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[Published in *The British Journal
for the History of Philosophy* 3
(1995), 279-300.]

SIRIS AND THE SCOPE OF BERKELEY'S INSTRUMENTALISM

I. Introduction

Siris, Berkeley's last major work, is undeniably a rather odd book. It could hardly be otherwise, given Berkeley's aims in writing it, which are three-fold: 'to communicate to the public the salutary virtues of tar-water,'¹ to provide scientific background supporting the efficacy of tar-water as a medicine, and to lead the mind of the reader, via gradual steps, toward contemplation of God.² The latter two aims shape Berkeley's extensive use of contemporary natural science in *Siris*. In particular, Berkeley's focus on what he calls fire (or aether or light) as a quasi-universal 'cause' of natural change³ serves these purposes, for the 'activity' of the aether, in his view, can both explain the miraculous virtues of a certain medicine, i.e. tar-water, and reveal God's action and his divine order.⁴

Berkeley's corpuscular speculations, including his use of fire-theory, are not especially idiosyncratic as natural philosophy. In his theorizing, as Jessop and other have noted, he is heavily indebted to the work of Hermann Boerhaave, the Dutch chemist, botanist, and physician whose teachings were highly influential in mid-eighteenth century Britain.⁵ Boerhaave, along with other Dutch natural philosophers cited by Berkeley, assigned a central role in accounting for physio-chemical activity to fire, a subtle, insensible particulate substance, sometimes identified with light.⁶

However, the combination of this sort of natural philosophy with Berkeley's earlier philosophy has struck many commentators as bizarre, so much so that some have seen him as capitulating to materialism.⁷ In *Siris*, however, Berkeley explicitly reaffirms his commitment to idealism and his opposition to attributing mind-independence or true causal powers to corporeal things.⁸ A typical example is provided by *Siris* 251-2:

. . . all phenomena are, to speak truly, appearances in the soul or mind; and it hath never been explained, nor can it be explained, how external bodies, figures, and motions, should produce an appearance in the mind. Those [mechanical] principles, therefore, do not solve, if by solving is meant assigning the real, either efficient or final, cause of appearances, but only reduce them to general rules.

There is a certain analogy, constancy, and uniformity in the phenomena or appearances of nature, which are a foundation for general rules: and these are a grammar for the understanding of nature, or that series of effects in the visible world whereby we are enabled to foresee what will come to pass in the natural course of things.

This sounds like the old, familiar Berkeley, and I see no reason not to take such affirmations at face value. My own *general* interpretive attitude towards *Siris*, which I cannot defend at any length here, is that it can for the most part be rendered consistent with the metaphysics of Berkeley's early works (as indeed Berkeley thought it could be), although the results are not always appealing. And, while Berkeley had not given up his idealism when he wrote *Siris*, he *had*

abandoned some of his former motivations for it--strict empiricism and a desire to uphold common sense against scepticism, for example.

My aim in what follows, however, is to examine one important and rather neglected aspect of the vexed question of the relation of *Siris* to Berkeley's earlier works, namely, the relation of Berkeley's philosophy of science in *Siris* to that expressed in his earlier works, especially *De Motu*, his treatise on mechanics.⁹ In doing so, I shall show that a complete understanding of Berkeley's philosophy of science cannot be obtained without taking the implications of *Siris* into account.

The relation between *De Motu* and *Siris* is, *prima facie*, a problematic one. In *Siris*, in the course of explaining the medicinal virtues of tar-water, Berkeley apparently endorses a sort of dynamical corpuscularianism, according to which many of the properties of bodies are explained by the motions, attractions, and repulsions of particles too small to sense. Moreover, Berkeley seems to assume the existence of many of the theoretical entities he describes, including particles of aether. This seems to sit rather oddly with *De Motu*, where Berkeley argues at length that the theoretical entities of *dynamic* theory, that is, *forces*, should be regarded as mathematical hypotheses or useful fictions, and that Newtonian dynamics should be treated as a calculating device, rather than as a literally true description of the world. In *De Motu* and *Alciphron*, Berkeley in effect develops a form of instrumentalism which he applies to Newton's mechanics. Why, one might well wonder, do corpuscles not receive a similar treatment in *Siris*, why does Berkeley not extend his instrumentalism to aetherial particles, for example?

Indeed, Berkeley's instrumentalism would seem to have very broad applicability. According to Berkeley, any discourse which has a consistent use in guiding or influencing action has a sort of significance in virtue of that use, and so may legitimately be assented to and regarded as 'true' in the sense of 'right-guiding.'¹⁰ Thus, any such useful discourse may be regarded instrumentally,

without commitment to its literal truth. One might, then, pose the general question: Why is Berkeley's instrumentalism confined to theories of forces?¹¹

Berkeley's failure to apply instrumentalism to *certain* theoretical entities of the science of his time is easily explained. While 'matter' might be considered a theoretical term basic to most physical theories from ancient times through the mechanical philosophy of the seventeenth century, Berkeley argues in the *Principles* that we have no need to posit matter; 'matter-theory' is otiose.¹² Moreover, he maintains that the employment of the term 'matter' has pernicious effects, rather than beneficial ones which could license an instrumentalist treatment:¹³

. . . so long as the names of all particular things, with the terms *sensible, substance, body, stuff*, and the like, are retained, the word *matter* should never be missed in common talk. And in philosophical discourses it seems the best way to leave it quite out; since there is not perhaps any one thing that hath more favoured and strengthened the depraved bent of the mind toward *atheism*, than the use of that confused general term. (3D 261)¹⁴

'Absolute space' and 'absolute motion' might also seem to be candidates for an instrumentalist treatment by Berkeley, since he argues that the terms are vacuous, while accepting, as we have seen, Newton's mechanics. However, he does not specifically advocate such a treatment because he believes that our clear conceptions of *relative* motion and space will stand in for absolute motion and space. Moreover, he argues that we implicitly rely on a relative conception of motion even when we suppose ourselves to be appealing to absolutes:

If we sound our own conceptions, I believe we may find all the absolute motion we can frame an idea of, to be at bottom no other than relative motion thus defined. For as hath been already observed, absolute motion exclusive of all external relation is incomprehensible: and to this kind of relative motion, all the above-mentioned properties, causes, and effects ascribed to absolute motion, will, if I mistake not, be found to agree. (PHK 114)

But motion and rest marked out by such relative space can conveniently be substituted in place of the absolutes, which cannot be distinguished from them by any mark. (DM 64)

No such easy explanation is available, however, of the fact that Berkeley does not offer an instrumentalist treatment of insensible aetherial particles. Berkeley clearly supposes that the corpuscular theory he describes is useful, both for explaining the medicinal effects of tar water and for contributing to our understanding of the cosmos. His attitude towards the particulate entities mentioned in theory, however, seems for the most part to be straightforwardly realistic. *Siris*, then, poses a special problem for understanding the scope and limits of Berkeley's instrumentalism.

My aim in this paper is to explore this problem and to examine the extent to which Berkeley's corpuscularianism in *Siris* is compatible with his instrumentalism about dynamics and, more generally, with his philosophy of science as expressed in *De Motu*.

I begin this task by defending, in the next two sections of the paper, a number of claims about Berkeley's philosophy of science in *Siris*. First, I briefly

show that Berkeley does remain an instrumentalist about forces in *Siris*, where he couples this dynamical instrumentalism with realism about corpuscles. Second, I argue Berkeley does have reasons which explain his taking different attitudes towards forces and corpuscles. I then go on to suggest that, although these conclusions dispel the worry that *Siris* and *De Motu* are outright inconsistent, they in turn raise a subtler problem about the nature of Berkeley's instrumentalism in *De Motu* and *Siris*.

II. Dynamical instrumentalism and particle realism in *Siris*

Berkeley makes heavy use of dynamical concepts in his theorizing in *Siris*. He voices a general preference for Newtonian force-based explanations of physical phenomena over strictly mechanical Cartesian theories:

Nature seems better known and explained by attractions and repulsions than by those other mechanical principles of size, figure, and the like; that is, by Sir Isaac Newton than Descartes. (S 243)

Moreover, aether-- the subtle, insensible, particulate stuff central to Berkeley's corpuscularianism in *Siris*-- is supposed by him to 'operate' by means of forces:

The pure aether or invisible fire contains parts of different kinds, that are impressed with different forces, or subjected to different laws of motion. . . . The different modes of cohesion, attraction, repulsion, and motion appear to be the source from whence the specific properties are derived, rather than different shapes or figures. (S 162)

However, Berkeley also makes clear that the dynamic elements of his theorizing are to be understood instrumentally, not as literal attributions of real forces to particles; to say that certain particles attract or are attracted is just to say that their movements agree with certain laws:¹⁵

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. (S 231)

Indeed, Berkeley explicitly echoes his *De Motu* interpretation of forces as mathematical hypotheses, or useful fictions:

There appears a uniform working in things great and small, by attracting and repelling forces. But the particular laws of attraction and repulsion are various. Nor are we concerned at all about the forces, neither can we know or measure them otherwise than by their effects, that is to say, the motions; which motions only, and not the forces, are indeed in the bodies (Sect. 155). Bodies are moved to or from each other, and this is performed according to different laws. The natural or mechanic philosopher endeavours to discover those laws by experiment and reasoning. But what is said of forces residing in bodies, whether attracting or repelling, is to be regarded only as a mathematical hypothesis, and not as anything really existing in nature. (S 234)

By contrast, Berkeley's attitude towards corpuscles in *Siris* is for the most part realistic, in the sense that the sorts of particles he invokes are frequently treated as things known to exist. Berkeley's realism about corpuscles is perhaps most obvious where it is implicitly contrasted with explicit instrumentalism about forces:

We are not therefore seriously to suppose, with certain mechanic philosophers, that the minute particles of bodies have real forces or powers, by which they act on each other, to produce the various phenomena in nature. The minute corpuscles are impelled and directed, that is to say, moved to and from each other, according to various rules or laws of motion. (S 235)

While Berkeley repeatedly cautions us against taking his talk of forces too literally, he never issues any parallel cautions in the case of the corpuscles themselves. Clearly, in Berkeley's view, positing corpuscles is legitimate, whereas positing forces is absurd.

What justifies these radically different treatments? This question may be answered, in part, by answering a related question: What's wrong with realism about forces, according to Berkeley? In the next section, I argue that neither of Berkeley's central *objections* to realism about dynamics in fact applies to realism about corpuscles.

III. Criteria for entity realism

Clearly, one reason that Berkeley attacks realism about dynamics is that he has metaphysical grounds for thinking that forces can't possibly exist. For any sort of corpuscular realism to be tenable, then, Berkeley's metaphysics must

allow that corpuscles could actually exist. We might call this the metaphysical criterion for realism about theoretical entities.

A. The metaphysical criterion

Forces manifestly fail the metaphysical test. In *Siris*, unlike *De Motu*, Berkeley makes explicit his metaphysical objections to the existence of forces. The existence of *active* corporeal forces contradicts one of Berkeley's central metaphysical tenets: only spirits are causally active. Berkeley raises this as an obstacle to dynamical realism at *Siris* 247:

In strict truth, all agents are incorporeal, and as such are not properly of physical consideration. The astronomer, therefore, the mechanic, or the chemist, not as such, but by accident only, treat of real causes, agents, or efficient. Neither doth it seem, as is supposed by the greatest of mechanical philosophers, that the true way of proceeding in their science is, from known motions in nature to investigate the moving forces; forasmuch as force is neither corporeal nor belongs to any corporeal thing. . . .

In addition, Berkeley's idealism implies that bodies, as bundles of ideas, are causally inactive. Berkeley makes this implication explicit in *Siris* 292:

Natural phenomena are only natural appearances. They are, therefore, such as we see and perceive them. Their real and objective natures are, therefore, the same--passive without anything active, fluent and changing without anything permanent in them.

Berkeley thus has strong metaphysical metaphysical reasons to maintain that forces cannot exist and dynamical realism is untenable.

Do corpuscles meet the metaphysical criterion? Could they exist in a Berkeleyan world? One *prima facie* objection to the existence of aether is suggested by passages like *Siris* 152, which describe the aether as a 'mighty agent' which must be 'restrained and governed with the greatest wisdom.' However, despite the frequency of passages attesting to the awesome power of aether, Berkeley makes clear elsewhere that he does not actually mean to attribute causal efficacy to the aether or to any other corporeal thing:¹⁶

We have no proof, either from experiment or reason, of any other agent or efficient cause than mind or spirit. When, therefore, we speak of corporeal agents or corporeal causes, this is to be understood in a different, subordinate, and improper sense. (S 154)

Therefore, though we speak of this fiery substance as acting, yet it is to be understood only as a mean or instrument, which indeed is the case of all mechanical causes whatsoever. They are, nevertheless, sometimes termed agents and causes, although they are by no means active in a strict and proper signification. . . . In compliance with established language and the use of the world, we must employ the popular current phrase. But then in regard to truth we ought to distinguish its meaning. It may suffice to have made this declaration once for all, in order to avoid mistakes. (S 155)

Thus, the existence of corpuscles, including aetherial ones, does not conflict with Berkeley's brand of occasionalism.

More serious problems for corpuscular realism are posed by Berkeley's most famous metaphysical dictum, to be is to be perceived (for non-spiritual items). Obviously, no corpuscles had ever been perceived by a human perceiver, in Berkeley's day, despite the rapid advances of microscopy. How then could he have defended the ideal existence of corpuscles? The obvious first step in such a defense is to appeal to God: If corpuscles exist, God has ideas of them, even if we don't. However, this defense is not adequate as it stands, for it does not fully resolve the question at hand. If we want to know whether corpuscles could actually exist in a Berkeleyian world, we need to know what the requirements for actual existence *are* in a Berkeleyian world. As Margaret Wilson has pointed out, while God's having an idea of X is surely a necessary condition for X's actually existing in Berkeley's view, it cannot be a sufficient condition, for it obviously lets in too much. Presumably, God has ideas of all sorts of things which don't actually exist.¹⁷

In the *Three Dialogues*, Berkeley appears to indicate his preferred way of determining actual existence in the course of giving a philosophical account of the creation:

May we not understand it [the creation] to have been entirely in respect of finite spirits; so that things with regard to us, may be properly be said to begin their existence, or be created, when God decreed they should become perceptible to intelligent creatures, in that order and manner which he then established, and we now call the laws of Nature? (3D 253)¹⁸

What actually exists, according to Berkeley is what God has decreed to be perceivable by his creatures. By this criterion, then, corpuscles exist just in case God has willed that they be perceived by finite spirits under certain circumstances.¹⁹

So, for corpuscles to exist there must be circumstances under which we would perceive them. What might those circumstances be like?²⁰

To start with the simplest case, it might be that corpuscles *will* eventually be observed with the aid of more advanced microscopes. Berkeley himself might well have supposed that many of the particles he employed in his theorizing would someday be observed in this way. Thus, he might have supposed that God had decreed that from the time of creation, whenever humans look through a certain kind of microscope, they will observe certain kinds of corpuscles. In virtue of this decree, these kinds of corpuscles would then exist.

Furthermore, it would seem that God could make such a decree, even while knowing that such a microscope would never be constructed. Such corpuscles would have been observed with microscopes which could have been built. Such corpuscles would then exist, by Berkeley's criterion, even though (due to the high cost of microscope construction, for example) they would never actually be observed.

However, the *aether*, as Berkeley characterizes it, seems to be in neither of the above categories and so seems to pose a special problem for Berkeley's metaphysics. In *Siris*, Berkeley describes the aether or fire as follows:

The pure fire is to be discerned by its effects alone. . . . (S 190)

. . . fire is a subtle invisible thing, whose operation is not to be discerned but by means of some grosser body, which serves . . . for a vehicle to arrest and bring it into view. . . . (S 197)

The pure invisible fire or aether doth permeate all bodies, even the hardest and most solid, as the diamond. (S 200)

It seems to be a part of Berkeley's *theory* of the aether that aetherial particles cannot be observed, perhaps because of their ability to freely penetrate all other bodies.²¹ Particles of aether are thus unobservable in principle, according to Berkeley, in the sense that the physical laws which govern them entail their unobservability.

It is, however, perhaps not logically impossible that the aether be perceived. Kenneth Winkler, in his discussion of the possibility of 'idealistic corpuscularianism' suggests that particles like this might be, in effect, perceivable by magic.²² That is, it could be that God has decreed that under certain very peculiar circumstances (which may or may not actually come about), the usual laws of nature governing the aether will be suspended and we will observe particles of aether. The question arises as to why this would count as observing aether rather than as having hallucinations about aether. Winkler's response is that if there exist 'reliable connections between the scenes [so] disclosed and the observations we make by other means,' such that the aether-sightings would have some predictive value, then they should be counted as observations.²³ (The existence of these reliable connections would presumably also be determined by the nature of God's decrees.)

It seems hard to deny that God *could* have made the sort of decrees Winkler suggests. Certainly the suggestion that the laws of nature might be

suspended by God for good reason and might not be as universally applicable as we imagine, although they are general enough to be highly useful, is quite in keeping with some of Berkeley's own remarks.²⁴

The difficulty with Winkler's solution lies in the claim that aetherial particles would, on this account, qualify as real things. After all, the orderliness and coherence of certain sorts of ideas is what allows us to distinguish, according to Berkeley, between real things and imaginary ones.²⁵ And the most crucial sort of orderliness is conformity to the laws of nature, as Berkeley himself remarks in *Principles* 30. Ideas whose occurrence violates a law of nature ought to be counted as chimaeras, rather than real things, on the *Principles* view.²⁶

Thus, there does seem to an unresolvable tension between Berkeley's championing of the aether in *Siris*, and the particular *esse est percipi* position defended in his early works. It appears that Berkeley, whether knowingly or not, has relaxed his earlier criterion for actual existence. This is not, however, to suggest that Berkeley has capitulated to materialism, for the aether can still enjoy a purely ideal existence in God's mind. Although Berkeley neither acknowledges nor resolves the issue of why the aether should then qualify as actually existing, he might simply assert that the nature of God's intentions could establish the aether as part of his plan for our world, even if the aether itself cannot be revealed to us directly because of the laws God has established.²⁷ Since God's ideas of the aether presumably could form a part of his plan for our world, aether could actually exist.

The corpuscles Berkeley invokes in *Siris*, then, may be said to pass the metaphysical test for entity realism, for realism about aether does not force Berkeley to abandon idealism, although it does require a revised (and less restrictive) account of what makes for actual existence.

B. The imaginability criterion

In *De Motu*, however, where Berkeley keeps his idealism under wraps, he invokes another sort of criterion to discredit realism about forces. There, Berkeley's main argument against dynamical realism is based on the *unimaginability* of forces. Since, as he supposes, forces are supposed to be *active* qualities distinct from all the ordinary sensible qualities of body, the term 'force', he contends, lacks sensory content. Lacking sensory content, he asserts, the term cannot refer, for in Berkeley's view sensory content is required for terms to refer to physical items. Realism about forces is thus nonsensical, according to Berkeley. This sort of argument can be made against any unimaginable entity, since for something to be unimaginable is precisely for the term for it to lack appropriate sensory content. Thus because forces are entities of a radically different kind from those we directly perceive, they fail the imaginability test for entity realism.²⁸

Corpuscles, by contrast, pass this test; they *are* imaginable, for they *are* supposed to possess qualities of a sensible kind. In *Siris* 131-3, for example, Berkeley clearly assumes that (molecules of) salts and acids have determinate *figures*, although we are unable to determine them precisely.²⁹

Likewise, Berkeley maintains that the aether is particulate and corporeal:
But it is now well known that light moves; that its motion is not instantaneous; that it is capable of condensation, rarefaction, and collision; that it can be mixed with other bodies, enter their

composition, and increase their weight (Sects. 169, 192, 193). All of which seems sufficiently to . . . shew light to be corporeal. (S 207)

Berkeley's corporeal aether is composed of tiny *bodies* with some determinate size, shape, weight, etc.³⁰ Although these sizes and shapes are submicroscopic, they do count as qualities of a sensible kind for Berkeley, since they can be imagined by direct analogy with our experience of tangible or visible sizes and shapes.³¹

Nor are corpuscles supposed to actually possess any unimaginable qualities, i.e. qualities of a kind distinct from all sensible qualities, such as real force or power. Although such qualities may be attributed to corpuscles within a scientific theory, Berkeley holds that these attributions are not to be understood realistically, as was made clear above.

One worry about the imaginability of corpuscles might be raised as follows: Berkeley must hold that we can't imagine an uncolored visible shape, since he maintains that color and figure cannot be abstracted from one another (and he counts pellucidness as a color).³² However, no corpuscular theories, including those that Berkeley relates in *Siris*, attribute color to corpuscles. The worry is easily resolved, however, for Berkeley's corpuscularianism does not require that corpuscles *be* uncolored. It does dictate that color, along with other sensible qualities on the traditional list of 'secondary qualities,' plays no important role in corpuscular explanation. Moreover, Berkeley seems to hold that the secondary qualities of observable bodies can be explained by (i.e. correlated in a law-like way with) the motions of corpuscles. But neither of these considerations implies that corpuscles have no colors.^{33, 34}

It turns out, then, that we can conceive of corpuscles, since they are supposed to be bodies with qualities of a sensible kind, despite being too small to

sense. 'Particle'-terms are therefore potentially referential; we can posit corpuscles, unlike forces, without speaking nonsense.

Thus, corpuscles pass Berkeley's imaginability test for entity realism; particle realism makes sense in a way that dynamical realism does not, on Berkeley's view.

We have discovered, then, some justification for the very different attitudes Berkeley adopts towards forces and insensible particles: Two sorts of considerations rule out realism about forces, while permitting realism about particles. While this allows us to acquit Berkeley of certain charges of inconsistency, it raises, I want to suggest, a deeper problem about the nature of Berkeley's instrumentalism about dynamics.

If Berkeley's central reason for advocating instrumentalism about dynamics is just that realism is ruled out, and if his reason for being a realist about corpuscles is just that such realism is not obviously untenable, then it appears that realism is Berkeley's preferred attitude towards scientific theories and the entities they posit. His instrumentalist treatment of dynamics, then, would simply be an ad hoc response to a successful theory with a metaphysical problem. Thus, while it would be accurate to say that Berkeley articulates a form of instrumentalism in response to the problem posed for him by the astonishing success of Newtonian dynamics, it would be misleading to call him a scientific instrumentalist, for his instrumentalism does not represent a general position about the proper interpretation of scientific theories.

I will argue, however, that Berkeley's instrumentalism is not merely an ad hoc response to one threatening theory. My final step will be to show that in *Siris* we can see the scope, as well as the limits, of Berkeley's instrumentalism.

IV. The scope of Berkeley's instrumentalism

The key passage here is *Siris* 228:

It is one thing to arrive at general laws of nature from a contemplation of the phenomena, and another to frame an hypothesis, and from thence deduce the phenomena. Those who supposed epicycles, and by them explained the motions and appearances of the planets, may not therefore be thought to have discovered principles true in fact and nature. And, albeit we may from the premises infer a conclusion, it will not follow that we can argue reciprocally, and from the conclusion infer the premises. (S 228)³⁵

Here, Berkeley carefully distinguishes between two types of scientific method, a (broadly-speaking) inductive method versus a hypothetico-deductive method. And, as I interpret him, Berkeley maintains that different attitudes are appropriate to the theories which result from these two methods. We are naturally and appropriately realists about the results of induction. Hypotheses, on the other hand, in Berkeley's view, should be treated as such; although we may appreciate their utility, we should not assume their truth, nor infer the existence of entities that they mention. Thus, Berkeley's instrumentalism extends to all theories which are based on hypotheses, rather than being inductively grounded.³⁶

This interpretation of Berkeley's position provokes two further questions, however: Did Berkeley regard Newton's mechanics, which he treats instrumentally, as hypothetical in the relevant sense? And, how could Berkeley have supposed that the corpuscularian theories he straightforwardly endorses in *Siris* are based on induction?

A. Instrumentalism about hypothetical theories, e.g. Newton's dynamics

The first question is considerably easier to answer, so I'll begin with it. The answer, in short, is 'yes.' Berkeley did see Newtonian dynamics as being based on a method of hypothesis, rather than induction. Of course, Newton himself famously presents his work as being straightforwardly derived from experience, as in the following passage from the *Principia*:

...whatever is not deduced from the phenomena is to be called an hypothesis; and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy. In this philosophy particular propositions are inferred from the phenomena, and afterwards rendered general by induction. Thus it was that the impenetrability, the mobility and the impulsive force of bodies, and the laws of motion and gravitation, were discovered.³⁷

However, by the time he wrote *De Motu*, Berkeley had clearly realized that Newton's laws could not be regarded as simple empirical generalizations. Newton's laws can't be the products of simple inductive generalization, according to Berkeley, precisely because they invoke forces, which don't directly correspond to anything sensible.³⁸ Thus, they fall into the category of hypotheses.³⁹ In response to this realization, in *De Motu* Berkeley expands his characterization of laws of nature from the *Principles*, allowing something to count as a law of nature if it permits us to *deduce* regularities in the phenomena, rather than simply *describing* such a regularity.⁴⁰

B. Realism about inductive theories, e.g. aether theory?

This brings us back, however, to the second question: If Berkeley directs us to be realists only about theories which are founded on induction, how is it that he is apparently so sanguine about corpuscular realism in *Siris*, when corpuscles themselves had never been sensed?

Now it's not clear that Berkeley commits himself to the actual existence of *all* the particles he refers to in his theorizing in *Siris*. In some cases he makes clear that he's putting forward *suppositions* about the nature of corpuscular constitutions which might underlie particular observed phenomena.⁴¹ In such cases, Berkeley's attitude towards theoretical particles is presumably an instrumentalist one; we may posit the existence of unobserved entities of a certain sort in order to systematize the phenomena and make predictions, although we may not infer the existence of the entities from the utility of the theory. Although the theory invoked then *is* true or false (unlike dynamics, whose central terms are not referential, according to Berkeley), the *point* of such hypothetical theorizing is its utility. Moreover, the theory's ability to explain the phenomena is independent of whether it is in fact true or false.⁴²

However, Berkeley is not always so cautious in his references to corpuscles. In many cases he makes clear that he is quite convinced of the existence of the particles under discussion, stating that, for example, 'air is in reality nothing more than particles of wet and dry bodies . . . rendered elastic by fire' (S 197) Particles of aether are treated by Berkeley as actual existents as well: at *Siris* 281 he states that the particles of light or pure fire are *known* to be heterogeneous.⁴³

Berkeley, then, treats some particles as undoubtedly real. What kind of inductive justification could he have for his confidence in their reality? Some justification might be provided by arguing that our experience of the world

supports the following generalization: the behavior of larger parts is correlated with an internal structure of smaller parts, down to the level of tiny particles. Such a view seems to underlie Berkeley's discussion in *Siris* 283:

It is a vulgar remark, that the works of art do not bear a nice microscopical inspection, but the more helps are used, and the more nicely you pry into natural productions, the more do you discover of the fine mechanism of nature, which is endless or inexhaustible; new and other parts, more subtle and delicate than the precedent, still continuing to offer themselves to view.

In this way our macroscopic and microscopic observations might give us reason to suppose that unobserved particles exist, without our inferring their existence merely from the predictive success of some corpuscular hypotheses.

However, while this sort of justification might apply to some sorts of particles, it does not obviously apply to the aether, as Berkeley characterizes it. For the particles of aether or light, in Berkeley's view, do not obey the same laws of motion as macroscopic bodies. This is clear from certain passages where Berkeley endeavors to justify the medicinal powers he attributes to tar-water:

Besides, it hath been discovered by Sir Isaac Newton, and an admirable discovery it was, that light is a heterogeneous medium (Sects. 40, 181), consisting of particles endued with original distinct properties. And upon these, if I may venture to give my conjectures, it seemeth probable the specific properties of bodies, and the force of specific medicines, may depend. (S 238)⁴⁴

Why may we not suppose certain idiosyncrasies, sympathies, oppositions, in the solids, or fluids, or animal spirit of a human body, with regard to the fine insensible parts of minerals or vegetables, impregnated by rays of light of different properties, not depending on the different size, figure, number, solidity, or weight of those particles, nor on the general laws of motion, nor on the density or elasticity of a medium, but merely and altogether on the good pleasure of the Creator, in the original formation of things? From whence divers unaccountable and unforeseen motions may arise in the animal economy; from whence also various peculiar and specific virtues may be conceived to arise, residing in certain medicines, and not to be explained by mechanical principles. For although the general known laws of motion are to be deemed mechanical, yet peculiar motions of the insensible parts, and peculiar properties depending thereon, are occult and specific. (S 239)

Thus, it is quite unclear how our observations of ordinary bodies obeying mechanical laws could give us any reason for assuming that this sort of aether exists, given that it consists of extremely subtle bodies *obeying laws entirely peculiar to themselves*.⁴⁵ The existence of such particles would seem to make the world less regular and less scientifically intelligible, not more so.

Berkeley's grounds for realism about the aether he describes are genuinely obscure; nevertheless, a plausible solution is available which does have textual support. I suggest that Berkeley sees the existence of the aether as a *consequence* of a certain *cosmological* theory which he takes to have inductive support. Many passages in *Siris* attest to the special place of aether in Berkeley's cosmology:

As the soul acts immediately on pure fire, so pure fire operates immediately on air. . . . (S 163)

The Platonists held their intellect resided in soul, and soul in an aethereal vehicle. And that as the soul was a middle nature, reconciling intellect with aether, so aether was another middle nature, which reconciled and connected the soul with grosser bodies. . . . (S 171)⁴⁶

And air may in some sort not improperly be said to be the carrier or vehicle of the soul, inasmuch as it is the vehicle of fire, which is the spirit immediately moved and animated by the soul. (S 280)

What other nature there should be [besides light], intermediate between the Soul of the world (Sect. 171) and this gross corporeal system, which might be the vehicle of life, or, to use the language of philosophers, might receive or be impressed with the forms of things, is difficult to comprehend. (S 283)

The basic structure of this cosmology, according to which aether serves as some sort of 'middle nature' or link between soul and bodies grosser than the aether, seems to be dictated by the doctrine of the great chain of being, which Berkeley describes as follows:

Jamblichus declares the world to be one animal, in which the parts, however distant each from other, are nevertheless related and

connected by one common nature. And he teacheth, what is also a received notion of the Pythagoreans and Platonics, that there is no chasm in nature, but a Chain or Scale of beings rising by gentle uninterrupted gradations from the lowest to the highest, each nature being informed and perfected by the participation of a higher. As air becomes igneous, so the purest fire becomes animal, and the animal soul becomes intellectual; which is to be understood not of the change of one nature into another, but of the connexion of different natures, each lower nature being, according to those philosophers, as it were a receptacle or subject for the next above it to reside and act in. (S 274)

In *Siris*, Berkeley for the first time explicitly endorses this ancient doctrine, which, as Lovejoy famously documented, still gripped the imagination of 18th century thinkers:⁴⁷

There runs a chain throughout the whole system of beings. In this chain one link drags another. The meanest things are connected with the highest. (S303)⁴⁸

The actual existence of the aether is thus required, in Berkeley's view, to fill in what would otherwise be a gap in the natures of things.⁴⁹ That nature has no gaps is presumably something that Berkeley, like many of his predecessors, thought that we could induce from experience. Locke, in fact, argues in just this way in the *Essay*:

That there should be more *Species* of intelligent Creatures above us, than there are of sensible and material below us, is probable to me from hence; That in all the visible corporeal World, we see no Chasms or Gaps. All quite down from us, the descent is by easy steps, and a continued series of Things, that in each remove, differ very little one from the other.⁵⁰

Thus, Berkeley might have felt entitled to regard aether theory in its most general outlines as a theory based on induction, despite the fact that particles of aether themselves could never be sensed by us.⁵¹ Of course, in order to grant Berkeley this, and to support the general claim that Berkeley would have us treat realistically only what can be based on induction, it's been necessary to construe induction rather broadly, so much so that one might begin to wonder what sort of theories *could not* be inductively grounded, on this view.

This question can be answered, however, and the answer brings out the fact that Berkeley's distinction between induction-based and hypothetical theories coheres very well with what I earlier labeled as his imaginability criterion for realism. Although induction may under certain circumstances allow us to infer the existence of things we haven't (or even can't) sense, one thing it won't do is lead us to posit things of a totally different kind from any we have experienced; that is, it won't lead us to posit the unimaginable entities which Berkeley holds (for independent reasons) that it's nonsensical to posit. And, furthermore, an imaginable entity is one that can be accommodated within Berkeley's idealist metaphysics.

Thus, while I've argued that proper attention to the implications of *Siris* shows us that the scope of Berkeley's instrumentalism is determined by his philosophical views about scientific method, those methodological views are

clearly in harmony with the metaphysical, semantic, and epistemological doctrines which he uses to criticize dynamical realism both there and *De Motu*.⁵²

¹*Siris*, Berkeley's introductory paragraph, *Works*, Vol. V, p. 31. All references to Berkeley are to the Luce-Jessop edition of Berkeley's works: George Berkeley, *The Works of George Berkeley, Bishop of Cloyne*, edited by A.A. Luce and T.E. Jessop (London, 1948-57), 9 vols. I have used the following abbreviations for Berkeley's works:

PHK	Principles of Human Knowledge
3D	Three Dialogues
DM	De Motu
S	Siris

References to these works are by section numbers, except for 3D, where they are by page number.

²On the last, see S 297, 303.

³S 158.

⁴S 237-9.

⁵On Berkeley's debt to Boerhaave, see Jessop's introduction to *Siris*, *Works*, Vol. V, p. 11. Jessop also collects relevant passages from the *Elementa Chemiae* as Appendix II to *Siris*. See also I.C. Tipton, "The "Philosopher by Fire" in Berkeley's *Alciphron*," in *Berkeley: Critical and Interpretive Essays*, edited by Colin Turbayne (Minneapolis, 1982), p. 161. On Boerhaave's views and his influence in Britain, see Robert Schofield, *Mechanism and Materialism: British Natural Philosophy in an Age of Reason* (Princeton, 1987), 134-157. The *Elementa Chemiae* was published in 1732 and translated into English in 1735 and again in 1741. An unauthorized edition compiled from student lecture notes had been published in 1724 and

translated into English in 1727. Berkeley also obviously draws some inspiration directly from Newton's *Optics*.

⁶Berkeley also mentions Nieuwentyt and Homberg, S 189-90.

⁷E.g. John Wild, 'Berkeley's Theories of Perception: A Phenomenological Critique,' *Revue Internationale de Philosophie*, 7 (1953): 134-151. Recently Catherine Wilson has claimed that by the time he wrote *Siris*, Berkeley had come to accept the existence of a mind-independent world. Catherine Wilson, 'Berkeley and the Microworld,' forthcoming in *Archiv fur Geschichte der Philosophie*.

⁸Berkeley's idealism is also evident in S 266, and 292. Berkeley's continued hostility to mind-independent corporeal substance or matter is exhibited in S 311, 316-319. Berkeley's continued commitment to a sort of occasionalism is discussed below.

⁹Gabriel Moked, in *Particles and Ideas* (Oxford, 1988) does acknowledge the mixture of instrumentalism and realism to be found in *Siris*. While I find Moked's classification of Berkeley's views in *Siris* to be for the most part helpful and accurate, it seems to me that he neglects to examine some of the important tensions among those views. Most surprisingly, he never addresses the question of *why* Berkeley feels entitled to assume the actual existence of certain submicroscopic particles, including particles of aether.

¹⁰See *Alciphron*, dialogue VII.

¹¹There are also interesting questions, which cannot be addressed here, about the relation between Berkeley's scientific instrumentalism and his views in the philosophy of mathematics. Although his treatment of arithmetic and geometry emphasizes their practical applicability, his critique of the calculus in the *Analyst* seems to suggest that he may hold mathematics (or, perhaps, the geometrical branches of mathematics) to a higher standard of intelligibility than physical

science (such that instrumentalism about the calculus would be inappropriate). Douglas Jesseph provides a very helpful treatment of this issue in *Berkeley's Philosophy of Mathematics* (Chicago, 1993), 213-226. I disagree, however, with Jesseph's interpretation of *De Motu*, according to which Berkeley holds that dynamical terms must be given experiential content. As I indicate below, I believe that Berkeley's main argument against realism about dynamics hinges precisely on the claim that the dynamical terms in question have no sensory content.

¹²See especially PHK 19-20.

¹³This point is also made by David Berman, 'Cognitive Theology and Emotive Mysteries in Berkeley's *Alciphron*,' *Proceedings of the Royal Irish Academy*, 81C (1981): 219-229.

¹⁴See also PHK 35.

¹⁵See also S 235-6, 243, 246-8.

¹⁶See also S 221.

¹⁷Margaret Wilson raises this difficulty in 'Berkeley and the Essences of the Corpuscularians,' *Essays on Berkeley: A Tercentennial Celebration*, edited by John Foster and Howard Robinson (Oxford, 1985), 140-1.

¹⁸See also 3D 252.

¹⁹And, of course, they *could* exist just in case God could will such a thing.

²⁰The partitioning of circumstances which follows is derived from Margaret Wilson's analysis in 'Berkeley and the Essences of the Corpuscularians.'

²¹See also S 195.

²²Kenneth Winkler, *Berkeley: An Interpretation* (Oxford, 1989), p. 272.

²³*Ibid.*, p.273.

²⁴E.g. S 239, PHK 63, PHK 106.

²⁵PHK 30, 33.

²⁶This point was suggested to me by a remark of Bas van Fraassen's on an earlier version of this paper.

²⁷I do not mean to claim that this suggestion alone would constitute an adequate defense of Berkeley's position. Rather, the suggestion is intended merely as support for my contention that Berkeley's endorsement of the aether, while it is in conflict with the specific *esse est percipi* position laid down in the *Three Dialogues*, does not obviously jeopardize idealism by requiring the acceptance of a mind-independent realm.

²⁸I provide a detailed critical analysis of this argument in 'Berkeley's Case Against Realism About Dynamics,' forthcoming in *Berkeley's Metaphysics*, edited by Robert Muehlmann.

²⁹Siris 131:

It seems impossible to determine the figures of particular salts. All acid solvents, together with the dissolved bodies, are apt to shoot into certain figures, and the figures in which the fossil salts crystallize have been supposed the proper natural shapes of them and their acids. But Homberg hath clearly shewed the contrary. . . .

In this case, as throughout Berkeley's corpuscular theorizing in *Siris*, he holds that the figures of these particles are less relevant for physical explanation of the phenomena than their 'attractive powers,' that is, their place in certain regularities of motion:

. . . it should seem the figures of salts were not of such efficacy in producing their effects as the strong attractive powers whereby they are agitated and do agitate other bodies. . . . (S 133)

However, the important point for present purposes is that the particles in question *have* shapes and sizes, and thus are imaginable.

³⁰See also S 162, previously quoted.

³¹See *The Theory of Vision Vindicated and Explained, Works*, Vol. I, sec. 51:

And here it may not be amiss to observe that figures and motions which cannot be actually felt by us, but only imagined, may nevertheless be esteemed tangible ideas, forasmuch as they are of the same kind with the objects of touch, and as the imagination drew them from that sense.

³²See PC 453.

³³Here I agree with Kenneth Winkler, *Berkeley*, p. 224. and Daniel Garber, 'Locke, Berkeley, and Corpuscular Scepticism,' *Berkeley: Critical and Interpretive Essays*, edited by Colin Turbayne (Minneapolis, 1982), 193-4.

³⁴It is somewhat puzzling that Berkeley seems to give *all* the primary qualities of corpuscles prominence over their secondary qualities (at S 266), given that in his view only the motions and tendencies to motion of particles have great explanatory significance. However, one might plausibly speculate, in keeping with his remarks, that he sees the sizes, shapes, and weights of particles as generally important for identifying types of particles with particular tendencies to motion. The other primary qualities would in that case derive predictive significance from the predictive significance of mobility.

³⁵This logical point, that an hypothesis cannot be definitively established by establishing that its consequences agree with observation was, of course, a familiar one. See e.g. Thomas Aquinas, *In Aristotelis Libros De Caelo et Mundo*, (Turin, 1952), L. II, l. XVII, p.226.

³⁶In being suspicious of hypotheses, Berkeley was very much in accord with the philosophical/scientific mainstream of his time. His originality lies in his acknowledgment of the important role which scientific hypotheses, *properly interpreted*, could play in science.

³⁷Sir Isaac Newton, *Mathematical Principles of Natural Philosophy*, translated by Andrew Motte, revised by Florian Cajori (Berkeley, 1962), Vol. II, p. 547.

³⁸See S 247

³⁹They are, however, hypotheses of a special sort, since Berkeley claims not merely that we cannot ascertain their truth, but that because they invoke unimaginable forces, it is actually nonsensical to suppose that they are literally true. Moreover, the instrumentalist interpretation which Berkeley recommends giving to Newton's laws might be described (awkwardly) as 'de-hypotheticalizing' them. That is, by regarding Newtonian mechanics as *merely* a calculating device, we cease to regard Newton's laws as hypotheses about the way the world is. The fact that Newtonian mechanics as a whole provides an excellent calculating device *can* be inductively established.

⁴⁰Compare DM 36-7 with PHK 62, 104-5.

⁴¹E.g. S 134, 209, 238-9.

⁴²Berkeley's conception of scientific explanation thus remains a pragmatic one in *Siris*.

⁴³See also S 207, previously quoted.

⁴⁴Other passages in *Siris* (including S 239, quoted below) make clear that by attributing 'original distinct properties' to light, Berkeley simply means to say that the particles of aether move in peculiar ways and are correlated with peculiar movements in other particles they 'affect.'

⁴⁵And given, of course, that Berkeley denies that the predictive power of a theory can provide adequate grounds for assuming its truth.

⁴⁶While it is not always clear to what extent Berkeley himself endorses the views he attributes to the ancients in *Siris*, I take it that Berkeley more or less agrees with the doctrine he attributes to the Platonists here, since he relates it to his own views later in the same passage.

⁴⁷Arthur Lovejoy, *The Great Chain of Being* (Cambridge, Mass., 1936).

⁴⁸The metaphor of the chain is, of course, central to *Siris* and provides the work with its title.

⁴⁹One wonders how well the aether (or anything else) could really bridge the chasm between spiritual and corporeal (i.e. ideal) things, since it itself is corporeal (and everything is either one or the other, in Berkeley's view), but I leave this issue aside.

⁵⁰John Locke, *An Essay Concerning Human Understanding*, edited by Peter H. Nidditch (Oxford, 1975), III.vi.12.

⁵¹This sort of appeal to induction would also be available to Berkeley to counter a possible objection to the claim that aether is part of God's plan for our world, namely: Why would God bother to make aether part of our world, if noone will ever observe it? Berkeley could respond by arguing that consistency on God's part requires continuity and connection in the natures of things, which requires the actual existence of aether.

⁵²Thanks are due to Margaret Wilson, Kenneth Winkler, and Bas van Fraassen for comments on a much earlier version of this paper. I have also benefited from discussing the paper with audiences at the University of Pennsylvania, Cornell University, and MIT. Lastly, I must thank an anonymous referee for particularly scrupulous and helpful comments.