Berkeley seems to accept such entities within limits, but rejects explanation by mechanical causes, as well as restricts the possible interpretations of such concepts as force and gravity.

A. EPISTEMOLOGICAL CONSIDERATIONS

Scientific explanation, for Berkeley, consists in showing that a particular event is consistent with established laws or principles. Such laws express regularities in the way ideas of the senses are presented to us. Ideas are perceived as atoms (Cf. Chapter II), but are always understood to be in relation

with other ideas. It is these relations between ideas which reappear regularly and allow us to discover scientific laws. There is no possible way that an isolated idea can appear to us according to a law, for a law by nature consists in expressing a regularity of relation. Even a law which asserts the appearance of an idea at regular intervals in time must, in Berkeley's philosophy, refer to a relation with other ideas; for time is but the succession of ideas according to Berkeley, and hence temporal regularities must presuppose a relation between an idea and the other ideas of the succession. In other words, if scientific laws express regularities in the way in which ideas are presented, then "the way in which ideas are presented" refers to the relations ideas have with other presented ideas.

The point I wish to make explicit is that scientific laws presuppose relations among ideas. Thus the epistemological problem of how we can know scientific laws is intricately connected with the problem of how we can know relations. The point may be an obvious one, but keeping it clearly in mind throughout the following discussion can lead to interesting observations.

We know relations by way of notions; this much is explicit (eg., Pr. 89) and not very helpful--Berkeley's doctrine of notions is far from clear. But this is all he says in his earlier works on the epistemological problems of his theory of science; not until Siris does he tackle the problem directly. There he makes it explicit that although science deals only with the data presented by our senses, sense in itself cannot have knowledge. Knowledge

requires thought, reason and intellect as well as sense; in other words, the understanding is required for knowledge.¹ This is Berkeley's way of saying that the mind must be active in knowing, a point made explicit in sections 305 and 308; "As understanding perceiveth not; that is, doth not hear, or see, or feel, so sense knoweth not:...For, as it is rightly observed in the Theaetatus of Plato, science consists not in the passive perceptions, but in the reasoning upon them..." (Siris, 305). Berkeley seems to agree with Plato (Cf. Siris, 304, 264) that sense cannot know because the objects of sense are fleeting, changing, and in a perpetual flux. This throws an interesting light on Berkeley's theory of the role of the actions of the mind which he calls notions; he almost seems to view them as permanent features of the mind. That is, he seems to suggest that notions are permanent dispositions of the mind to perform certain actions. He sometimes refers to them as habits,² and quotes with approval Plato's concept of "native inbred notions" or knowledge by reminiscence. In short, this section of Siris not only advocates that the mind is active in knowing, but that our notions, or the ways in which the mind acts, are innate and permanent, though sometimes latent, features of our mind.

It should be noted that mental activity is also essential for knowledge because relations are essential for knowledge, and because knowledge of relations requires activity in the mind, (Pr. 142).

¹Cf. Siris, 253, 264, 303, 305, 308..

²Siris, 309. This he also did earlier in T.V.V.; for example, sec. 28.

In other words, sense cannot know because sense cannot perceive relations. This point is important, for it is primarily on this point that Berkeley's theory of knowledge conflicts with his view of God's role in the universe, as I will discuss further on in this chapter.

Berkeley concludes that mental activity is necessary for knowing by discussing knowledge generally, not just scientific knowledge, but presumably the result is applicable to the latter. The mind, therefore, must be active in discovering, and understanding scientific laws. But does the nature of the mind's activities, or notions, in any way affect what sort of laws are discovered? Does the mind have certain predispositions to find certain laws? Do we "find" the laws at all, or are they created by the mind? Berkeley is completely ambiguous on this point. He seems, as I said above, to think of notions as somehow innate, but on the effect this could have on the nature of the laws we come to know, he is mute.

This problem can be extended to all relations, not just those involved in scientific laws. That the mind is active in knowing relations Berkeley had said explicitly in the Principles (142). But to what extent does the activity consist in discovering, and to what extent does it consist in creating? Such questions are interesting in connection with space and time, and especially in connection with the subsequent views of space and time of such philosophers as Kant.

In considering such questions, it is important to realize that Berkeley never explicitly says that our notions determine or affect what relations we see in sense data. He only suggests

(but again, does not explicitly say) that our notions are constant characteristics of our mind, and this only in his last major work.

This topic would remain one for interesting speculation and various interpretation if it were not for Berkeley's views on another matter, which put severe limitations on the active rôle of the mind in knowing. This matter is the role of God in creating what we mortals know when we learn science. God, as explained above, is the sole cause of the ideas we perceive by sense. He is also, Berkeley says repeatedly, the direct and immediate cause of those regularities which form the laws of science: "Now the set rules, or established methods, wherein the Mind we depend on excites in us the ideas of Sense, are called the laws of nature." (Pr. 30); "The force that produces, the intellect that orders, the goodness that perfects all things, is the supreme Being." (Siris, 320). Elsewhere, he talks of "...this consistent uniform working, which so evidently displays the Goodness and Wisdom of that Governing Spirit whose Will constitutes the laws of nature..." (Pr. 32).³ Berkeley seems quite explicit, then, in claiming that God produces the regularities in our perceptions which form the foundations of science. But by implication, he must also hold that the regularities are, in fact, in the ideas of sense as presented. Hence, they cannot be the product of the activities of the mind. Berkeley seems here to have committed himself to the position that the laws of science are discovered and not determined in any way by the activity of the mind.

³Cf. also Pr. 106, Pr. 107.

Berkeley's confusion on this point is occasionally strikingly obvious. One of the best examples is Siris 234 where he says, "Mechanical laws of nature or motion direct us how to set, and teach us what to expect. Where intellect presides there will be method and order, and therefore rules. There is therefore a constancy in things, which is styled the Course of Nature." (by emphasis). But the "Course of Nature" is the direct work of God; who is causing the order, God or our intellects?

Before we conclude that the above theological considerations can answer the problem of the extent the activities of the mind determine the relations amongst our ideas of sense, let us consider ~~some~~ problems that Berkeley has got himself into.

First of all, he has already allowed that finite minds can cause changes in their own perceptions and in the perceptions of others. An example of such causation is provided every time a person willing moves a visible part of his body. Such movements result in changed perceptions for all who witness them, and they are caused by finite minds. This Berkeley must admit if he is to retain his proof for the existence of other finite minds. But if finite minds can cause changes in our perceptions, how does one distinguish the regularities caused by God from those which might happen to be caused by other finite minds? This is simply another aspect of the problem of who, God or people, cause the relations amongst ideas of sense.⁴ It is obvious that we somehow know what

⁴ Cf. previous page.

sort of relations are a potential basis of scientific law, and which are humanly caused. But Berkeley makes no attempt to provide any criterion for distinguishing the two; he does not seem to see the need. This is one of the weak points of both his analysis of real cause and of his analysis of scientific laws.

A second problem arises when we try to extend the concept of God causing the relations amongst sensed ideas, to all our perceptions. Does God cause the relations of motion, space, and time?⁵ With motion, one has the problem of movement caused by finite minds, discussed in the previous paragraph. With space, and time, one encounters problems with Berkeley's theological beliefs. If God presents our ideas of sense already related by space and time, must not those relations exist for God? But God is outside and independent of space and time. It is precisely the idea that absolute space and time are somehow part of God that Berkeley thinks is the main reason for rejecting those notions (Pr. 117). Time in particular is a problem here; since time is only the succession of ideas, and God presents ideas of sense to us in a temporal order, then they must exist for him in a temporal order. How can God present ideas one after another when there is no succession in his activities or ideas? But God, Berkeley claims, is outside time; he is timeless and unchanging. The problem here is not simply that God creates a world in time while he remains outside time, but that he presents us with a

⁵All three are relational for Berkeley, see below, Chapter VI.

series of ideas, with each presentation presumably requiring an activity on his part, while those ideas do not exist in a temporal series for him, and while his activities do not exist in a temporal series. A similar argument applies to space; how can God present ideas which are spatially related when spacial relations do not exist for him?

A final and far more important problem arises out of Berkeley's claim that God causes those relations amongst our ideas of sense which form the basis of scientific laws. If God is the cause of these relations, then he must present them through, or with, our ideas of sense. He cannot cause them separately, for it does not make sense to say that relations can exist or are caused independently of the ideas related. Hence the relations must be in the perception of our senses. That is, we must perceive the ideas already related. Why, then, (and how), can sense not know them? Why can we not perceive relations? Why does it require an act of the understanding to know what is presented to our senses in the same way as, and along with, our ideas? One way to answer the last question would be to say that the perception of ideas also requires an act of the mind; that is, to say that we have notions of ideas.⁶ Thus our perception of ideas and relations would have similar status; we would have notions of both. This would be incompatible with any distinction between ideas as being fleeting, and notions as being

⁶For the implications of this step on the theory of notions, Cf. S. Majm, "Knowledge of the Self in Berkeley's Philosophy," see Chapter IV.

more permanent and providing the constancy necessary for knowledge. It would also, of course, be incompatible with the distinction between sense and understanding, and with the claim that sense cannot know because we cannot perceive relations. In fact, it reduces the need for notions in Berkeley's philosophy from a need to allow for knowledge of "things" which are not ideas, to a need to allow for activities of the mind. Besides, it still does not solve the problem of why we cannot perceive relations if God creates those relations and presents them to us with our ideas of sense.

One is forced to conclude that Berkeley has not adequately and explicitly worked out the role of mental activity in knowing the relations of ideas of sense on which science is based. Nor has he shown that such mental activity is consistent with God causing those relations, and hence with those relations being in sense along with the ideas. This is one of the largest problem areas in Berkeley's theory of science.

B. HYPOTHETICAL ENTITIES

It was explained in the previous chapter that for Berkeley scientific explanations must be only in terms of ideas, their relations, and rules or laws characterizing those relations. It is obvious that the science of his day used expressions and terms which did not refer to any idea presented to our senses. Such terms as matter, corpuscles, force, gravity, and mass seem both essential to science and unallowable on Berkeley's criterion. I

shall consider this problem by discussing Berkeley's rejection of the materialistic forms of explanation, his criticism of Newtonian physics, and the possibility of his accepting the use of hypothetical entities within well defined limits.

In scientific debate of the late seventeenth and early eighteenth centuries, the term "hypothesis" was shrouded in controversy. Newton had declared "I frame no hypotheses"⁷, and seemed to mean thereby that he did not attempt to offer mechanical explanations, (i.e., "mechanical" in the sense I use the term in this paper).⁸ Berkeley also denies that one should frame hypotheses,⁹ and seems to be using the term in very much the same sense as Newton. However, Berkeley also talks of "mathematical hypotheses"¹⁰, which he uses in a similar fashion as "mathematical abstractions" and "geometer's fictions."¹¹ The usage here indicates that Berkeley is using the term to refer to those entities in mathematics or physics which are not ideas or relations, but which are useful for calculations. It is this use of the notion of hypothesis that I

⁷ In the General Scholium: Thayer, Newton's Philosophy of Nature, p. 45. Cf. also the opening paragraph of the Optics.

⁸ Cf. footnote 1, p. III-17. Newton did not seem entirely consistent in his use of the term "hypothesis," which is the source of some of the controversy; Cf. Koyre, Newtonian Studies, Chapter II.

⁹ Dialogue III, P. 229.

¹⁰ Siris, 250. D.M. 66, 67.

¹¹ Cf. D.M. 39.

intend to discuss. In D.M. 40, Berkeley makes the use explicit; anything, he says, which science uses and which is not an idea, relation, or spirit, "must be considered to be of a kind with other hypotheses and mathematical abstraction." The problem of hypothetical entities is, as I use the term, the problem of how Berkeley can allow science to use "concepts" (or, as he calls them, mathematical hypotheses), which are not ideas, relations or spirits.

Berkeley did not allow the use of the concept of matter in scientific explanations because he did not think that matter existed. Matter was a meaningless notion which did not refer to anything. Whatever it was, matter was not an idea, a relation, or a spirit, and hence, did not fit into Berkeley's ontology. And, as it was explained in the previous chapter, an explanation, whether scientific or in terms of real causes, must not refer to anything outside Berkeley's ontology. I shall not attempt to explain Berkeley's reasons for not accepting matter, but shall confine myself to remarking on the influence of this stance on science. Much of the scientific thought of the seventeenth century¹² involved and was dependent on the concept of matter. It was dependent in two ways; first, scientists thought that ontologically the material world was the object of scientific discovery. Most (except Hobbes) accepted Descartes' division of the world into mind and matter, and all thought science dealt only with matter. In this consisted seventeenth century materialism. Secondly, seventeenth century

¹²And for a long time afterwards as well; Berkeley was not much listened to by scientists.

scientists thought that the only legitimate form of explanation¹³ was in terms of matter and its motions. If one allowed spirits, then one allowed teleological explanations; and such were banned from science. Acceptable explanations were either in terms of an all-encompassing vortex where matter completely pervaded all space, or in terms of corpuscles dispersed throughout a vacuum. In this consisted the mechanism of the seventeenth century. Newton was the only major exception to the use of mechanical explanations, and he was much criticized for re-introducing occult qualities into natural philosophy.

What was, or would have been, the result of Berkeley's advocated abandonment by science of mechanism and materialism? Berkeley would have said that nothing essential would be lost, and many philosophers since would agree with him. For Berkeley, the essential function of science was to describe how the world as we perceive it actually does behave; it is not, and can never be, the role of science to describe what is ontologically basic to the world, nor to offer explanations in terms of what is unperceived. Berkeley felt that the materialists were going beyond experience; that they did not realize that all hypothetical entities must be defined in terms of, and reducible to, the basic elements of experience: ideas, relations or spirits. Mechanical philosophers, he says, are "like other men, ... misled by prejudice, and take mathematical hypotheses for real beings existing in bodies, so far

¹³ That is, in terms of primary qualities.

as even to make it the very aim and end of their science to compute or measure those phantoms;..." (Siris, 250.)

It is not the purpose of this paper to examine science or the philosophy of science to determine whether Berkeley is right in claiming that science must restrict itself to experience. Berkeley only argues for it in terms of the possibility of meaning and knowing, and by such assumptions as that there are no necessary connections between ideas. The importance of this insight is that Berkeley attempted to work out the consequences of it. The rest of this paper examines how he proposed to reconstruct the ontology of the world and scientific explanation so as to rid philosophy of materialism and mechanism. I would like to suggest, although the question would obviously require a great deal of detailed examination of present day science, that even today science remains within the bounds of description only which Berkeley insisted on. Indeed, scientists of today are much more aware of this limit on their work.¹⁴ In fact, scientists today seem to have so forgotten the seventeenth century concept of explanation in science, or real explanation for Berkeley, that they fail to see the distinction between explaining and describing; explanation to them consists in describing.

Berkeley was not as harsh when dealing with the concepts of Newtonian physics. He realized that they were an essential part of science, and not just a disposable metaphysical underpinning like materialism and mechanism. Somehow he had to justify the use of

¹⁴ Cf. Karl Popper, "A Note on Berkeley as Precursor of Mach and Einstein."

concepts like force, gravity, mass, and action and reaction; and he had to find a way to render their use consistent with his ontology. It is obvious that none of these are ideas presented to the senses, and it is equally obvious that they cannot be allowed to remain in the domain of science if they are actions or spirits. How, then, can Berkeley find room for them in his ontology?

Berkeley knew that the reason he had to retain them for science was that they were used for calculations, (Cf. D.M. 17); they appear in the equations that had allowed Newton to do his astronomical calculations which were considered the greatest achievement of his physics. For this reason, Berkeley called them "mathematical hypotheses"--hypotheses because they did not really exist.

Though Berkeley clearly realized the usefulness of mathematical hypotheses, he did not think that this alone could justify their use. Popper seems to suggest that he thinks it could, and hence, seems to suggest that Berkeley was an instrumentalist. He says that for Berkeley, a mathematical hypothesis "is not based on observation and has only an instrumental significance;"¹⁵ or later he talks of mathematical hypotheses as being "nothing but instruments for the prediction of appearances."¹⁶ It is my contention that Berkeley goes beyond this; he sees it as his main problem not to prove that mathematical hypotheses are useful, (that issue he only refers to once, in D.M. 17), but rather to prove that

¹⁵ Popper, op. cit. p. 443.

¹⁶ Ibid., pg. 448; Popper's emphasis.

the use of mathematical hypotheses is consistent with his ontology. His attempt to do this renders him more of a reductionist than only an instrumentalist. This attempt I will now consider.

Since force, gravity, mass, etc., are not ideas, spirits or relations, they did not exist for Berkeley. Such non-existence involved first of all that they did not exist as qualities, attributes, or properties of material objects; for such was the opinion generally held at the time. Rejecting such a possibility followed, of course, from Berkeley's rejection of the material world. But it is important to note the consequences of this; force, gravity, etc., now become mind-dependent entities instead of being somehow entities in the real external world. They are mind-dependent not only in the sense that everything is mind-dependent for Berkeley, but also in the sense that they are not presented to us as ideas, nor immediately understood as relations are; hypothetical entities, as we shall see, are creations of the mind--created out of and reducible to more basic features of the world, such as motion. Even Newton, who did not view these concepts mechanistically, thought them to be entirely independent of mind, (except perhaps, in that they ultimately, like everything else, were created by God.).

Berkeley did not want to grant them even mind-dependent existence as entities; he obviously could not since they are not ideas. In De Motu, he makes it very clear that, despite their uses, mathematical hypotheses were not to be viewed as existing:

"39. And just as geometers for the sake of their art make use of many devices which they themselves cannot describe nor find in the nature of things, even so the

mechanician makes use of certain abstract and general terms, imagining in bodies force, action, abstraction, solicitation, etc. which are of first utility for theories and formulations, as also for computations about motion, even if in the truth of things, and in bodies actually existing, they would be looked for in vain, just like the geometers' fictions made by mathematical abstraction."

"40. We actually perceive by the aid of the senses nothing except the effects or sensible qualities and corporeal things entirely passive, whether in motion or at rest; and reason and experience advise us that there is nothing active except mind or soul. Whatever else is imagined must be considered to be of a kind with other hypotheses and mathematical abstractions..." (D.M. 39-40.)

Thus spoke Berkeley; giving a full statement of his views, with reasons, on the status of hypothetical entities. But one must now call to mind the Introduction to the Principles, and remember that Berkeley rejected all possibility of abstract general ideas. Thus, even if we concede the usefulness of concepts like force, we are still left wondering how they can have any meaning. To see the answer, let us consider some of these concepts separately.

Force, perhaps, is the most important of them.¹⁷ Berkeley rightly perceived that in Newtonian physics, force could never be known except by its effects;¹⁸ (which are, of course, changes in the state of rest or motion). Thus, force and laws using force can be viewed as shorthand for describing how bodies do in fact change

¹⁷ For Berkeley's discussion of force and gravity, see all of *De Motu*.

¹⁸ In D.M. 10 he explicitly says, "We must, however, admit that no force is immediately felt by itself, nor known or measured otherwise than by its effect."

their motions. Changes in motion are all that happen; such changes can be described, and using the concept of force is the shortest way.

An implication of this, and one which was not accepted at the time, but which has been more recently attempted, is that one can do Newtonian mechanics without using the notion of force. It would only take a little longer to write out. All those equations and laws which contain the concept of force can be rewritten replacing force by the effects by which it is known. For example, the inverse square law for gravitation could be restated in a more complicated fashion by saying that any two bodies, in the absence of other bodies, move with respect to each other in such and such a fashion, depending on their distance and mass. Thus, force need not be mentioned. (Berkeley reduces mass to motion as well. See below.)

What is true of forces in general, is true of any particular type of force; hence Berkeley must extend his conclusions to gravity. And this he does explicitly in De Motu. Gravity, or any other force, cannot be the principle or real cause (in the sense given in the last chapter) of motion, for force is not an active being or spirit. Gravity is only an abbreviation to express certain observed regularities of motion; "The force of gravitation is not to be separated from momentum; but there is no momentum without velocity, since it is mass multiplied by velocity; again, velocity cannot be understood without motion, and the same holds therefore of the force of gravitation." (D.M. 11.) Later, in

Siris (240), Berkeley puts the matter more plainly for all forms of attraction, not just gravity; "The words attraction and repulsion may, in compliance with custom, be used where, accurately speaking, motion alone is meant."

Even the Newtonian concept of mass, which one would think would cause Berkeley problems, is limited to its proper interpretation; "If anyone should think to infer the reality or actual being of matter from the modern tenet that gravity is always proportionable to the quantity of matter, let him narrowly scan the modern demonstration of that tenet, and he will find it to be a vain circle, concluding in truth no more than this--that gravity is proportionable to weight, that is, to itself." (Siris, 319.) In De Motu (12-13), weight is reduced to motion; thus, Berkeley has reduced force, gravity, attraction, action and reaction and mass all to motion.

One tends to wonder about this reduction of all science to motion, but it shows the central position that motion held in Berkeley's concept of what science does. In particular, one is sceptical of his treatment of weight and hence of mass. Mach, for instance, views weight, not motion, as basic to our experience of force; "All forces thus may be regarded as quantities of the same kind and be measured by weights."¹⁹ Science, perhaps, is not just about motions, and the reduction to experience may be more complicated than Berkeley thought, or, in fact, may not be possible at

¹⁹Ernst Mach, Science and Mechanics, p. 42. (Mach emphasis).

all in the way Berkeley imagined. I interpret Berkeley's attempt to reduce the various mathematical hypotheses to motion; and his conclusion that when we use these hypotheses, we are really "accurately speaking,"²⁰ talking only of motion, as a form of reductionism. Motion is perceivable by the senses for Berkeley, and hence a reduction of the concepts of science to motion is a reduction of them to sense experience. Berkeley is a reductionist in so far as he believed that the concepts of science must be reducible to elements in our experience, and that the concepts do not refer to entities which exist in any way, but refer to the experiences to which they are reducible.

Reductionism is perhaps not acceptable today; instrumentalism, however, is still considered a tenable thesis. Berkeley's claim that science must always be concerned with experience led him to an interesting examination of the connection between science and sense experience. Later, scientists were to reap benefit from such an examination; and on at least some points they agreed with his rejection of materialistic explanations,²¹ and with his claim that science is confined to experience at least in so far as it involved this rejection.

I have tried to make it clear how mathematical hypotheses are consistent with Berkeley's ontology. But before closing this

²⁰Cf. above quote from Siris, 240.

²¹Cf. Popper, op. cit. pp. 444-448. Popper calls this Berkeley's rejection of essentialism.

chapter, attention must be drawn to the most brilliant passage on mathematical hypotheses; namely, Siris, 228. There he outlines the logic involved. From a mathematical hypothesis it is possible logically to infer the existence of particular events; this is the purpose of such hypotheses. But it is not possible to argue the other way. From any number of events, no matter how great, it is impossible to deduce the truth of any mathematical hypothesis. An implication of this, and one which Berkeley makes explicit elsewhere,²² is that several hypotheses can explain the same events, and that in such cases there is no way of deciding which is true. Or rather, there is no question of truth since the hypotheses do not refer to anything real. "But mathematical entities have no stable essence in the nature of things; and they depend on the notion of the definer. Whence the same thing can be explained in different ways." (De Motu, 67.)

²²Cf. D.M., 67. Popper points this out in his article; op. cit. p. 442.

Chapter V

Science and Berkeley's Analysis of Perception

Science, for Berkeley, deals only with the world of sensed ideas. Ideas are distinct atomic units as I described them in Chapter II. This position poses the problem of how, and indeed whether, we can analyze our sense perception into ideas. Furthermore, there is the question of whether such an analysis, if accepted, is consistent with and sufficient for Berkeley's theory of science and scientific explanation. It is obvious that the concept of ideas is essential to Berkeley's philosophy of science, and so one needs to consider Berkeley's analysis of perception to see how it allows for the possibility of knowledge, and of scientific knowledge in particular.

Sensible ideas are always understood and related in a certain way; that is to say, some sensible ideas are constantly being presented together. This constant conjunction is the origin of our combining groups of ideas into objects (Pr. 1). It is also the origin of the widely held (but for Berkeley, false) belief that our different senses perceive the "same" objects in different ways. The characteristics of our sense perception which provide the possibility of our constructing a unified world out of the ideas presented by our various senses, are explained by Berkeley by the Divine Language Theory; a more earthy and less poetic name, but

one which will allow us to discuss the theory denuded of theological considerations, would be the Suggestion Theory.

The Suggestion Theory is both a psychological and an epistemological theory. It is psychological in that it describes the way the mind does in fact work. It is epistemological because it describes for Berkeley how we should obtain knowledge about the world. The most explicit statement of the theory, and the one I rely on most, is in T.V.V. sections 10-41. Most of what he says elsewhere on this topic is repeated there.

The ideas perceived by one sense may suggest to the imagination ideas which are normally perceived by another sense. The ideas thus occurring in the imagination can be so closely related to the sensed ideas that we can, for the most part, fail to notice their true relation. And, indeed, we can even fail to notice that the suggested ideas are in the imagination and are not part of the ideas of sense. I see, for example, a table a little ways off; what I actually see are a variety of colours, the distance and depth of the table are only suggested to me, though I think I see them. Thus, the imagined ideas may be combined with the ideas of sense to form a single object, all the qualities of which we believe are sensed. Berkeley put it thus:

"There hath been a long and close connexion in our minds between the ideas of sight and touch. Hence, they are considered as one thing; which prejudice suiteth well enough with the purposes of life; and language is suited to this prejudice." (T.V.V., 35)

The extent to which the mind may fail to notice its own suggesting

activity is again stressed later on in the same work; Berkeley says,

"Throughout this whole affair the mind is wonderfully apt to be deluded by the sudden suggestions of the fancy, which it confounds with the perceptions of sense, and is prone to mistake a close and habitual connexion between the most distinct and different things for an identity of nature.¹

Berkeley recognizes one of the main implications of our unawareness of the workings of suggestion; namely, that there is a distinction between an idea suggesting another, and our inferring an idea from another:

"To perceive is one thing; to judge is another. So likewise, to be suggested is one thing, to be inferred another. Things are suggested and perceived by sense. We make judgments and inferences by the understanding." (T.V.V. 42)

The important point to be concluded from this is that the suggestion theory does not rest on conscious inferences made by the understanding, as both judging and inferring do.

The sensed idea and the suggested idea are not related as cause and effect, though people usually think they are.² This must be the case for Berkeley because his theories of the nature of cause and of the nature of ideas are such that ideas cannot cause ideas.³ There are, therefore, two possibilities; one, the suggested ideas could be caused by God, or two, they could be caused by our own

¹T.V.V. 52. Cf. also N.T.V. 144.

²Cf. T.V.V. 13, 35.

³Ideas are always inactive; causes must be active. Cf. above, Chapter III.

minds or imaginations. If Berkeley accepts the causal origin of ideas as the ground for distinguishing between sense and imagination, then he obviously must accept the second of these. However, Berkeley does not appear to have appreciated this point very well. He talks throughout of the ideas of one sense suggesting those of another, as though the ideas were the cause.⁴ He also often seems to attribute the suggesting to God; "How comes it to pass that a set of ideas, altogether different from tangible ideas, should nevertheless suggest them to us, there being no necessary connexion between them? To which the proper answer is, that this is done in virtue of an arbitrary connexion, instituted by the Author of Nature." (T.V.V. 44). But is this to be interpreted to mean that God causes the ideas which are suggested? Berkeley cannot allow this and maintain the distinction between sense and imagination, for all the suggested ideas are in the imagination. Thus, our suggested ideas cannot be caused by either of the causes which Berkeley's language seems to imply. On the other hand, choosing the only alternative poses another problem. If the suggested ideas are caused by my own mind,⁵ and I am not aware of the difference between sensed and suggested ideas,⁶ then I am not aware of the suggesting; namely, I am not aware of my mind's causing the

⁴ eg., T.V.V. 28.

⁵ Berkeley does at one point refer to the "suggestions of the fancy." (T.V.V. 52).

⁶ Cf. paragraph above.

ideas in my imagination, is a necessary prerequisite of using their causal origins as a criterion for distinguishing ideas of sense from ideas of the imagination. This is not the only problem Berkeley will encounter if one tries to figure out which aspects of his theory we are conscious of. However, despite this problem, I must conclude that the most acceptable choice within the context of Berkeley's metaphysics is that we ourselves cause the ideas suggested to the imagination; the only problem to this choice is one of consciousness (or the lack of it), a matter which Berkeley often overlooked, and probably would have in this case too, if he had seen the problem.

If our own imaginations are responsible for causing the suggested ideas, then how do they (or rather, we) know which ideas to cause? Berkeley, like the good empiricist that he is, answers that we know by experience. We find that many of our sense ideas are often presented together; or at least that upon sensing one idea, certain behaviour will always produce a certain other sensed idea. For example, if I see a book and reach my arm out towards it, I normally have the sensation of touching it. It is the idea often sensed with another idea, or sensed with it when we perform certain acts, that is suggested to the imagination when we sense the first idea but not its usual companion.

If the connection between idea sensed and idea suggested is not one of cause and effect, what then is it? The two are, Berkeley says, "related as the sign to the thing signified." (T.V.V. section 13) It is at this point that theological considerations come crowding in. Ideas of sense are the language whereby God

talks to us and warns us about possible unpleasant sensations if we do not act rightly. God feeds us sense perceptions, other ideas are suggested by our imagination, and we then behave so as to avoid or encounter the sensations which the suggested ideas in our imagination represent. For example, I see a fire, which suggests the idea that I might get burnt; this is God's way of telling me that walking in a certain direction is going to produce the painful sensation of being burnt.

For Berkeley, vision was the most important of the senses for receiving God's instructions; and, as mentioned earlier, tactile ideas were the most important suggestions received, for touch was the most important sense for our survival. For this reason, it is often only vision which Berkeley describes as "the Language of the Author of Nature." (T.V.V. section 38.) Usually, ideas of sense suggest ideas of another sense, but there is no reason to suppose that they could not suggest ideas of the same sense (e.g., having a visual image of the back of a house when I see the front). Berkeley's priorities are clear from the passage where he says his purpose is "to inquire how one idea comes to suggest another belonging to a different sense, how things visible suggest things tangible, how present things suggest things remote and future." (T.V.V. section 14.)

I think an example is the only way to make clear how the suggestion theory works. Consider the case of our perception of distance by sight. For Berkeley, the only ideas received directly by vision are light, colour, and situation, extension, and position in

the visual field. Distance, both from us and between two objects, is properly sensed only by touch. But yet we do know distances, often very accurately, by sight. This is possible because we have learned by experience that certain visual sensations, or groups of sensations, always correspond with certain tactile distances. Such visual clues for Berkeley are visual magnitude, distinctness, and the sensations accompanying eye movements, (the last of which are not actually visual). Whether Berkeley has the right clues, or all the clues, by which we estimate distance, is an unimportant question. What is important is the claim that tactile distance is suggested to our imaginations by certain sensations, mainly visual, and the procedural claim that any explanation of visual depth perception must be only in terms of ideas which are actually present to our senses.

The Suggestion, or Divine Language Theory, provides for Berkeley an epistemological criterion for truth and falsity, and a foundation for "scientific" causality and hence for scientific procedure. With his rejection of the representative theory of perception, Berkeley eliminates the possibility of a representational theory of truth. He must, therefore, provide some other concept of truth which applies to statements other than those which only refer to our having certain sensations. This he can now do by conceiving truth as the "right" interpretation of God's messages to us; that is, by conceiving as true those judgments or suggestions which correctly predict what sensations will follow what actions, given certain sense perceptions.

Normally, the suggested ideas and the sensed ideas are so closely connected in our minds, that we consider them as one and the same. Our language is designed to fit this way of thinking. And God has had the decency to see that the way we think is the most conducive for our knowing how we should act.⁷ But it is not conducive to theoretical knowledge, science, or wisdom. To reach scientific truth (see above paragraph on truth) one has to consider carefully the legitimacy of the connection between the ideas sensed and the ideas they suggest. To do this, one has first to untangle precisely what is suggested, and what is sensed by which senses. Only by untangling our senses and imagination can we correct unwarranted inferences which we habitually make.

"The work of science and speculation is to unravel our prejudices and mistakes, untwisting the closest connexions; distinguishing things that are different, instead of confused and perplexed, giving us distinct views, gradually correcting our judgment, and reducing it to a philosophical exactness." (T.V.V. section 35)

Both the suggestions and their unravelling are necessary to finite minds:

"For, as useful as those immediate suggestions and constant connexions are to direct our actions; so is our distinguishing between things confounded, and our separating things connected, and as it were blended together, no less necessary to the speculation and knowledge of truth." (T.V.V. section 36)

This, without most of the details, is how I see Berkeley's theory of perception, and its connection with his theories of Divine Language, truth and science. There are one or two problems with the whole project and these we ought now to consider.

⁷Cf. T. V. V. 36.

The first problem arises when we attempt to introduce the notion of consciousness into Berkeley's system. I assume that since all perceived ideas are "in the mind," then we must be conscious of them all; and furthermore, since no ideas exist except such as are perceived, I assume that there are not ideas of which we are not conscious except those in God's or other people's minds.

At a pre-scientific (or pre-philosophical) level, I am conscious of an unanalyzed confusion of objects in space and time. My ideas, even my ideas perceived by different senses, are not separated, but are so thoroughly entangled that I assume that the ideas of several senses are of the same object. I see, feel, smell and taste, this apple; and am rather thoroughly convinced that it is the same thing that I see, feel, smell and taste.

Berkeley would agree to this picture of pre-scientific consciousness; he would simply add that it was the purpose of science to disentangle the mess. But to what extent is it possible to untangle? Obviously, we can untangle things to some extent; I can distinguish, upon reflection, my seeing the apple and my feeling it. And I can separate (mentally) this red part of the apple from this greenish part. Thus far without problems. But let us, for an example, look more closely at the colours which I group together to call the apple. Some of it is red, some greenish, and some various shades in between. However, upon closer consideration, I notice that this red shiny part is reflecting the light, and is not entirely red after all, but is white in places. Only an experienced painter, could ever possibly sort out the various shades of colour.

shadow and reflections which make up the visual image of an apple. But difficulty is not an objection to a theory. What I am worried about is the white patch of reflected light in the middle of what I originally thought to be a red part of the apple. Normally, one would simply say that I had not noticed it at first, but it was there all the time. But on Berkeley's theory, "where" (in a non-spatial sense) did the white reflected patch exist prior to my noticing it? Certainly not in my mind; I was not conscious of it before I noticed it, and therefore did not perceive it. The other possibility, and the only one acceptable in the context of Berkeley's philosophy, is that the idea was in God's mind and that he presented it to my consciousness when I noticed that the patch was not all red. This may be an acceptable answer, but it changes very substantially Berkeley's theory of analyzing perception. He claimed that we simply had to disentangle our ideas; it now appears that in so disentangling, new ideas appear which were not perceived before. The point is, the act of analyzing our perceptions to try to isolate the ideas and which senses present them, changes the ideas we perceive. Normally, it adds a whole host of new ideas which we did not notice (i.e., perceive) before. Thus Berkeley's theory is not just a way of viewing our perceptions to gain more knowledge about them, but rather is a way of behaving with respect to our perceptions which changes what we perceive and gives us new ideas. The latter is a much more complicated view. It disrupts slightly (but perhaps not beyond repair) the divine language theory: How can God speak to us with words (or signs)

which we do not perceive until we perform a scientific analysis? But perhaps God is making things simple for us by letting us see red apples instead of the multitude of colours, shadows and reflections which we see if we try to analyze our perceptions.

A second problem which one can raise is whether it is ever possible to analyze our perceptions completely; that is to say, can we ever untangle our perceptions until we are aware of the simple ideas? This problem is of course greatly complicated by the fact that the process of untangling seems to change our perceptions, as I described above. Consider, for example the case of vision. What is a single visual idea like? How can I know when I've found one? There are two possibilities here; first, single visible ideas may be an entire area which is a single colour, regardless of the visible size or figure of the area. Thus, this entire orange portion of this book cover is a single idea; or, if I were in a completely unlit room, then my entire visual field would be the single perceived idea of black. But first of all, most colour patches upon carefully consideration, are seen to consist of many shades of the predominate colour. Thus, what were single ideas often become multitude if we think about them. Secondly, it is almost impossible to determine the edges or figure of our perceptions of colour when they fade into one another. If ideas must be perceived, and they must be distinct, then surely their distinctiveness and limits must be perceived as well. Thirdly, ideas are not supposed to be divisible; patches of colour, especially large ones, obviously are. One could reply that when a

patch of colour was divided, that the idea was not divided qua idea, but rather disappeared from one's sensory field and was replaced by two new ideas of a smaller extension. One begins to wonder where the subtle turns into the ridiculous.

The other possibility is that single visible ideas are minima visibilia. Some students of Berkeley hold that minima visibilia are entailed by Berkeley's theory of perception, and that this proves the theory wrong since there are no such things. It is interesting to note that Berkeley develops this theory in his earliest book (A New Theory of Vision) and that it does not appear in his writings after that. In T.V.V., he does not mention even the expression, and, indeed provides an alternative theory (section 55 ff) for considering visible magnitude and position. But if one rejects minima visibilia, then one must accept the theory I outlined in the paragraph above, which has its own problems. The reason minima visibilia are thought questionable is that I do not seem to perceive them. Colours appear continuous; I am not conscious, and cannot even make myself conscious, of discreet, small sections of my visible field. And what I am not conscious of I do not perceive, and what I do not perceive cannot be an idea in my mind. Therefore, I have no ideas of minima visibilia. The questionable nature of minima visibilia can be seen from trying to figure out how large they are. Consider any coloured patch in your visual field and try to estimate how many minima visibilia it is wide. Berkeley gives us a hint in only one place; he says the visible moon is about 30 minima visibilia across. (New Theory of Vision, section 44). I do not think that is small enough;

I can distinguish marks smaller than $1/30$ of the visible moon.

The point I am making with respect to vision is equally applicable to the other senses. It is empirically very questionable that any of my perceptible fields are divisible into atomic units which fit Berkeley's definition of ideas. That is, are we ever, and can we ever be, aware of distinct, indivisible, simple ideas? If we cannot be aware of them, and I do not think we can, then we do not perceive them. And if we do not perceive ideas, Berkeley is in trouble. Or, to put the problem another way, is it ever possible completely to disentangle our perceptions; and if we cannot completely disentangle things, then can ideas exist only tangled up? I do not think they can.

Putting aside criticism of Berkeley's analysis of perception, there is another important question which concerns us. Are the suggestion and disentanglement theories, as theories of knowledge, sufficient for scientific knowledge as Berkeley describes it? Essentially, this is the question of whether Berkeley's treatment of perception is consistent with and sufficient for his philosophy of science.

I think it fairly clear from the description given above that the suggestion theory is, at least in part, an epistemological theory; it describes what it is to know something. (This does not mean that it includes all knowledge for Berkeley; it has nothing, for example to do with knowledge of notions. To know is correctly to have an idea suggested by a sensed idea. When I see a red hot stove, I know it will burn me if I touch it; the

tactile idea of burning is correctly suggested by what I see. The disentanglement theory completes the suggestion theory as a theory of knowledge. It explains how we can know something; it explains how we can tell if the suggestions of a sensed idea are the correct ones. We do this, of course, by experience, and we justify the procedure by the fact that God is not going to deceive us by suddenly changing the regularities of nature.

The connection between these theories and science is rather direct. Berkeley wishes to claim that the disentanglement of suggested ideas and sensed ideas and the judging of their connection by experience, is, in fact, what science ought to be doing.

"The work of science and speculation is to unravel our prejudices and mistakes, untwisting the closest connexions, distinguishing things that are different, instead of confused and perplexed, giving us distinct views, gradually correcting our judgment, and reducing it to a philosophical exactness." (T.V.V. 35)

There are two points I wish to be noted here, though both are mentioned earlier. First, Berkeley has been able to provide in his analysis of perception a criterion for truth, and hence, in a derivative sense, a criterion for what it is possible to know. Second, that this criterion is based on experience, and that it only refers to matters of experience. In other cases, (God, real cause, etc.) truth is different and may be reached by rational inferences.

But so far in this paper (especially in Chapter III) I have been discussing a slightly different view of science. I have quoted liberally from Berkeley to prove that he thought the purpose of science is to provide rules which govern our experience.

What is the connection between Berkeley's two claims that the purpose of science is to disentangle our ideas and that the purpose of science is to discover rules which govern our experiences? Berkeley never bothers to discuss the matter, so we have to attempt ourselves to see how they can be consistent.

The obvious question to be asked is: Does it make sense to say that scientific rules or laws are rules which tell us which ideas ought to be suggested by sensed ideas? It should be remembered here that for Berkeley the rules of science were primarily the laws of motion.

I think that within the context of Berkeley's philosophy of science, such a view of the rules of science does in fact make sense. The object of predicting the behaviour of a moving body is to predict where it will be at a certain point in the future. For a body to be at a certain point is for us (or someone) to have certain ideas of sight and touch.⁸ These are, of course, the ideas which ought to be suggested by the sensed ideas which were the moving object when the prediction was made. Thus the suggestion theory in fact makes explicit the form of scientific rules; they ought, in specific instances, to be able to tell us which ideas, which might be suggested by our sensed ideas, are the correct ones. Use of the rules hence depends on our first separating

⁸To be completely accurate, Berkeley would have to say that for an object to be at a certain place is either for God to be actively presenting those ideas in the right relations to some finite mind, OR, for the regularities of the natural world to be such that he would have to, if he wanted to preserve the regularities, present those ideas if a finite mind "were in the right place;" namely, if a finite mind had certain other perceptions.

what is sensed from what is so immediately suggested that it is confused with what is sensed. Hence, the need for disentangling. The fact that scientific investigation might reveal more sensed ideas (as described above) does not really matter; here are simply so many more clues as to what are the right suggestions.

From this discussion I conclude that Berkeley's analysis of perception has several major problems, the main one being whether there are such things as ideas. But on the other hand, he does provide a criterion for truth and knowledge when dealing with our sensed experience, though I think it more complex than he thought it was. Furthermore, this criterion of truth and knowledge is consistent with his theory of the nature of science as rules or laws.

One last question might be raised on this topic: Does Berkeley's philosophy of science require his analysis of perception? His arguments for limiting science to sensed experience rest very much on the notion of ideas, as was very obvious in my presentation in Chapter III. However, as I noted even there, this was because he defined the possibility of meaning and knowing in terms of ideas. Presumably then, if one attempted a different analysis of perception with a correspondingly different theory of meaning and knowing, then a corresponding version of Berkeley's argument about limiting science to experience, would be valid. That is, assuming one limited the possibility of meaning to what we experience. In other words, Berkeley's philosophy of science could remain intact if one attempted a different analysis of perception.

Chapter VI

Motion, Space, and Time

Motion, space, and time, it may be thought, are as much a concern of metaphysics as they are of science. Berkeley certainly treated them as such, for he approached them armed with a metaphysical position which did much to determine his opinion about them. But at the same time, he was very careful to refute arguments of a purely scientific nature which might threaten his position. The metaphysical principles that underlie Berkeley's views of motion, space, and time are the same principles as those which underlie his entire philosophy of science; and his arguments about the scientific nature of these three concepts exemplify his concept of science. I will, therefore, treat them very much as examples, and try to make explicit the underlying principles from which Berkeley argues. In this way, one will be able to see more clearly how Berkeley's philosophy of science, as outlined so far in this paper, would be expected to function.

As I have mentioned more than once in this paper, Berkeley thought motion was the main concern of science. Often, throughout his writings, he quotes the laws of nature with the laws of motion; (for example, in D.M. 41) and says that these are the main business of physics. (D.M. 35.) So let us first consider his views on motion.

The first principle of his philosophy of science, and the first principle which Berkeley applies to the question of motion, is that which says that science is to be entirely confined to what is perceived. But we perceive only ideas, and it is fairly obvious that motion is not an idea. It must, therefore, be a form of relation which can exist between ideas.¹ As such, it cannot be abstracted from those ideas,² and hence, is dependent on the mind. (which is obvious, given Berkeley's ontology, since motion is not a spirit). Thus, Berkeley, by a simple application of his principle, has reached the conclusion that motion is relational, and that it is dependent on the mind.³

But such views on motion are opposed to the views of the scientists⁴ of Berkeley's era. Indeed, Newton had argued⁵ on purely scientific grounds that motion was absolute; namely, that the motion of any particular body was independent of the motion of any other, and that all motion was independent of mind. Berkeley thought (rightly), that it was incumbent upon him to refute these arguments, or, by implication, his metaphysical principles were threatened.

¹ Cf. D.M. 58.

² Cf. Berkeley's refutation of abstract ideas, Introduction to the Principles: for application to motion, Cf. Pr. 99.

³ Cf. D.M. 43, 58.

⁴ Except Leibniz, Cf. The Leibniz-Clarke Correspondence, pp. 25-26; 37-39, 66-78.

⁵ In the Scholium to Def VIII, Mathematical Principles of Natural Philosophy, Cf. Thayer, Newton's Philosophy of Nature, pp. 12-25.

The debate centers around Newton's bucket experiment. A bucket full of water is set spinning, and abruptly stopped when the water has begun to spin. It is claimed that the effect of centrifugal force on the water allows one to determine which is in "real" or absolute motion--the bucket or the water. It is experiments of this sort which led Newton to claim that "real" motion could sometimes be distinguished from relative motion. Modern physics, however, realizes that such arguments only prove acceleration with respect to inertial frames; in other words, that all is relational, but that one can identify acceleration.

To make clear how Berkeley reacted to Newton's arguments, we must first be clear on the relation between Berkeley's theory of force as a mathematical hypothesis and his theory of motion as relational.⁶ In the Principles, Berkeley points out that although all motion is relative to another body, we often distinguish between which body is moving and which is remaining still. For example, a man moves when he walks; the ground under him remains still (Pr. 113). We distinguish the moving body from the unmoved by deciding which has a force applied to it; motion requires the application of force. "For to denominate a body moved, it is requisite, first, that it change its distance or situation with regard to some other body; and secondly, that the force or action occasioning that change be applied to it." (Pr. 115.) But, it is

⁶ The relevant passages are: Pr. 110-117; D.M. 60-70.

remembered, force is only a mathematical hypothesis, and is dependent on motion. How then can motion be dependent on force?

It does not seem that Berkeley saw this problem for he discusses it nowhere. But careful attention to what he has said on force and motion will prove that he has not made as obvious a blunder as it may appear; he just does not bother to make the subtleties explicit.

Force, as we saw, was reducible to motion in that it was a useful shorthand for expressing the regularities in the way bodies actually moved. If motion is in turn to depend on force, then motion depends on the regularities of motion. In other words, if two bodies are changing their distance from one another, we decide which one is moving by referring to other motions, past and present, and to the regularities of those motions; that body is said to be in motion which allows us to preserve the laws governing motion.

Berkeley does not examine the implications of his own thinking far enough to make this explicit. Hence, of course, he does not provide an example which demonstrates how preserving laws can determine motion. However, if we elaborate on the example of motion he provides, we should be able to construct how the process would work. When a man walks along the street, we say he moves, but we say that the stones under his feet remain at rest, even though the stones' distance from the man changes as much as the man's distance from the stones (Pr. 113). In this example, the earth is viewed as still; things on it as moving. For the purposes

of everyday life, the earth as a standard of motion is sufficient. Newton's laws of motion work fairly accurately if one views the earth as still.⁷ They do not work at all, however, if one views a walking man as still and everything else in motion. Thus it is not really the force applied to the man which makes us say he is in motion but the fact that the laws of motion do not work if we view him as still.⁸ Normally, the earth provides a sufficient standard for motion; but usually the earth itself is said to move in the heavens. When dealing with celestial matters, Berkeley rightly suggests the fixed stars as the proper standard.⁹ Whatever the standard, it is merely a matter of convenience determined by which standard preserves the laws of motion.

Does this not sound like the modern notion of inertial frames, when references of motion are decided by how well that frame allows the laws of motion to work? In a way it does, but Berkeley now makes a blunder in his science which is as distracting as his brilliance in the philosophy of science is engaging.

Berkeley, when it suits his fancy (i.e., when he is talking of the inactivity of ideas) is fond of drawing attention to the then recent conception that both motion and rest are passive states of a

⁷ An exception would be Foucault's pendulum, which was not known in Berkeley's day.

⁸ Actually, of course, according to Newton's laws, a force is exerted on the earth as much as on the walking man. I will comment below on Berkeley's failure to understand Newton's laws.

⁹ Cf. D.M. 48; also Pr. 114.

body (D.M. 27-28; Dialogues, p. 217). Furthermore, he must have known Newton's first law of motion;¹⁰ he refers to the Principia innumerable times¹¹ and on one occasion quotes the third law (D.M. 69). But despite all this, Berkeley has succeeded in completely missing the point. Nowhere is there any indication that he realized that it was acceleration, or change of motion, that required a force, not motion itself. Indeed, he often says things that prove otherwise. One of these is his comment in the Principles on the bucket experiment; he says:

"For the water in the vessel, at that time wherein it is said to have the greatest relative circular motion, hath, I think, no motion at all:...

115. For to denominate a body moved, it is requisite, first, that it change its distance or situation with regard to some other body: and secondly, that the force or action occasioning that change be applied to it." (Pr. 114-115.)

The point is that Berkeley realized (for metaphysical reasons) that all motion was relational and was shared by all objects which changed distance with respect to one another. He further realized that we do say that some objects move while of others equally in motion we say that they are at rest. The difference, he saw, had nothing to do with the nature of motion; but was a mere matter of convenience. Furthermore, it follows from Berkeley's notion of force, though Berkeley did not make this explicit, that the most

¹⁰ Thayer, Newton's Philosophy of Nature, p. 25. For a general discussion on the history of this conception, see Koyré, Newtonian Studies, pp. 188-191.

¹¹ Eg., Pr. 110 ff.

convenient way of deciding motion and rest is by deciding what will make the laws of motion the simplest. What he failed to realize, and this is why he showed the bucket experiment less respect than it deserved, was that acceleration is determinable.¹² It is possible, if two bodies are accelerating with respect to one another, to determine which is accelerating. But the peculiar thing is, and this shows the insight of Berkeley's metaphysical principles, that acceleration is determinable on precisely the grounds that Berkeley wants to decide motion for the sake of convenience; namely, by what will make the laws of motion the simplest for our use.

Berkeley's other criticism of the scientific arguments for absolute motion is interesting because it was raised again by Mach.¹³ The rotating bucket experiment is taken as indicating absolute motion in absolute space; but the experiment is not, and cannot, be performed in empty space, but only in the presence of mass of the earth, sun, fixed stars, etc. Hence, all we are entitled to conclude is that such is the behaviour of objects when in the presence of such bodies. As Berkeley notes, the right conclusion to the experiment is that the fixed stars are best viewed at rest and other motions decided accordingly. Or, in today's terminology, the fixed stars are the best inertial frame.¹⁴

Berkeley's treatment of space and time is very similar to his treatment of motion. Space is sensed, but is not an idea.

¹²Cf. Bondi, Relativity and Common Sense, C.XII.

¹³Mach, Science of Mechanics, p. 232:

¹⁴Cf. D. H. 48.

Hence, like motion, it must be purely relational; it has no existence independent of the ideas related, and hence, also has no existence independent of minds or spirits. This, of course, precludes any possibility of there being absolute space. The scientific arguments for the necessity of absolute space were all refuted with the refutation of absolute motion.

Berkeley has, however, other reasons for rejecting absolute space which were, for him, far more important than any scientific consideration; namely, absolute space (and time) threatened God's supreme place in the universe. "But the chief advantage arising from it (the rejection of absolute space) is that we are freed from that dangerous dilemma, to which several who have employed their thoughts on that subject imagine themselves reduced, viz. of thinking either that Real Space is God, or else that there is something besides God which is eternal, uncreated, infinite, indivisible, immutable." (Pr. 117.) Berkeley probably had Henry More in mind, but the great Newton himself later acknowledged that he accepted an integral relation between absolute space and God.¹⁵ In his lead, many of his students followed.¹⁶ So Berkeley's apprehensions were well-founded.

Time is a slightly different case from space and motion; unlike them, time is a relation which holds between ideas of the

¹⁵ Cf. General Scholium to Principia; Thayer, Newton's Philosophy of Nature, pp. 41-46. This Scholium was not published until the second edition of the Principia in 1713.

¹⁶ Eg., Samuel Clarke--Cf. Leibniz-Clarke Correspondence.

memory and imagination as well as those of the senses. But again, the same results are reached: time is a relation only and does not exist independently of the ideas it relates or of the mind which has those ideas. To be specific, for Berkeley time is the succession of ideas.

Motion, space, and time are relations; this Berkeley concludes from his metaphysical principles. But what, one asks, does he mean by this claim? Time is the easiest one to consider, because he tells us what relation it is; namely, succession. Ideas are perceived by us in an orderly temporal succession, though presumably we can entertain more than one idea at once. Time is relational because it is nothing but the generic name for all relations of succession. There is no entity, "time," for time is neither an idea nor a spirit. Space, likewise, refers only to all spatial relations; there is nothing besides. In both time and space, the relations hold always between two ideas. The theory differs from, for example, Newton's theory of Absolute Space and Time. In such a theory, the place and time of an object or event would be decided by a relation, but by a relation to an independent entity call Space or Time, not by relations with other ideas. Motion is slightly more complex, for it is not a relation which holds directly between ideas. Rather, it is the change of spatial relations as the temporal relations change.

An immediate corollary of the above view is that time, space,

and motion are relative.¹⁷ That is, that there is, and can be, no absolute standard for any of the three. One can, of course, compare the spatial and temporal relations of various ideas, but the relations between any particular ideas cannot be viewed as the absolute standard, except as a matter of convenience. Motion, as I described above, also has no standard, but there one has the convenience of simpler laws of motion when using certain motions as standards.

Thus it can be concluded that the basic principles which underlie Berkeley's philosophy of science also underlie his views on space, time and motion. However, there remains one major question on Berkeley's views of space and motion which is of great concern for science. In the light of Berkeley's perceptual atomism, is his theory of space and motion adequate for science? I think it is, but I present the following discussion to clarify the points involved.

Space, it will be remembered, relates only those ideas which are perceived by sense. But Berkeley goes even further than that; touch, he says in the New Theory of Vision,¹⁸ is the only sense that can perceive space. Sight can only suggest to us magnitude and distance. In the New Theory of Vision, he seems to view space as actually external to and not dependent on the mind, but in

¹⁷ Berkeley usually uses the word relative to describe what I outline in the previous chapter; eg., Pr. 112. I use it in a slightly different sense, as described.

¹⁸ He does not discuss space directly in this work, but talks throughout of figure, extension, magnitude and distance which are all obviously spatial relations.

the Principles (sections 43-44), he carefully points out that he simply had not bothered to argue otherwise. He wishes to maintain, of course, that neither touch nor sight can perceive an objective or absolute space; there is no such thing for him. But why, then, are the relations perceived by touch considered to be spatial while those of sight, serve only to suggest the relations of touch? One reason is that the ideas of touch are more important for our survival; for they can injure us and things only seen seldom do.¹⁹ Secondly, and more important, is the fact that visual magnitude is always changing, only tactile magnitude is constant enough to provide a foundation for science. The visual magnitude of an object changes with even the slightest change in distance from the perceiver, hardly an adequate foundation for a science whose purpose it is to find order and regularities.²⁰

Sight, as already said, can only suggest to us real (i.e., tactile) spatial relations. But this is not to deny that the ideas of sight are presented to us ordered by their own relations, which, to confuse things, are known by the same names as the tactile relations they often suggest.²¹ We see magnitude, which Berkeley first considered as being the number of minima visibilia of an object, (N.T.V. 80-82), but later suggests that it can be decided by dividing the perceptual field into squares (T.V.V. 55). We also

¹⁹ Cf. N.T.V., 59.

²⁰ Cf. N.T.V., 55.

²¹ Examples are figure, magnitude, position.

are presented by sight with the relations of position in the visible field, of visible figure, and of visible motion.

This position of Berkeley of course precludes any possibility of there being a space common to both sight and touch. Berkeley is very explicit in his denial of this, (he has the following all in italics);

"The extension, figures, and motions perceived by sight are specifically distinct from the ideas of touch, called by the same names; nor is there any such thing as one idea, or kind of idea, common to both senses."
(N.T.V. 127)²²

Science, however, must obviously deal with both the senses of sight and touch. How can it operate with two spaces? Obviously it cannot; nor does Berkeley commit such an error. Tactile space is the space of science; and objects seen are fitted into that space by inference. There is, therefore, a lot of inferring to be done. We infer that objects seen have a corresponding possible tactile object that could be felt; we infer that this possible tactile object has spatial relations with other tactile and possible tactile objects (and we infer what these relations are); and lastly, we need to infer a consistency in all these spatial relations. It is to be noticed that these possible tactile ideas and their relations do not have the same ontological status as the mathematical hypotheses described above; such were only convenient shorthand devices that did not represent any idea. But in this case, we are imagining the existence of ideas and relations which might very well exist,

²² Cf. the entire section N.T.V.. 121-146.

(presumably in God's mind) and could be presented to us upon willing the right behaviour (i.e., feeling in the right direction).

All of this theory is meant to be, and is, consistent with Berkeley's perceptual atomism. Furthermore, there is nothing in the theory which is inconsistent with science. Nor is it obvious that the theory is inadequate for science, although that question would involve a great deal of investigation. The point I conclude from the above discussion is that Berkeley has made an attempt (mainly in the New Theory of Vision) to consider whether the spatial relations required for human knowledge are possible if one accepts his perceptual atomism. And I think it can be conceded that Berkeley has met the obvious objections.

Berkeley, it must be pointed out, is right at least in the general approach he takes. If science is limited to sensed experience, then obviously the spatial relations which we see are inadequate for science. Seen objects change their sizes, shapes, positions, and motions with great abandon; (even the moon cannot be trusted to behave itself in this respect). One must, therefore, construct a space by inferences. And Berkeley's suggestion that we construct it out of tactile space is not obviously ridiculous, though its adequacy for all of science has not been proved.

As a closing remark on this topic, I would like to point out that this sort of inferring of objects from one sense to another will require a great deal of mental activity. This is one area at least where the mind cannot simply passively receive related ideas from God.

Chapter VII

Conclusion

Throughout this paper, I have attempted to establish a number of things. Most importantly, I have argued that Berkeley in his writings has presented a mostly consistent philosophy of science. He has explained the nature, function and limits of science, has given a detailed description of the nature of scientific explanation, has explained the proper function of such non-perceived concepts as force, and has described the nature of motion, space and time in a way consistent with the rest of his philosophy of science. Furthermore, he has done all this without major inconsistency with the rest of his philosophy. Indeed, he argues for his view of science by appealing to his ontology and epistemology. There are some minor inconsistencies and problems with this project of Berkeley's, and I have tried to point these out; but it seems to me that most of the problems in Berkeley's philosophy of science are the result of problems in other areas of his metaphysics. For example, he has attempted to integrate his theory of science into his analysis of perception, and has a great deal of success in presenting for the most part a consistent theory. The problem is with his analysis of perception.

But despite the problems, Berkeley has provided many valuable insights into the nature of science, most of which were

not appreciated until long afterwards. Part of the value of his theory of the nature of science is that much of it is independent from other more questionable aspects of his philosophy. His attempts to describe the relationship between science and experience and his attempts to limit science to experience, contain many worthwhile insights even if one rejects his view of ideas.

Berkeley's greatest insight is that science must concern itself only with that which is presented by experience; at all times, he carefully observed the principle that the nature of science is determined by the nature of our experience. This principle involved the epistemological point which many seventeenth century rationalists missed; namely, that experience contains nothing which necessarily is the way it is and which hence can be known by rational thought alone. The principle also involved the rejection of the seventeenth century idea of scientific explanation. Mechanical explanations, or explanations in terms of matter's primary qualities of extension, solidity and motion, do not refer to experience when they involve corpuscles, aethers, and vortices. Berkeley is to be complimented for making explicit a form of explanation which avoided these.

This is not to say that either this paper or Berkeley ever bothers to prove that science must be confined to sense experience; Berkeley, in effect, assumes this when he assumes that there are no necessary connections between ideas. His importance as a philosopher of science is that he made explicit the implications of this assumption. Much later, scientists were to reap great benefit by

following Berkeley's procedure and examining precisely how science and experience are related.¹

Unanswered in this paper is whether Berkeley's philosophy of science is sufficient for science as it is actually practiced. And if not, whether science or Berkeley's philosophy ought to be changed. This is an interesting question, but it would involve a detailed study of science, both in Berkeley's day and in the present. Such, of course, is far beyond the scope of this paper.

Berkeley himself was not a scientist, and never made any contribution at all to science. Why, then, was he so interested in constructing a philosophy of science? Historically, Berkeley was actually another religious apologist faced with the un-rejectable success of science, and at the same time thinking religion true and necessary for the good of man. He was interested in defining the limits of science just to make sure those limits did not infringe on the theological and moral areas of religion. He was much more successful at this than the other philosophers who fought the (losing?) battle to keep religion safe from science. For example, Descartes and his followers could never bridge the gap they created between the mental and physical worlds. Or again, Henry More and Newton incurred the wrath of theologians when they allowed the scientifically determined concept of space to take on a religious significance. Berkeley successfully avoided these sorts of problems.

¹Cf. Popper, "Berkeley as Precursor of Mach and Einstein."

He kept science and religion distinct by his two notions of cause (real and scientific) and by limiting science to experience. The problems he encounters are mostly philosophical, not religious or scientific.

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