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Berkeley's Approach to Newtonian Dynamics

Berkeleyho přístup k newtonovské dynamice

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Anotace:

Práce se týká Berkeleyho reakce na newtonovskou dynamiku. Představuje Berkeleyho argumentaci proti realistickému pojetí dynamiky a popisuje a hodnotí Berkeleyho pozitivní koncepci fyzikální síly jako matematické hypotézy.

Klíčová slova:

dynamika, filosofie vědy, instrumentalismus, redukcionismus, britský empirismus, fyzikální síla, sémantika dynamických termínů, mechanicismus

Annotation:

The essay concerns Berkeley's reaction to Newtonian dynamics. It introduces Berkeley's arguments against dynamic realism as well as describes and evaluates his positive account of force as a mathematical hypothesis.

Key words:

dynamics, philosophy of science, instrumentalism, reductionism, British empiricism, physical force, semantics of force-terms, mechanical philosophy

Contents

Introduction

The topic my essay is Berkeley's attitude towards Newtonian dynamics. While Berkeley admired the usefulness, simplicity and generality of Newton's laws and principles, he is, none the less, concerned with their ontological implications. The view that physical bodies have forces by means of which they can causally affect other physical bodies, which was attributed to Newton by some of his followers, implies that physical bodies are active and is thus inconsistent with the basic principles of Berkeley's immaterialist metaphysics – namely with the view that the only sources of activity in the universe are spirits. Berkeley tries to solve this conflict by offering an account of force which avoids these undesired metaphysical commitments. My aim in this essay is to describe and evaluate this account.

Berkeley's philosophy of science has drawn a lot of attention during the last few decades and it has been by many thinkers seen as strikingly modern.[1] Berkeley has been interpreted by these thinkers as putting forward such contemporary concepts as the underdetermination of theory by data thesis, the instrumentalist view of science or the concept of scientific reduction. While I certainly agree with the view that Berkeley's philosophy of science has many modern and interesting features, I believe that we have to be very careful when it comes to ascribing to Berkeley the above-mentioned particular modern concepts, because there is a danger of misinterpreting his views and of losing touch with his real philosophical concerns.

In the first chapter of this essay I introduce Newton's view of force and try to show that this view is open to a realist interpretation, even though, as I try to show, the realist interpretation is certainly not the only possible one. I also discuss the relationship between dynamic realism and the 17th century mechanist paradigm, focusing mainly on the problem of possibility of action at a distance which the existence of the force of gravitation posited by Newton seems to imply but which was seen as utterly unintelligible by the mechanist thinkers, such as Descartes or Hobbes.

In the second chapter I investigate the relationship between dynamic realism and Berkeley's ontological and epistemological views. I argue that dynamic realism is inconsistent with Berkeley's metaphysical and epistemological views, the main reason being that our ideas, as something essentially passive, cannot represent activity and therefore cannot represent force conceived as a cause of motion. Moreover, even though we, according to Berkeley, have a notion of active power acquired from knowledge which the mind has of itself and its activities, this notion cannot be extended to physical bodies. I try to investigate and evaluate Berkeley's reasons for this restriction.

1 See e.g. Newton-Smith 1985, Myhill 1957, Hinrichs 1950.

In the third chapter I discuss and evaluate three of Berkeley's arguments against the realist view of force which he presents in the *Principles* and in his 1721 shorter work *De motu* and tackle the question whether we are justified in attributing to Berkeley the underdetermination of theory by data thesis made famous in the 20th century by Quine, Duhem and others. Berkeley's first argument concerns the fact that physics leaves us utterly ignorant of the cause of gravitational attraction and therefore we do not have a good reason to any particular version of dynamic realism. The second argument I discuss concerns Berkeley's claim that even though various thinkers say very different, even opposing things about force, they still attain truths about the physical world by means of the concept of force and therefore we should, Berkeley argues, consider force to be a mathematical hypothesis rather than something real in the world. The third argument I consider concerns the semantics of force-terms. Berkeley thinks that since we have no concept of force as a cause of phenomena, force-terms, as used by a dynamic realist, are utterly empty and therefore meaningless.

The fourth chapter is a discussion of the positive part of Berkeley's project. I describe Berkeley's view that there should be what we could perhaps call a 'division of labour' between metaphysics and natural philosophy. While the task of natural philosophy in Berkeley's view is to discover regularities in the natural world and in this way arrive at the laws of nature which he sees as the grammar of the language in which God speaks to us, the task of investigating the efficient causes of the sensible phenomena, Berkeley thinks, belongs exclusively to the realm of metaphysics. After that I focus on Berkeley's positive claims concerning physical forces and argue that his concept of force has instrumentalist features. I also analyze a tension which Berkeley's claims about force seem to bring about, a tension between the view that force is nothing but the sensible phenomena, on the one hand, and the view that force is a mere mathematical hypothesis, on the other hand, and suggest an interpretation of Berkeley's concept of force which would avoid such tension.

1. Newton on force

Berkeley's concept of force, as introduced in the *Principles* (1710) and in *De motu* (1721), can be seen as a reaction to or a commentary on Newton's understanding of force. Therefore, before I discuss Berkeley's approach to force, I will talk about some features of Newton's conception of force, focusing mainly on the issue of gravitational attraction. The concept of force is clearly one of the key concepts of Newton's thinking. In his *Philosophiae Naturalis Principia Mathematica* (hereafter cited as the *Principia*), a work first published in 1687, Newton states three laws of motion and it is no coincidence that all three of these laws explicitly or implicitly concern forces.[2] Moreover, what Newton calls 'gravity' or 'gravitational attraction', is itself a kind of physical force.[3]

Newton uses the concept of force to explain the ability of a physical object to causally affect another physical object, for example, to set this object in motion, to stop its motion, to change the trajectory of its motion or to break the object. Force is then used by Newton to show the regularity or lawfulness of the kinetic behaviour of physical bodies, i.e. their motion, rest and the changes between these. The force of gravitational attraction, for example, enables us to explain various aspects of the kinetic behaviour of physical bodies which we observe on an everyday basis, such as the descend of heavy bodies, the movement of the Moon or the tide of the sea.[4]

Importantly, the concept of force, as used by Newton, is quantifiable.[5] By observation and measurement of the behaviour and qualities of physical bodies (such as their mass) and by means of mathematical calculation, we are, according to Newton, able to arrive at the precise quantity and direction of force responsible for a particular movement. For example, Newton's second law of motion tells us roughly that the acceleration of a body depends directly on the motive force impressed on the body and inversely on the mass of the body.[6] We are thus able to calculate the quantity of the motive force as long as we have measured and thus quantified the acceleration and the mass of the body. The fact that forces are quantifiable makes them very useful “tools” for making precise predictions about the kinetic behaviour of physical objects.

While the concept of force is highly useful for discovering regularities in nature, it, on the other hand, brings about certain philosophical perplexities, the most serious being the question what exactly force is. Is force a real entity in the world exercising causal impact on physical objects or is it, on the other hand, a purely theoretical entity which does not and cannot exist outside physical

2 Janiak 2004, pp. 70-72.
3 Ibid., p. 61.
4 Ibid., p. 92.
5 Ibid., p. 86.
6 Ibid., p. 71.

theories? My main goal in this essay is to discuss Berkeley's answer to this question. However, before I do so, I will briefly mention the way Newton answers it.

The realist view of force and its problems

One crucial question we might want to ask about Newton's treatment of force is whether his concept of force is a realist one. To hold a realist view of forces, or to be a realist about forces means to hold that forces somehow really exist out there in the world and have a capacity to causally affect physical objects. A realist about force will, for example, say that the descent of a stone which I have just dropped is an effect caused by gravitational attraction, a force pulling that stone towards the centre of the Earth. My definition of realism about forces then includes two conditions. A thinker is a realist about forces if and only if he claims that (1) forces really exist in the world and that (2) forces are (efficient) causes of the changes in the kinetic behaviour of physical bodies.[7]

Clearly, my definition of realism about forces leaves a lot unanswered. We might want to know more about the ontological character of force. If forces really exist in the world, what kind of entities are they? The basic ontological distinction often used in the 17th century and inherited from scholasticism was the one between things and their qualities or, more precisely, between substances and their accidents. If we ask whether forces are things or qualities of things, we will notice that neither option seems quite unproblematic. It seems to me, however, that the first option (i.e. that forces are substances), is much more problematic than the second option (i.e. the view that forces are qualities of objects). An example of gravitational attraction might show us why the first option is problematic. Gravitational attraction is a force which is active, for example, between me (as a physical unit) and all the other physical objects in the universe, even though of course I am attracted to these objects with varying degrees of intensity. As Newton puts it, “all bodies gravitate toward one another”.[8] I am then attracted by gravitational attraction to every single physical object in the universe except myself and so is everything else in the universe. One way to elucidate this point is to say that it is true for every *x* that if *x* is a physical object, then *x* is attracted by the force of gravitational attraction to all physical objects in the universe except *x*. It seems to me that if we said that forces are substances we would end up with an extremely 'bloated' universe. Among the more serious problems of the view that forces are substances is the question regarding the spatial location of forces.

It seems to me that while the second option (i.e. the view that forces are qualities of objects) is more viable, it is also not quite unproblematic. If we claim that forces are qualities, we have to

7 See Janiak 2007, p. 127.
8 Janiak 2004, p. 88.

add, it seems to me, that they are rather special qualities, quite unlike any other qualities which we ascribe to physical objects. One reason why forces might be seen as rather special qualities is that they do not seem to fit comfortably into either side of the primary – secondary dichotomy. The other reason is that it might be seen as problematic that a quality of one physical object would have a direct causal influence on the state of motion of another physical object. Let me now briefly say a bit more about each of these problems.

It is not clear whether we can unproblematically treat force as either one of primary qualities or one of secondary qualities. It was commonly held in the 17th century that macroscopic physical objects have two kinds of qualities, the primary ones and the secondary ones.[9] The primary qualities were taken to be basic in the sense that every physical object in the universe has them and that they give rise to secondary qualities and are therefore necessary for their existence. The list of primary qualities slightly differed from thinker to thinker, but the classic examples are extension, shape, motion and (arguably) solidity. It was commonly believed by the so called 'mechanists' or 'mechanical philosophers'[10] that the universe ultimately consists of submicroscopic particles which have only primary qualities.[11] Other qualities we commonly ascribe to things around us, such as colours, smells or tastes, were called the secondary qualities. John Locke, for example, takes these to be strictly speaking just powers of physical objects to cause certain kinds of sensations in our minds.[12] Locke thinks there is nothing in the objects themselves that would resemble our sensations of secondary qualities, such as redness or bitterness, while our perceptions of primary qualities, such as extension or movement, do resemble real qualities of physical objects.

According to some thinkers, gravitational attraction – a kind of physical force – should be understood as one of the primary qualities. A leading proponent of this view was Roger Cotes, a mathematician and an astronomer who closely cooperated with Newton and wrote the famous introduction to the second edition of Newton's *Principia* published in 1713. In his introduction Cotes claims that "[a]mong the primary qualities of all bodies universally, either gravity will have a place, or extension, mobility, and impenetrability will not".[13] It seems to me that treating gravity as one of primary qualities is problematic to some extent because, as Janiak emphasizes, gravity does not meet the 'lonely corpuscle' criterion.[14] In other words, if we imagine a world whose only "inhabitant" would be one corpuscle, there would be no gravity at all, while there would still be the classical primary qualities such as extension, shape or movement. The reason for this is that for

9 See e.g. *Essay* II. 8. 9-13.
10 I will say more about mechanism later in this chapter.
11 See e.g. *Essay* II. 8. 8.
12 *Essay* II. 8. 15.
13 Newton 1999, p.392
14 Janiak 2009.

there to be any sort of attraction there needs to be at least two bodies. Gravity then can exist only in the worlds where there are at least two physical particles. Because gravity fails to meet the 'lonely corpuscle criterion', it is not a quality that necessarily belongs to any physical body and therefore it seems to be problematic to rank it among primary qualities.[15]

Does this mean that gravity is a secondary quality? This option seems to be equally problematic. We saw that according to Locke, secondary qualities are powers of objects to cause sensations in our minds.[16] Clearly, gravity is a kind of power of physical objects, a power to attract other physical objects. Does this mean that we can say that gravity is a secondary quality? I don't think such a conclusion would be correct for the following reason. Locke thinks that we have an idea of active power which we acquire in an imperfect form from the observed interactions of physical bodies and in a more perfect form from reflection on the activity of our will.[17] It seems reasonable to assume that Locke held that our idea of active power bears resemblance with various powers of bodies. However, we saw that in the case of secondary qualities there is no resemblance between our ideas of them and the qualities themselves. Therefore, it seems reasonable to reject the option that gravity might be a secondary quality of bodies.

Another reason to reject this view seems to be the fact that if we say that the redness of a rose is a secondary quality, we are saying that ultimately the rose itself is not really red, it just has a power to cause sensations of red in a certain kind of perceiving minds. Now for a dynamic realist this cannot be true about gravity, since the the universe contains physical forces, not only powers to produce our ideas of force.

This is then one argument for the view that it might be problematic to think of forces as of qualities of physical objects. It seems to me that it could easily be objected against this argument that it presupposes correctness of the view that all qualities there are in the universe are either primary or secondary. If this supposition is false, then we could easily say that perhaps force is an instance of a quality which stands outside the primary – secondary distinction.

I believe this objection is valid. Locke, for example, was aware that forces and powers of bodies to affect other bodies in general do not comfortably fit on either side of the primary – secondary distinction. This might be why he considers all powers of bodies except their powers to affect our senses to be separate category of qualities.[18] He thus distinguishes between powers to

15 It should, however, noticed that the lonely corpuscle criterion is somewhat controversial as an indication of primary qualities. Locke, for example, lists texture as one of the primary qualities (*Essay* II. 8. 14.) and, arguably, there need to be many corpuscles in order for there to be texture. Another problem connected with the use of this criterion is the problem of motion. If we claim that there is only relative motion (as, e.g. Berkeley does in the *Principles* 114), then motion, even though it is a classic example of a primary quality, does not meet the lonely corpuscle criterion.

16 *Essay* II. 8. 1. and II. 8. 5.

17 *Essay* II. 21.1.

18 *Essay* II. 8. 23.

affect our senses (secondary qualities) and powers to affect other physical bodies (a separate, third category). What these categories have in common is their ontological dependence on primary qualities.

Even though then my argument isn't conclusive, it at least illustrates some of the problems we have to face if we say that forces are qualities of physical bodies. Another reason why this view is problematic seems to be that it is questionable whether a quality of an object can causally affect the state of motion of another object. This is especially problematic in the paradigm of mechanism, in which the state of motion of one body can be altered only if the body collides with or is pushed by another body. I will, however, say more about mechanism later.

I have thus defined what I mean by a realist view of force and sketched some of the general metaphysical problems that a proponent of this view has to face. I will now tackle the question whether Newton was a realist about forces.

Questions about Newton's position

It is not quite clear whether Newton was a realist about forces. There are passages in his works that certainly have a realist ring. One such passage is in the General Scholium, a text added to the second edition of the *Principia* from 1713.[19] Here Newton contends that "it is enough that gravity really exists, acts according to the laws that we have set forth, and suffices for all the motions of the heavenly bodies and of our sea"[20]. The second edition of the *Principia* also includes the above mentioned introduction by Roger Cotes in which gravity is ranked as a primary quality. Another passage, where Newton himself speaks as a realist, is in his letter to the editor of the *Memoirs of Literature* weekly paper which was written in 1712 but remained unpublished during Newton's lifetime.[21] In this letter, a rebuttal of Leibniz's criticism of Newton's theory published in the *Memoirs* in May 1712, Newton states that "God could create planets that should move round of themselves without any other cause than gravity that should prevent their removing through the tangent. For gravity without a miracle may keep the planets in."[22] Newton seems to be saying here that gravity itself can be the cause of circular motion and expresses a realist view of gravity. It seems to me that passages like these might lead us to the view that Newton at the later stages of his thought might have inclined towards realism about forces.

However, certain passages from earlier Newton's works suggest that Newton was aware of the problems which realism about forces brings about and thought that these problems were serious

19 Janiak 2004, p. 89-93.
20 Janiak 2004, p. 92.
21 Janiak 2004, pp. 114-117.
22 Ibid., p. 117.

enough to reject realism. Of course one might speculate whether Newton wasn't perhaps in his heart of hearts always a realists who only 'officially' and temporarily accepts the mechanist principles and therefore rejects realism about forces. For the purposes of my paper it is not important to decide whether Newton really was a realist, all I want to do here is to describe some considerations that might pull us towards the various competing interpretations.

It is important to notice that the realist view of forces could have been seen by Newton as bringing about certain difficulties. One of these difficulties is the fact that the view seems to imply a possibility of action at a distance, while the other one is the problem that the realist view of gravity, a kind of force, implies that one body is able to pull another body towards itself.

I will now explain why these two implications of the realist view of gravity could have been seen as problematic. In order to do this I need to say a few words about the so-called 'mechanism' or 'mechanical philosophy', a view widely accepted in the 17th and early 18th century natural philosophy field and held, for example, by Descartes, Gassendi, Hobbes and to some extent by Leibniz, Boyle and others.[23] As Alan Gabbey emphasizes, it is very difficult, perhaps impossible to define mechanism or mechanical philosophy.[24] For the purposes of my paper I will use the term 'mechanism' for a view of the world according to which the whole universe and the processes happening in it can be understood in analogy to a machine, perhaps an extremely complex clockwork, consisting ultimately of corpuscles, submicroscopic particles which have only the above-mentioned primary qualities. The macroscopic objects around us, such as tables or chairs, have, on the other hand, two kinds of qualities, primary and secondary.[25] Importantly, just like it seems to be the case in a clockwork, according to mechanism, causal interactions in the natural world only happen by impulse and one particle can only push another particle, it can never pull it towards itself.

In the mechanist paradigm then the only way in which a physical body can directly causally affect another body is by impulse.[26] In other words, there can only be direct causality between two objects if there is physical contact, i.e. if the two objects collide, or if one of them pushes the other one. If, on the other hand, the two bodies are distant from each other and there is no physical intermediary between them (i.e. there is only vacuum between them) there is for a mechanist no way the two bodies could causally interact. This principle is expressed, for example in Leibniz's letter to Clarke where Leibniz writes that “[a] body is never moved naturally, except by another body which touches it and pushes it; after that it continues until it is prevented by another body

23 Gabbey 2002, pp. 337–338.
24 Ibid., p. 337.
25 See e.g. Downing 2005, p. 231.
26 Janiak 2007, p. 128.

which touches it. Any other kind of operation on bodies is either miraculous or imaginary."[27]

Newton's concept of gravitational attraction was seen by some thinkers as inconsistent with the principle of impossibility of action at a distance. This criticism was raised, for example, by Leibniz in the *Theodicy*[28] as well as in some of his letters to Samuel Clarke, a friend and disciple of Newton's. In the third letter, he uses the principle of impossibility of action at a distance to criticize Newton's concept of gravitational attraction.[29] He claims that there cannot be a natural explanation of the situation in which a physical body moves freely around another physical body in circles without something else constantly acting upon the circling body by impulse. As we saw, according to the mechanists, the only way to causally affect a body is by impulse. However, for a movement of a body to be circular, the body needs to be constantly affected because, once it it stops being affected, it will stop moving in circles and will start moving in a tangent to the circle. Therefore, in the mechanist paradigm for a body to circulate it needs to be constantly pushed. This is why Leibniz, for example, explains planetary motion by the presence of vortices.[30] These vortices of moving liquid act on the planetary bodies by impulse and thus cause them to move in ellipses. However, *ex hypothesi* the circulating body is moving freely (i.e. without being constantly pushed by anything else). Such a free circular movement then cannot be – in mechanism – explained naturally, it has to be a result of a miracle.[31] Leibniz claims that "'[t]is also a supernatural thing, that bodies should attract one another at a distance, without any intermediate means".[32] According to Leibniz then, if Newton's theory presupposes action at a distance, as he thinks it does, it presupposes a perpetual miracle, and clearly a theory which presupposes a miracle doesn't really explain anything.

There are passages in Newton's writings which signal that he shared the mechanist view that action at a distance is impossible. In a letter to Richard Bentley, an English theologian, Newton claims that "[t]hat gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it".[33] This passage suggests that Newton might have embraced the mechanist principle of impossibility of action at a distance. Moreover, it seems that he recognizes the

27 Alexander 1956, p. 66.
28 See *Discours de la Conformité de la Foi avec la Raison*, §19.
29 Alexander 1956, p. 30.
30 See Janiak 2007, p. 138.
31 Ibid.
32 Alexander 1956, p. 43.
33 Janiak 2004, p. 102.

inconsistency of this principle with realism about forces and takes this inconsistency to be a reason to reject realism about forces.

Earlier I mentioned another problem of the realist view of gravity, namely its implication that one body must be able to pull another body towards itself. It might be clear from what I have said about mechanism that this implication is problematic. As we saw in the quote from Leibniz's letter, in mechanism pulls, unlike pushes, are not allowed. This principle is revealed in the attempts of the proponents of mechanism to account for cohesion of physical objects. Since mechanism denies the existence of attracting, pulling forces, it was necessary to look for an account of cohesion of physical bodies which would not rely on such forces. One attempt to provide such an account was Gassendi's thought that corpuscles have 'hooks and claws' by means of which cohesion is provided.[34] The 'hooks and claws' hypothesis is an attempt at accounting for cohesion without employing the notion of power of attraction.

It seems to me that all of these problems implied by the realist view of force might be why there are passages in Newton which reject realism about forces in the sense I tried to define above. I will conclude my discussion of Newton by mentioning a few of these passages.

Is gravity reducible to mechanical processes?

In some passages Newton tries to come up with a mechanist explanation of gravitational attraction. It seems to me that we can call these passages 'reductionist' in the sense that Newton is saying here that gravity is really nothing but mechanical processes. When we talk about gravity, we are really just talking about mechanical processes in a different way. I think we can see these passages as attempts at accounting for gravity without presupposing the possibility of action at a distance or the existence of 'pulls', i.e. forces of attraction.

Newton seems to be proposing such a reductionist view of gravity in a letter to Robert Boyle where he suggests that gravity can be understood simply as the workings of an aetherial substance.[35] This view is sometimes referred to as the 'aether hypothesis'.[36] This hypothesis has a long history in philosophy and might be of a neo-Platonic origin. Newton approached it with varying levels of trust and scepticism at different stages of his intellectual development and used it to explain a wide range of phenomena, such as the properties of light, the cohesion of solid bodies, static electricity or magnetism.[37] Aether is characterized by Newton as a “substance, capable of contraction and dilitation [i.e. dilation], strongly elastic, and in a word much like air in all respects but much more

34 See Hill 2004, pp. 612-614.
35 Janiak 2004, pp. 1-4.
36 Gabbey, p. 340.
37 Ibid., p. 341.

subtle".[38]

Regarding gravitational attraction Newton suggests that the whole universe is full of aetherial substance whose density varies in different areas of the universe. The aether also pervades the physical bodies, since it is in their pores, however, there its density is very low.[39] Another area of low density of aether is around the physical bodies in their vicinity. Whenever two physical bodies move close enough to each other, the following happens: in the area in between these two bodies the density of aether grows even lower and at the same time the area of lower density grows further from the surfaces of the bodies.[40] This has two consequences. Firstly, the area of extremely low density of aether between these two bodies will 'try' to return to the normal level of density and there will thus arise reluctance against the two bodies moving any closer towards each other.[41] Secondly, the aether surrounding the bodies from the other sides will be much denser and will therefore push the bodies towards each other.[42] There will thus arise two opposing 'pushes' on the two bodies and if these pushes are balanced, the two bodies will keep a constant distance from each other, which is the phenomenon Newton tried to explain. Newton seems to be saying here that gravity is reducible to something we can account for in mechanical terms – the activity of aether. In the light of this passage, gravity does not seem to be in conflict with the mechanist picture of the world because what seems to be action at a distance is ultimately action mediated by aether and all the seeming pulls are really just pushes of the corpuscles of aether.

However, later in his writings (Newton's correspondence with Boyle dates back to 1678/9) Newton grew sceptical of the view that gravitational attraction can be reduced to mechanical processes. In the above-mentioned General Scholium, for example, Newton claims that there is a difference in kind between the cause of gravity and the mechanical causes, which means that he saw the view that gravitational attraction has a mechanical cause as problematic. He mentions three reasons to believe that the cause of gravity is not mechanical. Firstly, he says that the cause of gravity "penetrates as far as the centers of the sun and planets without any diminution of its power to act".[43] I believe Newton is saying here that the quantity of gravitational attraction between two physical objects is not diminished by the presence of any number of physical obstacles placed between the two attracted objects. Mechanical causes, such as the workings of aether, on the other hand, seem to be of necessity physically influenced and altered by the presence of obstacles. For example, even though aether, *ex hypothesi,* pervades all physical bodies through their pores, the

38 Janiak, 2004, p. 1.
39 Ibid.
40 Ibid., p. 3.
41 Ibid., p. 4.
42 Ibid.
43 Ibid, p. 92.

presence of obstacles still has influence on its workings because it affects its density and thus its motion.

Secondly, Newton emphasizes that the force of gravity does not act "in proportion to the quantity of the surfaces of the particles on which it acts (as mechanical causes are wont to do) but in proportion to the quantity of solid matter".[44] This again is a problem for the mechanical explanation of gravity because when it comes to mechanical causes the quantity of solid matter itself is irrelevant. What matters are the primary qualities, i.e. extension, shape, motion and solidity. It seems, for example, that according to mechanism, a hollow globe and a solid globe would have the exact same mechanical properties when it comes to interactions with their environment as long as their primary qualities would be the same.

Thirdly, Newton claims that the cause of gravity is a cause "whose action is extended everywhere to immense distances, always decreasing as the squares of the distances".[45] Newton is stressing the fact that while the intensity of gravitational attraction decreases with the growing distance between the two attracted bodies, it never completely ceases. In this sense then, the cause has to be active everywhere. It is a question whether such a cause could be something mechanical.

A Divine cause of gravity

The last mentioned fact might lead us to the question whether gravity could not be caused by God's activity. After all, in the preceding paragraph of the General Scholium Newton claims that God is "*always* and *everywhere*".[46] If God is everywhere, could he not be the cause of gravity "whose action is extended everywhere"?[47] Newton does not explicitly embrace this hypothesis in the General Scholium. He in fact expresses agnosticism concerning the cause of gravity here. He, however, in Query 31 of the *Optics* claims that God can – among many other things - move physical bodies existing in the universe.. Here Newton characterizes God as "a powerful ever-living agent, who being in all places, is more able by his will to move the bodies within his boundless uniform sensorium, and thereby to form and reform the parts of the universe, than we are by our will to move the parts of our own bodies".[48]

I believe Newton expresses here the Cartesian view that we have an idea of how God can move physical objects because we are conscious of the fact that we can by the power of our will move physical objects.[49] From the fact that we have this ability it is reasonable to infer that God has

44 Janiak 2004
45 Ibid.
46 Ibid, p. 91.
47 Ibid., p. 92.
48 Ibid., p. 138.
49 See Gabbey 2002, p. 346.

such an ability, only a perfect version of it. Now while this clearly is not an argument for the view that Newton thinks that the cause of gravity is God's activity, it shows that Newton's system allowed for such a possibility. It might be that Newton in the General Scholium does not explicitly mention this option because he would consider such a statement as feigning the hypotheses, i.e. as inferring more than the phenomena give us justification for.

Is gravity the kinetic behaviour of physical bodies?

There seems to be another possible interpretation of gravity. This interpretation is present in Clarke's fifth letter to Leibniz. According to Clarke, gravity is not an efficient cause of the kinetic behaviour of physical objects, it is rather this kinetic behaviour itself. Clarke claims that "by that term ['gravity'] we do not mean to express the cause of bodies tending towards each other, but barely the effect, or the phenomenon itself, and the laws or proportions of that tendency discovered by experience".[50] What Clarke seems to be saying here is that when we speak about gravity we are really just speaking about the relevant behaviour of the physical objects and the tendencies or dispositions of these objects to behave in a certain – lawful – way.

Importantly, if we fix the reference of the term 'gravity' in this way, we are not committed to explain what the physical processes underlying gravity are, in other words this position is compatible with agnosticism about the causes of the phenomena. Such agnosticism allows for the option that the mechanistic framework described above might be insufficient to provide the physical basis for gravity and indeed Clarke claims that the physical processes underlying gravity may not be mechanical.[51]

While this 'behaviourist' concept of gravity is present in Clarke's letter, it's not clear to what extent we are justified in ascribing such a concept to Newton himself. It is true that Newton repeatedly expresses agnosticism regarding the cause of gravity. Famously, in the General Scholium Newton states that he hasn't been able to discover the cause of gravity and the reasons behind its properties and that he is unwilling to feign hypotheses (*"hypotheses non fingo"*), rejecting thereby all the speculations which are not deducible from the phenomena.[52] Similarly, in the Optics, he emphasizes that the causes of the forces of attraction are beyond the scope of his interest.[53] However, I'm not sure if such agnosticism necessarily leads to the concept of force which Clarke seems to ascribe to Newton.[54]

50 Alexander 1956, p. 115.
51 Alexander 1956, p. 118.
52 Janiak 2004, p. 92.
53 Janiak 2004, p. 132. (Optics, Q. 31.)
54 Janiak (2007) argues that Clarke misinterprets Newton in the sense that Newton never held the view that gravity is just the phenomena and thought that gravity is the cause of the phenomena.

Conclusion

I have thus discussed four possible interpretations of Newton's approach to gravity: the view that gravity is a real quality of bodies and an efficient cause of kinetic behaviour, the view that gravity is ultimately just the mechanical processes, the view that gravity is caused by God and the view that gravity is just the kinetic behaviour of physical bodies. I'm not claiming that all four interpretations have equally good textual support in Newton's writings, neither that Newton actually held each of them. It seems to me in fact that it is somewhat doubtful whether there is a straightforward answer to the question as to what characteristics Newton's concept of gravity had. There seem to be reasons to think that his approach to gravity underwent development and that he adopted various approaches for strategic reasons. Moreover, the resulting unclarity might signal the fact that he just was not interested in the ontological questions regarding forces, perhaps it was enough that the concept of force proved to be astonishingly productive when it came to uncovering regularities in the behaviour of objects. If this last hypothesis is correct, it moves Newton's concept of force close to what I will later call the instrumentalist view of force.

All these conclusions might sound a bit vague and hypothetical, however, as I stressed at the beginning, it was not my intention here to decide what Newton's position was, rather to sketch various possible interpretations of Newton. I believe such a general background will help us understand Berkeley's approach to physical forces better. It seems to me that one way to understand the account of force in Berkeley's *De motu* and in the *Principles* is to see Berkeley as arguing for a non-realist reading of Newton. In the next chapter I will try to show what reasons Berkeley had for preferring a non-realist concept of force.

2. Berkeley and realism about force

I'll now discuss Berkeley's reaction to Newton's dynamics. Without going into details it might be useful to mention a few historical facts. It seems that Berkeley was born into a very exciting time for someone interested in what was then called natural philosophy, physics (*physica*) or physiology (*physiologia*).[55] Newton's *Principia* were first published in 1687, shortly after Berkeley turned two. Their second edition with the above-mentioned important additions of the General Scholium and Cotes's introduction were published in 1713, three years after the first edition of Berkeley's *Principles*. Berkeley's engagement with Newtonianism must have started very early in his philosophical career since he polemically discusses Newton's doctrine of absolute motion in his *Notebooks* which were probably written between 1706 and 1708 when he was in his early twenties.[56] Berkeley's general attitude towards Newton's doctrines seems to be twofold. On the one hand he clearly values Newton's work[57], on the other hand, however, as we have just seen, his admiration is not uncritical. Our main concern in this essay will be Berkeley's approach to the realist view of forces, which seems to be, as I tried to show in the first chapter, one of the views that might be attributed to Newton. As we have seen, the second edition of Newton's *Principia* with its additions only reinforced the realist tendencies in Newton, which was something Berekeley can't have been too happy about. In this chapter I will discuss Berkeley's reasons to reject dynamic realism while in the chapter which follows I will introduce three arguments against this doctrine which Berkeley presents in the *Principles* and in *De motu*.

Forces and Berkeley's immaterialism

According to Berkeley's immaterialism, the ontological view which he introduces in two of his early works, the *Principles* and the *Dialogues*, the whole universe consists purely of two kinds of entities: the perceiving minds (or spirits) and the perceived objects, ideas.[58] The physical objects around us, such as chairs or books, are, Berkeley claims, nothing but collections or bundles of ideas. We can see what he means if we look at his example of an apple. According to Berkeley, we observe that certain ideas of taste, smell, colour and consistency typically appear together and therefore we treat them as a single thing – an apple. Berkeley thinks that every physical object in the universe is nothing but such a collection of ideas which typically appear together.

Clearly, this might sound rather obscure. Most people would perhaps agree that when they

55 See Gabbey 2002, p. 330.
56 See Downing 2005, p. 258, fn. 11.
57 See *Principles* 110.
58 *Principles* 1 and 2.

perceive a physical object, they have collections of typical perceptions, but surely the perceived objects are distinct from these perceptions. In other words, our perceptions are commonly taken to represent physical objects in the world, but the very relation of representation seems to imply that the perceptions – our representations - should not be identified with the represented physical objects. Berkeley, however, in the two above-mentioned works offers an ingeniously argued rejection of such a view. There is certainly not enough space to go into details here, so I will just say that for Berkeley the existence of an unperceived and unperceivable object is self-contradictory and unintelligible.[59] Famously, in the *Dialogues* Philonous encourages Hylas to try to think of an object existing outside the mind perceiving it, and then tries to demonstrate that any such attempt must necessarily fail (this is sometimes referred to as Berkeley's 'master argument').[60] The reason is simple: just as it is obviously contradictory to see something unseen, it is, Berkeley argues, equally contradictory to conceive of something unconceived. It seems to me that we can doubt whether to conceive of something unconceived is a clear contradiction. Even if we accept that our idea of an unconceived tree is itself necessarily conceived (which for Berkeley follows from the mere fact that it is an idea), it can, it seems to me, still have an unconceived tree as its content.[61] For Berkeley though, conceiving of an unconceived object was a clear contradiction. If, however, we cannot conceive of anything unconceived, then we cannot conceive of anything existing outside the mind. For Berkeley then only things existing *in* the mind are conceivable or intelligible. Therefore, he argues, the physical things we perceive on an everyday basis exist only in the mind, their *esse* is *percipi.*[62] Since, however, the only objects that can exist in the mind are, according to Berkeley, ideas, it follows that physical things themselves are, strictly speaking, nothing but collections of ideas.

Ideas are, for Berkeley, by definition completely inert and passive[63] and therefore unable to participate in causal chains. This again might sound quite strange. Surely we experience on an everyday basis that physical objects causally interact; fire makes wax melt and a stone can break a glass window. Can Berkeley account for this common sense view? He thinks that this view arises as a result of regularities in the flow of our ideas of sense. According to Berkeley, "when we perceive certain ideas of Sense constantly followed by other ideas and we know this is not of our own doing, we forthwith attribute power and agency to the ideas themselves and make one the cause of another,

59 *Principles* 3.
60 Slightly different versions of the 'master argument' are introduced in the *Dialogues*, pp. 183-184, and in the *Principles* 22 and 23.
61 For more on this objection and an attempt to block it see Gallois 1974.
62 *Principles* 3.
63 *Principles* 102.

than which nothing can be more absurd and unintelligible".[64] It seems to me that Berkeley is saying here that if we observe that a certain idea always or very often appears after another one, we start treating the first idea as a cause and the other one as a consequence. We thus interpret the constant conjunction of two ideas as a case of causality and start to believe there is a necessary connection between the two ideas. Berkeley thinks that such an explication of constant conjunction is illegitimate and misleading.[65] He indeed thinks there is nothing but conjunction between ideas.[66]

Although I'm using Hume's term 'constant conjunction', it should be noted that there are some important differences between Berkeley's and Hume's account of causality. While both thinkers would agree that there is no necessary connection between our ideas of sense, for Hume the constant conjunction itself is a case of causality.[67] Moreover, Berkeley's account of causality would not be complete if I did not mention his view that while there are strictly speaking no causes and effects on the physical level, he thinks the relationship between, say a lemon and sour taste in my mouth, is that of a sign and a thing signified.[68] The relation is thus just like the linguistic relation between a word and its meaning: not necessary but regular and uniform.[69] Berkeley then emphasizes that our ideas of sense, even though their occurrence is not necessary, occur in a highly lawful and orderly way because they are excited by God in accordance with his own set of rules which Berkeley calls the 'laws of nature'.[70]

Is there then no place for causality in the Berkeleian universe at all? Such a conclusion would be incorrect since Berkeley thinks there is causality between spirits and ideas in the sense that spirits are efficient causes of ideas. Ideas of sense are caused by the Eternal Spirit – God, while ideas of imagination are caused by 'human' spirits.[71]

The efficient cause of the observed changes in motion as well as other changes of physical bodies is thus always the activity of God. Therefore it seems that Berkeley's immaterialism is inconsistent with realism about forces. In my definition of dynamic realism in the previous chapter I stated that this view implies that forces are efficient causes of changes in kinetic behaviour of physical bodies. If Berkeley's immaterialism is correct though, this seems impossible and realism is thus ruled out.

64 *Principles* 32.
65 *Principles* 32.
66 *Principles* 31.
67 *Enquiry* VII. 29.
68 *Principles* 65.
69 I will say more about Berkeley's concept of the Divine language in the last chapter of my essay.
70 *Principles* 30.
71 *Principles* 102.

Forces in Berkeley's epistemology

I will now discuss the relationship between dynamic realism and Berkeley's epistemological views. I will thus address the question whether we have in Berkeley's view cognitive access to realistically conceived forces. My question here is then whether dynamic realism is compatible with Berkeley's epistemology.

In the first paragraph of the *Principles* Berkeley talks about the objects of human knowledge and for a reader of Locke's *Essay* Berkeley's list must sound familiar. Berkeley distinguishes here between three kinds of ideas, ideas of sense, ideas "perceived by attending to the passions and operations of the mind" and ideas of memory and imagination.[72] If we understand Berkeley as saying that the objects of our knowledge are only ideas, we need to ask whether we can have an idea of a force. It seems to me that Berkeley would give a negative answer to that question. I will now describe Berkley's reasons for such an answer.

The first reason, explored mainly in Berkeley's *De motu,* an essay published in 1721*,* consists of the view that in our sense experience we don't encounter forces but only their effects and therefore we cannot get an idea of force from our senses. All the phenomena we perceive, such as motion of bodies or our feeling of fatigue when we carry heavy objects, are effects of forces. We therefore when it comes to the natural world never perceive forces themselves.[73] The realistically conceived forces, even if they existed, would be unperceived and unperceivable causes of the sensible phenomena.[74] Such a conclusion, however, makes their very existence deeply problematic in Berkeley's system, since Berkeley thinks that we cannot conceive of an object that is unperceived, that exists outside the mind.

It seems to me that someone might raise the following objection against this view: perhaps Berkeley is right that we only have sensual access to the effects of forces, but we can infer that there is a cause of these sensible effects and we can get the idea of force by abstracting from all the sensible effects.

Berkeley must have expected such an objection because in the passage where he introduces the concept of force as a cause inaccessible to our senses, he warns his readers against employing abstract terms in meditation.[75] It seems to me that Berkeley would deny the option that we can get an abstract idea of force. Let me now state my reason for this claim. When Berkeley discusses abstract ideas in the Introduction to the *Principles*, he rejects the option that we can frame various abstract ideas, such as the idea of a particular colour abstracted from other ideas such as extension

72 *Principles* 1.
73 *De motu* 4.
74 For a different interpretation of Berkeley according to which we get ideas of forces from our sense of touch see Palkoska 2009, p. 212.
75 *De motu* 4.

or shape, on the grounds that he cannot imagine colour without any extension or shape at all.[76] It seems then that his view is that we cannot have an idea of *x* if we cannot imagine *x*. If I'm right in ascribing this criterion to Berkeley, it seems to me that he would have to reject the possibility that we might have an idea of force, since we certainly cannot imagine force itself without any of its sensible effects. Any attempt at imagining force must necessarily end up by imagining the effects of it. The option of arriving at the idea of force by means of abstraction then seems closed for Berkeley. I have thus described one reason why we cannot have an idea of force. The second reason consists in the way Berkeley characterizes ideas.

As we saw, in Berkeley's view ideas are completely inactive in the sense that they cannot cause any changes in other ideas or in themselves. In Berkeley's words "there is nothing of Power or Agency included in them".[77] Realistically understood forces, on the other hand, seem to be essentially active. They are, after all, conceived as real causes of motion and attraction. Berkeley thinks that the very fact that forces are active makes it impossible for us to frame an idea of force. The reason for this is Berkeley's principle that an idea - as something essentially passive or inert - cannot represent anything active.[78] If, however, we cannot frame ideas of forces, our cognitive access to them might seem to be problematic.

Why can't there be, according to Berkeley, an idea of something active? Berkeley thinks that the validity of this principle can be revealed to anyone who attempts to frame such an idea. It seems to me that this principle is valid as long as we see an idea as an image or a mental picture while it might be more controversial to think an idea is more like a concept. I think Berkeley might be right that a completely passive and inert mental picture can hardly represent an activity. Berkeley considers this principle to be evident. Do we then in Berkeley's view have no epistemological access to forces whatsoever? Such a conclusion would be too hasty because in Berkeley's view we can know of things which we do not have ideas of. Our knowledge is for Berkeley not exhausted by our possession of ideas.

A notion of an active power

Berkeley's view that we can have knowledge of entities which we do not have ideas of is revealed whenever he talks about spirits or minds. Spirits are for Berkeley the only substances in the universe and they are essentially active, perceiving beings which ideas exist in.[79] Now, one might wonder how can we know all this about spirits if, as we saw, we cannot have an idea of

76 Introduction 7 and 10.
77 *Principles* 25.
78 *Principles* 27.
79 *Principles* 2.

anything active.[80]

Berkeley is not very explicit about this, but it seems that his view is that our knowledge of spirits is based on what he calls a 'notion' of a spirit.[81] The term 'notion' in this technical sense wasn't used in the first edition of the *Principles* published in 1710. It first appeared only in the second edition, published in 1734.[82] Berkeley's doctrine of notions roots from certain semantic considerations. Berkeley accepts Locke's view that what makes some (not all) words meaningful is the fact that they stand for ideas.[83] Nouns like 'tree' or 'chair' then are significant because they stand for ideas. Such an explanation, however, creates a problem with the significance of words standing for minds (such as 'mind', 'spirit' or 'soul') and their operations (such as 'perceiving' or 'willing').[84] Since Berkeley claims that we do not have ideas of minds and their operations, these words might seem to lack significance and therefore be meaningless. However, as Berkeley emphasizes, we understand these words. I believe Berkeley tries to solve this tension by the concept of notion used in a technical sense. In an important passage added to the second edition of the *Principles,* Berkeley claims that "it must be owed at the same time that we have some *notion* of soul, spirit, and the operations of the mind […] inasmuch as we know or understand the meaning of these words".[85] It seems that he is suggesting that mind-words are meaningful because they stand for or represent notions.

It might be objected that the doctrine of notions creates a problem for Berkeley's metaphysical commitments. One of the pillars of his metaphysics, as we saw, is the view that there are only two kinds of things in the universe: the perceiving minds and the perceived ideas.[86] Since notions cannot be classified as either of these, they might seem to be rather mysterious.

I think Berkeley would reject the possibility that notions are a kind of things or objects though. My reason for thinking that is that the main example of a notion is our knowledge of ourselves, of our own minds, and Berkeley never says that we know our own mind via a kind of object which represents it to us. On the contrary, he seems to think that our knowledge of ourselves is not mediated by anything. In the Third Dialogue Philonous claims: "I know what I mean by the terms *I* and *myself*; and I know this immediately, or intuitively".[87] It seems then that Berkeley's term 'notion' could be referring to the bare fact of knowledge or acquaintance or perhaps to something like direct self-consciousness. It is no coincidence that in *De motu* Berkeley says that we know our

80 *Principles* 27.
81 *Principles* 27.
82 Woozley 1976, p. 428.
83 *Essay* III. 1. 2.
84 Woozley 1976, p. 430.
85 *Principles* p. 78.
86 *Principles* 89.
87 *Dialogues* p. 221.

own minds “by a certain inner consciousness” (*conscientia quadam interna*).[88]

If we thus have a notion of our own mind and its operations, and our mind is something essentially active, shouldn't we say that we also get a notion of active power from reflection on the activities of our mind? I think the answer to this question should be positive. I will now try to explain why I think it is reasonable to believe that we can in Berkeley's system have a notion of an active power based on what we know about our own minds.

Berkeley observes that our faculty of imagination enables us to willingly excite ideas in our minds[89] and that minds have a power to move bodies[90]. My mind then can be an efficient cause of an occurrence of an idea. If I want to start imagining the Eiffel Tower right now, I can. If I do so, the occurrence of my mental image of the Eiffel Tower will be caused by my mind itself and by imagining it I experience or am conscious of a certain power of my own mind – a causal power to operate with ideas at will. It seems that Berkeley would say that all this is something we just know about our minds. However, since we have no ideas of these powers of the mind, it is, I believe, reasonable to think that we know these things by means of notions. It seems then that we have a notion of an active power of the mind. This conclusion is confirmed in a passage in the *Principles* quoted above, where Berkeley says that we have a notion of the operations of the mind and gives willing (the activity of will) as an example of such an operation.[91] I have thus cognitive access to an active power of my own mind, even though I do not get this access through sense experience.

As we saw, physical force, considered realistically seems to be a certain causal power of one physical object to affect another object. I have already mentioned that this seems to be, for example, Locke's view of force. It seems then that our notion of active power is in a sense a notion of force, even though a notion of spiritual force rather than physical force. Since Berkeley admits that we have a notion of an active power, we might ask whether this notion could not give us cognitive access to physical forces. If it were so, it would seem that Berkeley's epistemological views are actually fully compatible with dynamic realism. However, I think Berkeley would reject such an option and I will now try to explain why I believe that our concept of active power cannot be extended to the sphere of physical bodies.

A good way to elucidate the problem might be to contrast Berkeley's view with the view of John Locke. According to Locke, we can acquire a clear and distinct idea of active power from reflection on the operations of our minds.[92] I observe that I can move my hand, for example, by merely deciding to do so and thus I discover that my mind has the ability to start a motion, i.e. it has

88 *De motu* 21.
89 *Principles* 28.
90 *De motu* 25.
91 *Principles* 27.
92 *Essay* II. 21. 4.

active power. The idea I acquire in this way can then, according to Locke, be extended to physical bodies. Similarly, Berkeley claims that our faculty of imagination enables us to willingly excite ideas in our minds[93] and he claims that we have some notion of force based on our experience of this.[94] It might seem plausible then to say – with Locke – that this notion of active power can be extended to physical bodies.

For Berkeley, however, such an option is ruled out because he, as we have seen, thinks that physical objects are ultimately nothing but collections of ideas and ideas are utterly inert and have therefore no powers whatsoever. Berkeley would then clearly reject any attempts at ascribing activity or agency to physical bodies.[95] It seems then that dynamic realism is incompatible with Berkeley's epistemological views. Even though we do have a notion of active power, we cannot extend this notion to physical objects and therefore it seems that we do not have any cognitive access to physical forces.[96]

I have thus tried to show why both Berkeley's metaphysics and Berkeley's epistemology are incompatible with dynamic realism. I believe these tensions were the main reasons why Berkeley rejects dynamic realism. While these reasons were surely serious for him, one might doubt that they were taken too seriously by a reader who does not embrace Berkeley's immaterialism. Therefore in the next chapter I will talk about Berkeley's arguments that were meant to motivate other thinkers, who did not necessarily share Berkeley's metaphysical views, to abandon dynamic realism.

93 *Principles* 28.
94 *De motu* 25
95 Berkeley offers some reasons for this restriction independent of the validity of immaterialism in *De motu.* I will mention some of these reasons in the following chapter.
96 I will return to this point in the next chapter and there I will try to evaluate its plausibility.

3. Berkeley's arguments against dynamic realism

I will now discuss three arguments that Berkeley uses to motivate his readers to abandon the realist view of forces. In a sense, of course, we could see his whole immaterialist project introduced in the *Principles* and in the *Dialogues* as an argument against dynamic realism since it implies passivity of physical bodies. I have, however, mentioned the problem of forces in immaterialism in the previous section of my essay and I won't return to it here. Instead I will focus on three of Berkeley's arguments against dynamic realism whose soundness does not depend on the correctness if immaterialism.

Argument from ignorance

The first of these arguments is stated in Berkeley's *Principles*.[97] Berkeley remarks that physicists explain various natural phenomena, such as the descent of bodies or the movement of the moon, by the concept of attraction and he asks "how are we enlightened by being told this is done by attraction?".[98] To answer the question simply, he thinks we are not enlightened at all, because physics tells us nothing about what kind of forces actually cause the phenomena and where these forces are placed. He notices that when a physicist speaks of gravity, "[...] nothing is determined of the manner of action, and it may as truly (for aught we know) be termed 'impulse', or 'protrusion', as 'attraction'.[99] Berkeley then thinks that since physics keeps us utterly ignorant about how and where forces act, it doesn't matter which of the terms we use. We, for example, observe the fall of a stone towards the ground and we have, according to Berkeley, based on what we know from the phenomena no reason to prefer the view that there are attractive forces in both bodies which attract the two bodies towards each other to the view that there are 'pushing' forces of protrusion outside the bodies pushing the two bodies towards each other. The kinetic phenomena themselves reveal nothing about the "manner of action" and therefore give us no reason to prefer either of these views. Therefore, if a dynamic realist claims that attractive forces are qualities of the bodies, his claim lacks justification.

Is Berkeley's argument persuasive? It seems to me that the first thing that needs to be said is that the argument doesn't show that *any* version of dynamic realism has to be wrong, it merely shows that we lack a criterion which would enable us to decide which version is the correct one. Berkeley thus, I think, manages to show that the version of dynamic realism which postulates

97 *Principles* 103.
98 Ibid.
99 Ibid.

attractive forces in the bodies, is just one player in the game and not the only player.

It seems to me that we can also understand Berkeley in this passage as warning us against being misled by language. If the physicists talk about 'attraction', it surely seem as if they are talking about some determinate hidden real qualities or processes hidden behind the observable phenomena and causing them. However, as we have seen, such a belief is utterly unjustified because the physicists do not see what is behind the phenomena any more than we do.[100] This is, I believe, why Berkeley claims that the term 'attraction' signifies nothing but the observable effects, i.e. not the cause, but the caused phenomena. If we accept such a 'surface' view, we will not be misled by language any more.

Argument from different views

Berkeley offers another argument against dynamic realism in a widely-discussed passage of *De motu.*[101] Here Berkeley observes that even though different thinkers say very different and sometimes contrary things about forces, many of them "attain the truth". From this it is clear, Berkeley thinks, that "force is not a thing certain and determinate". He then offers an alternative view of force. He claims that "forces attributed to bodies are mathematical hypotheses [...]. But mathematical entities have no stable essence in the nature of things; and they depend on the notion of the definer"[102] Berkeley seems to be making an interesting point here. He asks how it is possible that people holding conflicting views of forces still manage to arrive at truths about the world and he answers that it is because force is not a certain and determinate thing.

It seems to me that we can elucidate the structure of this argument if we imagine what a realist opponent of Berkeley might say to defend his view. A realist opponent might, I think, reply that the fact that different thinkers have different views of forces can be explained by the fact that some of these views are simply wrong. At the same time though, these thinkers with opposing views are able to discover the truths about the world. This must be because they are not wrong about any of the important features of force. Even though then thinkers hold a lot of wrong views about force, force still helps them calculate correct predictions about the world and formulate correct physical laws. Berkeley thinks that the wrong views concerning force root from the idea that force is a determinate thing, something really existing out there in the world. As I tried to show earlier in this essay, such a realist commitment leads to a lot of problems concerning the ontological characteristics of forces. Even though then thinkers struggle with these ontological features of force, they are still able to use force in calculations if they consider it as a mathematical concept.

100*Principles* 105.
101*De motu*, 67.
102Ibid.

Does Berkeley give us a good reason to reject dynamic realism? It seems to me that while this argument can work as a motivation for us to approach force as a mathematical concept rather than as something which has real existence in the world, it, strictly speaking, doesn't rule out that forces might be real entities in the world. Of course, one explanation of the varying opinions of thinkers when it comes to force is that forces do not exist at all. However, there are other explanations. Perhaps forces are just entities which somehow show us the limits of the traditional metaphysics with its substance – accident dichotomy. In other words, perhaps forces really exist but for some reason resist the attempts of philosophers to describe them in the terms of the traditional metaphysics and that's why the opinions of various thinkers concerning forces vary a great deal and are sometimes contradictory.

Did Berkeley hold the underdetermination of theory by data thesis?

Berkeleian scholars have payed a lot of attention to a claim Berkeley makes in this passage. We saw that the above-mentioned argument is based on the claim that there are many different thinkers with many different opinions about forces. Berkeley uses the examples of Torricelli and Newton to show what he means. He discusses some differences between their (incompatible) views and then he remarks: “But although Newton and Torricelli seem to be disagreeing with one another, they each advance consistent views, and the thing is sufficiently well explained by both.”[103]

Based on this remark and the passage discussed Berkeley's first argument (*Principles* 103), some commentators have attributed to Berkeley the view that has been made famous by Quine, Duhem and other twentieth century thinkers as the 'underdetermination of theory by data thesis' (hereafter cited as 'underdetermination thesis).[104] The underdetermination thesis is a view in the philosophy of science that “for any subject matter there will be a pair of evidentially equivalent theories which are logically incompatible”.[105] Two theories are evidentially equivalent if they meet the following two conditions. Firstly, no possible observation or test can confirm one of them without confirming the other or disconfirm one without disconfirming the other. Secondly, the theories are equally “good” in the sense that whatever we decide to use as a criterion for theory choice (such as simplicity, the range of explained phenomena etc.) the two theories fare equally well.

The underdetermination thesis, if true, is itself an argument against scientific realism. Let me explain why. If two theories are logically incompatible, they posit different theoretical entities, or we could say that the theoretical sentences of the two theories contradict each other. However, there

103*De motu* 67.
104Newton-Smith 1985, p. 155-156.
105Ibid., p. 156.

is no empirical test available to decide which of the two competing theories is true. Therefore there is no way to decide whether the theoretical sentences of each of the theories are true and that's why we should treat all the theoretical entities posited by the theories (such as gravity, force of field) as mere theoretical hypotheses. This, however, rules out realist view of theoretical entities.

Does Berkeley really use the underdetermination thesis (or perhaps some primitive version of it) as an argument against dynamic realism? I think our evidence for the view that he does is rather weak. It is true that Berkeley says that when it comes to dynamism, there exist two theories which are incompatible, but arrive at truths anyway. Also, Berkeley says that "the thing is sufficiently well explained by both". Moreover, in the above-discussed passage from the *Principles* he claims that based on the phenomena there is no way to decide which of the two theories (the 'protrusion theory' or the 'attraction theory') is correct.[106] However, it seems to me that the underdetermination thesis is much stronger than this.[107] Firstly, there should be two evidentially equivalent, yet logically incompatible theories *for any subject matter.* There is no reason, it seems to me, to think that Berkeley held such a view. Also, Berkeley never says that there could be no criterion which would show that one of the theories is more useful (perhaps such a criterion might be simplicity).

For these reasons I'm not quite sure whether Berkeley really holds the underdetermination thesis and uses it to argue against dynamic realism. It seems to me that if he did hold a view similar to the underdetermination thesis, he would have stated this view at more length than in two short passages.

Semantic argument

According to Lisa Downing, Berkeley offers another argument against dynamic realism in *De motu*. The argument is supposed to show that the terms used by dynamic realists are meaningless because they do not refer to anything.[108] Downing's reconstruction of the argument goes like this: if force-terms (i.e. words like 'force' or 'gravity') are supposed to be meaningful, there must be something which they refer to. However, we don't have sensory access to forces. Therefore, "the term 'force' is empty of any significance adequate to secure reference".[109] If we express the argument in this way, it might seem that it presupposes that the only kind of significance adequate to secure reference is sensory significance. However, the validity of this principle is dubious.

Let me therefore describe the argument in more detail. Berkeley claims in *De motu* and

106*Principles* 103.
107I thus agree with Downing's criticism of Newton-Smith's interpretation of Berkeley's philosophy of science. See Downing 1995, p. 211.
108Downing 1995, p. 212.
109Downing 1995, p. 205.

elsewhere that based on what we observe about physical bodies, we have no reason to think that we can ascribe to them physical forces as their qualities. After all, all the sensible qualities of bodies do not seem to be active in any way.[110] If we consider extension, shape, color or any other observed qualities of bodies, they all seem to be utterly passive. Berkeley claims that "[i]f therefore by the term *body* be meant that which we conceive, obviously the principle of motion cannot be sought therein".[111] Our senses then give us no knowledge of any active powers of bodies, including forces. We should notice that this is an epistemological claim and it is therefore different from the ontological claim made in the *Principles* stating that bodies are bundles of ideas and therefore by definition inactive.

As I tried to show in the previous chapter, Berkeley thinks that we have a notion of active power from the capacity, which he calls reflection or intellect, a notion based on inner consciousness of the operations of our own mind. However, as we have seen, this notion is, according to Berkeley, not extendable to physical bodies. I also discussed a reason why for Berkeley such an extension is impossible – the utmost inertness of our ideas.

Berkeley notices that dynamic realists commonly use force-terms and claim that they refer to some real qualities of bodies. If, however, Berkeley is right that we cannot apply our notion of active power to physical bodies it seems that force-terms lack all reference securing significance and are therefore empty. Although this might sound rather technical, the thought behind the argument does not seem to be complicated. We saw that Berkeley shares Locke's view that some words (such as many nouns) are meaningful because they stand for ideas. We saw that with words like 'mind' or 'spirit' the situation is different, they are, in Berkeley's view, made meaningful by our possession of relevant notions.[112] This, however, brings in the question on the basis of what are force-terms meaningful. We have seen that since Berkeley thinks that forces are not observable, force-terms cannot stand for ideas. There is though still the option that they could stand for notions, especially since we have a notion of spiritual force. However, since this notion is not, according to Berkeley, applicable to physical bodies, it cannot provide significance to the term 'physical force'. This rejection, however, leads to the conclusion that force terms are utterly meaningless and dynamic realism is therefore deeply problematic.

I will now try to decide to what extent is Berkeley's argument, as reconstructed by Downing, persuasive. The most problematic point of the argument seems to be Berkeley's epistemological restriction that even though we have – through our faculty of reflection – some knowledge (a notion) of active power, this knowledge cannot give significance to force-terms because our notion

110*De motu* 29.
111Ibid.
112See *Principles* 27.

of active power cannot be extended to physical bodies. We have seen that if we accept Berkeley's view that our ideas are utterly inert, such an extension is ruled out. According to Downing, Berkeley tries to offer independent justification for the impossibility of this extension in *De motu* because the essay was written for readers who Berkeley could not expect to share his immaterialist views.[113] Indeed, *De motu* was submitted to a competition organized by the Paris Academy of Sciences and Berkeley could expect the judges to have generally Cartesian views.[114] What reasons does then Berkeley give us for the view that we cannot extend our notion of active power to physical bodies?

Firstly, Berkeley talks about the very limited scope of the faculty of reflection (intellect).[115] Berkeley claims that the intellect is "concerned only with spiritual and unextended things, such as our minds, their states, passions, virtues, and such like".[116] If we thus have our notion of active power from the intellect and the intellect deals exclusively with spirits, than the notion of active power has to stay in the realm of spirits. As Downing emphasizes, however, Berkeley doesn't give us a reason why the activities of the intellect are restricted in this way.

The second reason why the notion of active power cannot be extended to physical bodies, is Berkeley's view that the spirits and bodies are utterly heterogeneous. In *De motu* 30 Berkeley reports Anaxagoras's view that mind and body have nothing in common. If then minds have active power and Anaxagoras's view is correct, it is automatically ruled out that bodies could have active power. The controversial premise of this argument is the view that there is an absolute heterogeneity between minds and bodies. Again, Berkeley doesn't offer an argument for this heterogeneity in *De motu*.

These are then two reasons, which Downing suggests Berkeley can use to justify the epistemological restriction. I agree with Downing that these reasons offer only limited justification for the epistemological restriction. Downing then tries to support Berkeley's argument by bringing in Berkeley's antiabstractionism.[117] While in the published version of the Introduction to the *Principles,* Berkeley attacks the view that we possess abstract ideas, in the first draft of this Introduction his argument is stronger – it problematizes our possession of abstract concepts in

113Downing 2005, p. 237.

114This is one explanation of the fact that some passages in *De motu* have a dualist, broadly Cartesian character (e.g. *De motu* 21). Another explanation of this fact is that Berkeley - at least partially - gave up his metaphysical views. After all, *De motu* was published in 1721, more than a decade after the *Principles* and eight years after the *Dialogues*. In this essay I will presuppose that the first explanation is correct and that Berkeley just was not explicit about his immaterialism in *De motu* for strategic reasons.

115It is enough for my purposes to say that Berkeley means by 'intellect' in *De motu* rougly the same as what he means by 'reflection' in the *Principles*.

116*De motu* 53.

117Downing 1995, p. 208.

general. Berkeley claims here that “an impossibility cannot be conceiv'd”.[118] Berkeley seems to be arguing here that whatever cannot exist separately, cannot even be conceived as existing separately. Therefore, because the causal activity of our mind cannot exist separately from our mind, we cannot even conceive of it in abstraction and apply this concept to physical bodies.

Just to summarize: firstly, our faculty of reflection only deals with spirits and therefore cannot extend its notions to physical bodies, its notions cannot be be mixed with the ideas from our senses. Secondly, bodies and souls are completely heterogeneous and cannot share any qualities or powers and thirdly, the option that we could abstract the notion of the mind's active power from the notion of the mind as a whole seems to conflict with Berkeley's anti-abstractionist views.

It seems to me that Downing offers an interesting attempt to reconstruct one of Berkeley's arguments. I do, however, agree with her that the persuasiveness of this argument is limited. It seems to me that a thinker who disagrees with immaterialism might easily criticize the above-mentioned epistemological restriction and Berkeley doesn't seem to be able to offer a persuasive support for this restriction. I'm also not sure whether bringing in Berkley's antiabstractionism helps the argument very much, since it is not clear whether Berkley's target reader would accept this doctrine.

118First draft, p. 125.

4. Berkeley's concept of force

After focusing mainly on the negative part of Berkeley's approach to dynamics, namely his criticism of dynamic realism, I would now like to move to its positive part and talk about Berkeley's own view of physical forces. It seems to me that a superficial reader of Berkeley's early works might be tempted to wonder why Berkeley didn't just reject the existence of physical forces altogether. After all, immaterialism rules out any kind of causality between physical bodies.

The main reason might be that Berkeley highly valued Newton's work[119] and was aware that Newton's laws of motion and his theory of gravitational attraction can be used to show that the flow of our ideas of sense is regular and orderly.[120] It was this regularity and order in the flow of our ideas of sense which was an important premise in Berkeley's argument for the existence of God.[121] According to Berkeley, it is the "constant regularity, order and concatenation of natural things" which is a clear sign of the existence God, the author of this natural order. If natural philosophy is a discipline which reveals this order and which shows us the regularities in nature, it clearly had to play a very important role in the Berkeleian universe. However, no matter how important the role of natural philosophy is, its role is, according to Berkeley, also in important aspects restricted. What role did Berkeley then ascribe to natural philosophy?

Berkeley's view of physical explanation

The role of natural philosophy,[122] according to Berkeley, is to reveal regularities in the phenomena, not to discover the efficient causes of the phenomena. Berkeley claims that the difference between a layman and a natural philosopher consists not in the fact that the natural philosopher would know more about the efficient causes of the phenomena but in the fact that a natural philosopher has a greater understanding of the phenomena themselves.[123] The reason for such a restriction of the realm of natural philosophy was simple: Berkeley thought that describing the causes of natural phenomena is exclusively the business of metaphysics. Berkeley explicitly states this restriction in *De motu* when he says that "metaphysical principles and real efficient causes of motion and existence of bodies or of corporeal attributes in no way belong to mechanics or experiment nor throw light on them, except [...] they may serve to define the limits of physics".[124]

This understanding of physics might naturally lead us to the question what kind of explanation can physics, thus restricted, provide. In order to answer this question it might help to

119*Principles* 110.
120*Principles* 146.
121*Principles* 146.
122In the following text I will use the terms 'physics' and 'natural philosophy' interchangebly.
123*Principles* 105.
124*De motu* 41.

contrast this understanding of physics with a more traditional one. As we saw, in Berkeley's time the prevalent scientific paradigm was that of mechanism. In mechanism to explain a phenomenon means roughly to show what its efficient causes are.[125] If we understand how exactly a certain phenomenon is caused, we understand that the phenomenon happened necessarily.[126] As we said though, according to Berkeley, this kind of explanation is in principle unavailable to physics, because there are no necessary connections, no cases of causality on the physical level.

Berkeley none the less thinks that physics can provide a sort of explanation of a phenomenon by showing that it happens in a regular or orderly way. The role of physics is then to uncover the rules according to which phenomena appear, to uncover the laws of nature.[127] The kind of explanation that belongs to the realm of physics "consists only in showing the conformity any particular phenomenon hath to the general Laws of Nature".[128] However, it might seem that to understand that a phenomenon is a part of a regular pattern doesn't always mean that we have an an explanation of the phenomenon. If I, for example, observe that the sun rises every morning, I still seem to lack the explanation of why it happens. My conclusion that the sun rises every morning is a result of an inductive inference based on my observation of many mornings in which the sun rose. It seems, however, that this inductive inference has not brought us much closer to the explanation of the phenomenon itself.

It is important to keep in mind the difference between a mere regularity and a law of nature. While by inductive inference we always arrive at a regularity, we don't always arrive at a law of nature. Unlike a mere regularity, a law of nature has to be universal. My above-mentioned conclusion that the sun rises every morning can turn out to be wrong if one morning the sun doesn't rise. A law of nature, however, as long as it is a real law of nature cannot turn out to be wrong. If it did we would be inclined to say that it wasn't a law of nature. It seems that in the *Principles* Berkeley wasn't fully aware of this difference.[129] In section 30 of the *Principles*, for example, Berkeley says that we learn the laws of nature from experience. However, it seems that what scientists do is much more than learning from experience. In *De motu,* on the other hand, Berkeley seems more aware of this difference. He claims here that what mechanical philosophers discover are the basic, general and simple principles "which have been proved by experiments, elaborated by reason and rendered universal".[130] The laws discovered by physicists, such as Newton's laws of

125Dancy 1987, p. 97.
126For more on mechanical explanation and its contrast with the traditional - scholastic view of explanation see Palkoska 2009, pp. 191-194.
127*Principles* 30.
128*Principles* 62.
129See Downing 2005, p. 249.
130*De motu* 36.

motion, are then clearly not mere observed regularities.

Does this specification help to make the view that a phenomenon can be explained by showing its conformity with a law of nature more persuasive? It might seem that it doesn't because we are still missing the essential part, the knowledge why a particular law of nature is valid. We still, in other words, seem to lack the feeling of necessity which a mechanical explanation is able to evoke. If we are, for example, told that the movement of the moon can be explained by the law according to which, roughly speaking, any two physical bodies attract each other, we still lack the knowledge how and why this happens, we still want to know more. Even if physics cannot tell us the whole story, we want to at least have a sort of hope that the causes of the phenomena can be discovered and the phenomena be can be shown as necessary. According to Berkeley, however, by discovering the particular law of nature we have reached the limits of physics. There is an explanation why the laws of nature are valid, but this explanation belongs to the realm of metaphysics. This last explanation will be an appeal to the will and wisdom of God.

According to Berkeley, the discovered laws of nature do not pick out necessary connections between phenomena. Berkeley, however, does not consider this to be a weakness of his philosophy of science for at least three reasons. Firstly, he would probably say that the feeling of necessity we get from mechanical explanations is nothing but an illusion. As his immaterialism shows, the occurrence of the effects which mechanism sees as fully necessitated by the occurrence of the causes, is in fact wholly dependent on the will of God and therefore there is no necessary connection between the physical causes and effects.

Secondly, Berkeley thinks that once we accept that God is the only efficient cause of all the phenomena we can see the whole world as a sort text written by God for us in which the ideas of sense are words in God's language. According to Berkeley then, immaterialism leads to the view that all our sense perceptions are signs which God uses to talk to us. Now, this might sound rather obscure, let me therefore explore this view in more detail.

Physics as linguistics

A certain form of this view appeared already in the *Essay towards a New Theory of Vision* (1709), Berkeley's first published work. Berkeley claims here that our visual ideas are signs which inform us about tangible objects and thus enable us to avoid various dangers and, on the other hand, find the things we need for our survival. Berkeley claims here that “the proper objects of vision constitute an universal language of the Author of nature, whereby we are instructed how to regulate our actions in order to attain those things that are necessary to the preservation and well-being of

our bodies, as also to avoid whatever may be hurtful and destructive of them".[131]

In the *Principles,* Berkeley seems to embrace a more general version of this view when he claims that all our sense perceptions are marks or signs of other sense perceptions.[132] He illustrates his point with a few examples: "The fire which I see is not the cause of the pain I suffer, but the mark that forewarns me of it. In like manner the noise that I hear is not the effect of this or that motion or collision of the ambient bodies, but the sign thereof."[133] The relation between the open fire and my burned hand or between the coffee in the cup and the bitter taste in my mouth is then for Berkeley not the relation between a cause and effect but rather a relation between a sign and the thing signified. Importantly, there is clearly no necessary connection between a sign and the thing signified. There is no way I could find out from a word of an unknown language what the word signifies just by investigation of the word itself. For Berkeley, however, the same thing and events is true for objects in the physical world, I cannot discover the effect of one event just by investigating this event because the connection between the cause and the event is not necessary. It is, on the contrary, arbitrary and I can therefore only learn it from experience.

This conception of physical reality gives physics a highly noble task: by discovering the laws of nature it discovers the grammatical rules of the divine language.[134] Importantly, just like few people would say that the rules of grammar do not explain our language usage because the relations between language units are not necessary, we should not think that physicists do not explain the natural world just because they do not discover necessary connections between things and events.

The third reason why Berkeley would claim that the fact that physics does not discover necessary connections should not be seen as a weakness of physics is his highly pragmatic approach to physics and science in general. Even though physics does not discover necessary connections, it can be very useful to us in the conduct of our everyday life because it enables us to make correct predictions of the phenomena.[135] In other words, in everyday life we do not need to know that A causes B as long as we know that B always happens in conjunction with A.

Force as a useful tool

Since Berkeley for reasons mentioned above did not want to claim that forces do not exist at all, he had to look for an interpretation of physical concepts such as force or gravity which would do the desired explanatory job without the undesirable ontological commitments, namely a concept which would avoid the inconsistencies with idealism described in chapter two. Berkeley tries to

131*New Theory* 147.
132*Principles* 65.
133*Principles* 65.
134*Principles* 66, 108.
135See e.g. *Alciphron* VII. 7.

offer such a concept in *De motu*.

At first sight it might seem that there is a certain tension between various things Berkeley says about physical forces. He puts forward two different characteristics of force. In various passages he identifies force with the observable kinetic phenomena while elsewhere he claims that force is merely a mathematical hypothesis. I would like to tackle the question whether these two characteristics are logically compatible.

Force as the kinetic phenomena

The first of these characteristics can be found in the already quoted section 102 of the *Principles* and in various sections of *De motu.* In these passages Berkeley seems to be saying that the terms 'force' or 'attraction' refer to the kinetic phenomena themselves, i.e. to certain features of the observable physical behaviour of the bodies. It seems to me that the general tone of these passages is roughly reductionist. Force is reducible to the observable behaviour in the sense that force is really nothing but this behaviour. It seems that Berkeley is here very close to Clarke's view of forces as revealed in his letters to Leibniz.[136] In the *Principles* Berkeley claims that the term 'attraction' signifies nothing "besides the effect itself".[137] Similarly in *De motu* Berkeley claims that the term 'gravity' means "nothing other than the sensible effect, the cause of which we seek".[138] The tone of these passages has led some contemporary thinkers to see Berkeley as a sort of precursor of scientific reductionism in the modern sense.[139] The central claim of reductionism as a theory of science is the claim that that all the sentences about the theoretical entities are fully translatable into sentences about the phenomena. In the case of dynamics this amounts to the claim that all the talk of forces is fully translatable into talk about motion and rest of bodies.[140] If a physicist thus says that a force of certain intensity was impressed on a physical body, his sentence ultimately says something about the kinetic behaviour of the body. Is the interpretation of Berkeley as a reductionist justified? I will later in this chapter try to show that it is not.

Force as a mathematical hypothesis

There is, however, one more important characteristic that Berkeley ascribes to physical force. This characteristic does not appear in the *Principles*, however, it is repeatedly mentioned in *De motu*. In these passages, force is described as a sort of fiction, a mere theoretical entity. In section 39 of *De motu* Berkeley says that force is like a device of a geometer (such as a geometrical point or

136See chapter 1.
137*Principles* 103.
138*De motu* 22, for similar formulations see sections 6 and 11.
139See e.g. Hinrichs 1950, p. 492.
140Downing 2005, p. 263, fn. 51.

a perfect circle). It seems to me that this analogy says two things about force. Firstly, it says that force is, just like a geometrical point or a perfect circle, nowhere to be found in the physical world, it is then not a real quality of physical bodies. Similarly, in another sections of *De motu* Berkeley claims that we should see attraction as a "mathematical hypothesis, and not a physical quality"[141].

Secondly, however, the analogy with a geometrical device shows that force is a useful tool. Berkeley claims that concepts like attraction or force are "of first utility for theories and formulations, as also for computations about motion".[142] Forces are then seen as theoretical tools whose postulation is justified by their utility. Another passage of *De motu* in which Berkeley emphasizes the usefulness of the concept of force is section 17 where Berkeley says that terms like 'force', 'gravity' or 'attraction' are "useful for reasonings and reckonings about motion and bodies in motion".

These and similar passages of *De motu* have led some contemporary thinkers to consider Berkeley's account of force an instrumentalist one.[143] Instrumentalism in the theory of science is a view according to which a theory is an instrument, a tool for making correct predictions,[144] a calculating device.[145] The theoretical entities posited by a theory are then not claimed to really exist in the physical world, they are posited only in virtue of being useful for scientific explanations, only because they are able "to facilitate the business of making correct observational predictions".[146]

Tension in Berkeley's concept of force

It seems to me that we might now be able to see a certain tension in Berkeley's concept of force. On the one hand force is supposed to be nothing but the kinetic phenomena while on the other hand force is a mathematical hypothesis. The problem is that while it might seem that a mathematical hypothesis does not have any existence in the perceived physical world, the kinetic phenomena, on the contrary, clearly exist in the perceived physical world where we can observe them. Berkeley's concept of force then seems to, at least at first sight, contain an inner contradiction because nothing can at the same time exist and not exist in the physical world.

This inner tension in Berkeley's concept has led some thinkers to the question whether Berkeley holds an instrumentalist or a reductionist view of forces.[147] The thinkers who say that Berkeley's view was (broadly) reductionist put emphasis on the first characteristic mentioned above

141*De motu* 28.
142*De motu* 39.
143See e.g. Downing 2005, p. 248 or Newton-Smith 1985, p. 155.
144Newton-Smith 1985, p. 150.
145Downing 2005, p. 263, fn. 51.
146Newton-Smith 1985, p. 150.
147Downing 2005, p. 263, fn. 51.

while the thinkers who interpret Berkeley as an instrumentalist tend to emphasize the second one. I would now like to try to decide whether either of these interpretations is plausible. In order to do that, however, I first need to investigate whether the above-mentioned apparent tension in Berkeley's concept is a real tension. Let me therefore start with this question.

I believe there is a real tension between the two kinds of claims Berkeley makes about force, because I think that force strictly speaking cannot be both a useful hypothesis and the observable behaviour of bodies. After all it seems to me that no *x* can be a hypothesis – a theoretical entity – and some real observable phenomenon at the same time. Is there a way to solve this tension?

I tend to think that one charitable way to deal with this tension is not to take Berkeley's claim that force is the observable behaviour of bodies at face value. My interpretive suggestion is that Berkeley really thought that force is a hypothesis, a theoretical entity and therefore his claim that force is the phenomena has to be understood as not being meant literally. Such an interpretation is clearly somewhat controversial. One might challenge it by asking: if, as you claim, Berkeley does not really mean that force is the sensible phenomena, why then does he repeatedly say so? It seems to me that there are at least three reasons why Berkeley does this.

Firstly, it is worth noticing that in all the passages that I know of which seem to conflict with my interpretation[148] Berkeley is concerned with a semantic question. He is not directly speaking of what force is, about the ontological character of force, but rather about what force-terms signify. On the one hand, one might think that surely the term 'force' stands for force itself, and since for Berkeley force is not the cause of the phenomena, it stands for the phenomena themselves. Therefore, one is tempted to conclude, the phenomena just are force. However, one might try to resist this interpretation for the following reasons. As we have seen, Berkeley thought that nouns are meaningful by standing for ideas or notions. Also, in the previous two chapters I tried to show that we do not have an idea or a notion of force. However, Berkeley thinks that the word 'force' is still meaningful and the easiest way to explain this is to claim that it stands for the ideas of the sensible effects which we get from our sense experience. Therefore, I believe, we should interpret Berkeley as being led by semantic considerations when he claims that force-terms signify the phenomena. Therefore, it might seem that he does not really think that force just is the phenomena.

Secondly, one cannot help but notice that the context of all of the "problematic" claims is Berkeley's criticism of dynamic realism.[149] It might be therefore that Berkeley claims that force-terms only signify the sensible phenomena because he wants to contrast his view with the view of the dynamic realist who thinks that force-terms signify the unobservable causes of the phenomena.

148I.e. *Principles* 103, *De motu* 6, 11,22.
149This observation is mentioned in Downing 2005, p. 263, fn. 51.

It might be that Berkeley did not state his real view of force in these passages because it would imply that force-terms signify mere mathematical hypotheses. This view could, however, be seen as equally problematic as the realist view because a hypothesis is nothing we have empirical access to. Therefore then, I think Berkeley chose the safer strategy of simply saying that force-terms stand for the effects, even though he does not really think that forces are the effects.

Thirdly, it may be that Berkeley claims that force-terms signify the sensible phenomena simply because force can be calculated by observing and measuring the sensible phenomena, therefore by a sort of abstraction from the sensible phenomena. Clearly, even a dynamic realist would admit that we can measure forces only indirectly - by measuring their sensible effects, we do not have any direct access to them. If we thus know enough about the sensible effects, we can calculate the intensity of force. Now if we can calculate force from the sensible effects it means that force is a hypothesis that we arrive at purely by considering and measuring the sensible effects. Therefore, I think, Berkley might have meant that force is the phenomena in this vague sense.

Was Berkeley an instrumentalist or a reductionist?

Does my interpretation say anything about the question whether Berkeley was an instrumentalist or a reductionist? It seems to me that it shows that the reductionist interpretation of Berkeley is problematic for the following reason. If force is a hypothesis, something which does not exist out there in the world, it seems problematic to claim that force is reducible to the kinetic phenomena. I have mentioned that one reason why we might think that force is reducible to the observable phenomena is that all the talk of forces is translatable to the talk of the observable phenomena. This option, however, does not seem to be available if we claim that force is a hypothesis. After all, one sentence we could say about a hypothesis is that it is a mere theoretical entity. Now, if reductionism is true, all the talk about forces must be translatable into talk about the kinetic behaviour. It seems, however, that there is no way the claim that force is a mere theoretical entity could be translated into talk about the behaviour of the observed bodies. I therefore, tend to

agree with Downing[150] that we should not see Berkeley as a reductionist.[151]

Was Berkeley an instrumentalist? It seems to me his account of force has instrumentalist features. He clearly sees dynamics as a theory which is very good at making predictions and discovering regularities but also as a theory whose theoretical terms do not correspond to any real entities or qualities in the world. The second reason why I tend to think that the instrumentalist reading of Berkeley is correct is that he repeatedly emphasizes the usefulness of dynamic concepts. According to Newton-Smith, for an instrumentalist "the aim of the scientific enterprise is merely the production of theories that are empirically adequate in the sense that they give successful observational predictions".[152] The status of the theoretical sentences in instrumentalism is thus different from the status of the observational ones. While the observational sentences express facts about the world and are either true or false, the theoretical sentences either do not have a truth value (in the case of 'semantic instrumentalism') or they have a truth value but it is considered irrelevant (in the case of 'epistemological instrumentalism'). The theoretical sentences then do not tell us truths about the world, they only help us arrive at truths about the world in the form of correct predictions. Newton-Smith the attributes to Berkeley semantic instrumentalism "in at least an embryonic form".[153]

It seems to me that even though Berkeley of course never explicitly embraces this view, it is implicitly present in what he says about force in *De motu*. Namely, I believe that if we claim that force is a mere mathematical hypothesis, we have to treat sentences in which we ascribe forces to bodies as sentences, strictly speaking, without a truth value. I therefore tend to agree with Newton-Smith that Berkeley's view of Newtonian dynamics can be called semantic instrumentalism.

I have thus tried to show that for Berkeley force is a mathematical hypothesis. Such a claim, of course, leaves a lot unanswered. It is interesting to ask, for example, what exactly Berkeley means when he speaks about a hypothesis. Firstly, it is not clear whether he understood by 'hypothesis' a proposition (such as "Bodies have forces") or a fictional entity (such as "force" or

150Lisa Downing argues that Berkeley was an instrumentalist. She offers three reasons for her interpretation. The first reason is that whenever Berkeley justifies the use of hypotheses and fictions he does so by pointing out their utility, not their translatability into kinematic motions. If a theory uses fictions or hypotheses, it needs to justify the use of these. One sort of justification could be that these entities are useful for explanations, another reason could be the fact that these hypotheses or fictions are fully translatable to the observable phenomena and the theory can therefore legitimately use them and clearly, Berkeley never directly mentions translatability. Downing's second reason for her claim that Berkeley was an instrumentalist about force is that she thinks the passages which sound reductionist should be understood as merely criticizing dynamical realism by stressing that forces aren't any extra entities existing apart from the observable phenomena. The third reasons Downing uses to support her interpretation is the fact that in Berkeley's later work Si*ris, pu*blished in 1744, i.e. more than two decades after *De motu*, where Berkeley specifically says that "motions only, and not the forces, are indeed in the bodies" and thus, Downing thinks, rejects the reductionist view.

151Downing 2005, p. 263, fn. 51.

152Newton-Smith 1985, p. 150.

153Ibid., p. 155.

“gravity”). In *De motu* 61 Berkeley gives us an example of a geometrical hypothesis. He remarks that “a curve can be considered as consisting of an infinite number of straight lines, though in fact it does not consist of them. That hypothesis is useful in geometry. Here then, the term 'hypotheis' seems to refer to a theoretical proposition rather than to a particular fictional object. Other passages, however, suggest that Berkeley means fictional or hypothetical entities rather than propositions. In *De motu* 28, for example, Berkeley says that attraction is “a mathematical hypothesis, and not a physical quality”. In *De motu* 39, similarly, Berkeley speaks of fictional entities like force or attraction, which do not really exist in bodies, and compares them to “geometers' fictions” or “devices”. Berkeley's use of the term 'mathematical hypothesis then seems to be somewhat ambiguous (see Downing, 2005, p. 263, fn. 50). It seems to me, however, that his central use of the term 'hypothesis' in *De motu* amounts to fictional entities rather than propositions. After all, Berkeley's concern in the relevant passages is the question what is force and we have no reason to suppose that he thought that force was a proposition.

Another question one might like to ask about Berkeley's concept of force as a mathematical hypothesis is whether this hypothesis is necessary for anyone who wants to understand nature and formulate the laws of nature or if this hypothesis is just something that simplifies the formulation of these laws for the human minds with their limited capacities. Another way to ask this question is to ask, whether for Berkeley the concept of force would figure in the physical description of the natural world done by a superhuman mind. It seems to me that one way to approach this question is to try to see the parallel with other mathematical hypotheses. The problem of course is that, Berkeley doesn't say very much about what he means by these hypotheses apart from the fact that they are useful for calculations. One might speculate that one such a mathematical hypothesis is the square root of minus one.[154] Even thought there is nothing in the world that would correspond to such a number, the number is, nevertheless, highly useful in mathematical calculations and it seems that certain mathematical calculations could not be done without it. Therefore it seems that, if the square root of minus one is a mathematical hypothesis, it is a necessary hypothesis, not just something that makes calculations easier for limited minds.

Similarly, we can perhaps use the example of a geometrical proof of the fact that the three angles in a triangle always add to 180 degrees. To do this proof we need to use a geometrical hypothesis of a straight line parallel to one of the sides of of the triangle such that the vertice opposite this side lies on this parallel straight line. It seems to me that we can treat the parallel straight line as a geometrical hypothesis. If it is a hypothesis, it seems to be a necessary hypothesis since there does not seem to be another way to prove or demonstrate that the angles in a triangle add

154Berkeley discusses this number in *Alciphron*.

to 180 degrees. Thirdly, if a geometrical point is a geometrical hypothesis (there are no geometrical points in the natural world), it is, I think, a necessary hypothesis because it has to figure in any geometry. It seems therefore that if Berkeley thinks that force is a hypothesis in any of these senses, then he must have thought that it is a necessary hypothesis. From this we may conclude that he thought that forces necessarily figure in the laws of nature.

To conclude, I would like to raise one question regarding Berkeley's account of force. I have argued that for Berkeley force is a mathematical hypothesis arrived at by abstraction from the sensible natural phenomena. Now, it seems to me that one might object to this that perhaps this view of force is equally problematic from the point of view of Berkley's metaphysics, epistemology and semantics as is the realist view (see chapter 2). Let me just briefly outline this objection. It is not clear what the ontological status of a hypothesis would be for Berkeley. Also, it is not clear whether, if force is a hypothesis, we can have a notion or an idea of force. If so, however, it is still not clear what force-terms refer to.

It seems to me that Berkeley was aware of this problem, because he seems to suggest a solution to it in the seventh dialogue of *Alciphron*.[155] There he discusses the significance of words like like 'force', 'God's grace' or number-words. He claims that even though we do not have clear ideas or notions which these words would stand for, they are still very useful and beneficial in the conduct of our lives and it is their use or their function which makes them meaningful and significant. The character of Euphranor claims here that "though it seems neither you nor I can form distinct simple ideas of number, we can nevertheless make a very proper and significant use of numeral names. They direct us in the disposition and management of our affairs, and are of such necessary use, that we should not know how to do without them".[156]We can see Berkeley as saying here that the utility of a certain term in guiding our lives gives the term its significance. In the case of force, Berkeley specifically emphasizes the utility of dynamics in the construction of engines "by means of which thing difficult and otherwise impossible may be performed".[157] Even though we then, according to Berkeley, do not have an idea or a notion of force, we still can use force as a mathematical hypothesis in physical calculations because we, nevertheless, have a meaningful term at our disposal. Therefore I believe the concept of force as a mathematical hypothesis is not in conflict with Berkeley's overall philosophical position.

155*Alciphron* VII. 7.
156*Alciphron* VII.5.
157Ibid. VII.7.

Conclusion

In the first chapter of this essay I discuss Newton's views of forces and I show that one possible interpretation of Newton is to see him as a dynamic realist. In the second chapter I try to show Berkeley's reasons for rejecting the realist view of forces. I argue that dynamic realism is in conflict with both his metaphysics and his epistemology. In the third section I discuss three of Berkeley's arguments against realism about forces. I try to show that while these arguments expose some of the problems of dynamic realism, they do not, in my view, show that any form of dynamic realism must be false. In the fourth and final section of this essay I discuss the positive part of Berkeley's project, the concept of force presented in Berkeley's *De motu.* I argue that there is a tension between the claims that Berkeley makes about force in *De motu* and offer an interpretation of Berkeley as an attempt at avoiding this tension. According to my interpretation, Berkeley's view of force is an instrumentalist one. Lastly I consider certain aspects of the view of force as a mathematical hypothesis and try to show that while such a view might seem to be in conflict with Berkeley's semantic and metaphysical views, it needn't be so if we consider the semantic considerations introduced in Berkeley's *Alciphron*.

Summary:

The essay concerns Berkeley's reaction to Newton's dynamics. While Berkeley admires the usefulness, simplicity and generality of Newton's laws of motion, he is, none the less, concerned with their possible ontological implications. If we interpret Newton in a realist manner, his doctrines seem to imply that physical objects are active and are thus inconsistent with the basic principles of Berkeley's metaphysics, namely with the view that the only sources of activity in the universe are spirits. Berkeley tries to solve this conflict by offering an account of force according to which force is a mathematical hypothesis and which thus avoids metaphysical commitments. The author suggests that there is a tension between different claims that Berkeley makes about force in *De motu* and offers an interpretation of Berkeley's view in which he tries to avoid this tension. According to the offered interpretation, Berkeley's view of force is an instrumentalist one. In the last chapter various aspects of Berkeley's view of force as a mathematical hypothesis are considered. It is argued that even though such a view might seem to be in conflict with Berkeley's semantic and metaphysical views, it needn't be so if certain semantic considerations introduced in Berkeley's *Alciphron* are considered.

Résumé:

Práce se týká Berkeleyho reakce na newtonovskou dynamiku. Berkeley na jednu stranu obdivuje užitečnost, jednoduchost a obecnost Newtonových pohybových zákonů, na druhou stranu si ale uvědomuje jejich možné nežádoucí ontologické implikace. Pokud totiž interpretujeme Newtona v realistickém duchu, jeho nauky, zdá se, implikují, že fyzické předměty jsou aktivní. Proto je realisticky chápaná Newtonova nauka v příkrém rozporu s Berkeleyho názorem, že jedinými zdroji aktivity v univerzu jsou duchové. Berkeley se pokouší vyřešit tento konflikt tím, že nabízí koncept síly jako matematické hypotézy. Pokud totiž sílu chápeme takto, zdá se že jsme se zbavili nepřijatelných metafyzických závazků. Podle autora je mezi jednotlivými tvrzeními, která Berkeley činí o síle ve spise *O pohybu* jisté napětí a navrhuje interpretaci Berkeleyho koncepce, která se má tomuto napětí vyhnout. Podle této interpretace má Berkeleyho koncept síly instrumentalistický charakter. Závěrem se pak autor zabývá vybranými aspekty Berkeleyho konceptu síly jako matematické hypotézy a tvrdí, že i přesto, že by se mohlo toto pojetí zdát být v nesouladu s Berkeleyho metafyzickým stanoviskem, tento zdánlivý nesoulad se rozplyne, vezmeme-li v úvahu sémantickou koncepci představenou v Berkeleyho *Alkifrónu*.

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