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The Hume-Edwards Principle and the Cosmological Argument

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1. Introduction

The Cosmological Argument for the existence of God claims that the universe is as a whole contingent and the only possible explanation for its existence is that it has been created by a necessary entity or entities, where a *necessary* being (or, alternatively, a *self-explainer*) would be one for which a sound ontological argument holds, even though finite humans might not be smart enough to find this ontological argument or to verify its premises. This paper will follow the tradition of Samuel Clarke's version of the Cosmological Argument.[1]

One famous attack against the Cosmological Argument has been to the effect that an infinite chain of contingent causes could also provide a sufficient explanation for the existence of the universe even if the chain had no first element. Were the universe such a chain, then every entity would be explained through the causal efficacy of some entity further down in the chain, and Hume has argued that this would provide a sufficient explanation of the universe as a whole (or of the universe considered as an individual). Hume's argument is based on the principle that if each element of a collection is given a causal explanation, then the aggregate of all the elements has likewise been explained. Reacting doubtless to Clarke's argument, Hume wrote:

> Did I show you the particular causes of each individual in a collection of twenty particles of matter, I should think it very unreasonable, should you afterwards ask me, what was the cause of the whole twenty. This is sufficiently explained in explaining the cause of the parts.[2]

Paul Edwards has also invoked a similar principle in his criticism of the Cosmological Argument.[3] Rowe has called the principle *the Hume-Edwards Principle*:

> *If the existence of every member of a set is explained, the existence of that set is thereby explained.*[4]

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If the Hume-Edwards Principle could be refuted, then Hume's and Edwards' objections to the Cosmological Argument would be seriously damaged.

One criticism of the Hume-Edwards Principle has been recently given by Richard M. Gale who noted that explanation is not in general 'agglomerative'.[5] Explaining each element of an aggregate does not explain the whole aggregate, since there are cases in which the elements of the aggregate have a common property which calls for a *common* cause. Thus, if a hundred philosophers were gathered in some small town, a causal story in terms of the movements of cars, trains, buses and airplanes explaining how each philosopher has arrived there would not satisfy our thirst for explanation, since we would consider the presence of a hundred philosophers in a small town to be an unlikely coincidence. We would thus seek for a common cause, such as a philosophical convention being held in the town.[6]

A different criticism was offered by Rowe:

> The principle underlying the Hume-Edwards criticism seems plausible enough when restricted to finite sets, i.e., sets with a finite number of members. But the principle is false, I believe, when extended to infinite sets in which the explanation of each member's existence is found in the causal efficacy of some other member.[7]

Unfortunately, however, Rowe's counterexample to the Hume-Edwards Principle in the infinite case is essentially question-begging.[8]

I will provide three types of counterexamples to the Hume-Edwards Principle. The examples will be fundamentally different from Gale's non-agglomerativeness of explanation argument. They will support Rowe's above-quoted claim in the infinite case, though they go further in criticism of the Hume-Edwards Principle by also noting that this principle fails in finite cases exhibiting circularity of explanation.*

The Hume-Edwards Principle has been invoked by Hume and Edwards as a *conceptual* claim. Therefore, it suffices for counterexamples to it to be merely logically possible. Nonetheless, the first of my counterexamples will in fact be not only possible, but apparently (except perhaps for the unessential details of the exact times specified) *actual*. The second counterexample will be merely logically possible, while the third will be precisely of the type in which Hume and Edwards wished to apply their principle. If a variant of the third counterexample is accepted as an appropriate model of the universe, then my argument, together with an appropriate Principle of Sufficient Reason, will constitute a Cosmological Argument for the existence of a necessary

* To be fair to Rowe, he explicitly rules out circularity in explanation in his work.

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being, i.e., a God. Finally, I will criticize Campbell's recent defense of the Hume-Edwards Principle.[9]

2. The cannonball's self-explaining flight

2.1 *A concrete counterexample.* Consider the following example:

> (*The cannonball*) A cannon has shot out a cannonball. The cannonball has landed at noon, having been shot out at 11:58 a.m.

I will argue that if the Hume-Edwards Principle holds, then the cannonball's flight preceding impact can be completely explained with no reference to any cannon. This absurd conclusion I will take to constitute a disproof of the Hume-Edwards Principle.

Consider the collection C of time-slices of the cannonball's state between 11:59 a.m., non-inclusive, and 12:00 noon, inclusive, during which time the cannonball is travelling through the air and finally landing. Thus, C is the state of the cannonball for a minute before impact, starting at 11:59 a.m., but not including the state of the cannonball precisely *at* 11:59 a.m. I claim that *according to the Hume-Edwards Principle*, C is completely explained in terms of itself. To see this, consider any given member of C, namely the state of the cannonball at some time T after 11:59 a.m., but not after 12:00 noon. Then, let T' be any time before T, but still after 11:59 a.m. – such a time T' exists, as there is an infinite number of moments of time between 11:59 a.m. and T. But the state of the cannonball at the earlier time T' provides a full explanation of the state of the cannonball at the later time T if we apply the appropriate deterministic Newtonian laws of physics[10] which ensure that the cannonball, which was moving at the earlier time T', will continue to move until air friction or some impact brings it to a stop. But of course the state of the cannonball at time T' is also in C.

Therefore, what we have produced is an explanation of each of the cannonball states in C in terms of an earlier such state also in C. By the Hume-Edwards Principle, having thus explained every cannonball state in C, we have completely explained all of C. But because each cannonball state in C was explained in terms of another cannonball state in C, it follows that in fact C is a self-explainer. In other words, the cannonball's movement between 11:59 a.m., non-inclusive, and 12:00 noon, inclusive, is a *self-explainer*. And since the cannonball had left the muzzle of the cannon at 11:58 a.m., it follows that we have completely explained the movement of the *cannonball* for a minute before 12:00 noon *without making any reference to any cannon*! The conclusion is absurd since, unless the cannonball is an Aristotelian substance equipped with a self-moving entelechy,[11] any complete explanation

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of the movement of the cannonball must involve the cannon.[12] Self-moving entelechies apart, if the cannonball's flight were self-explaining, then it would be *necessary* (i.e., there would be a sound ontological argument for it, albeit we might not be able to find it); but only Spinoza would want to deny that the cannonball's flight is contingent. Therefore, the Hume-Edwards Principle, implying as it does that C is a self-explainer, must be false.[13]

2.2 *Generalizations and technical points.* The cannonball counterexample can be extended to the explanation of the states of the universe between times T_0, non-inclusive, and T_1, inclusive, for any $T_0 < T_1$. Let $C(T_0, T_1)$ be the collection of all such states. Then, the state of the universe at a time T with $T_0 < T \leq T_1$ can be explained in terms of appropriate laws of physics and the state of the universe at some time T' between T_0 and T, and the Hume-Edwards Principle again implies that we have explained $C(T_0, T_1)$ in terms of itself. But this conclusion is absurd, since the explanation of how the universe has behaved after time T_0 *must* involve data on how it has behaved *at and/or before* time T_0, and the state at time T_0 is not found in $C(T_0, T_1)$.

Hume would wish to apply the Hume-Edwards Principle to the state of a universe that has always existed. Suppose the current time is T_1. Let $C(-\infty, T_1)$ be the collection of all the states of the universe up to and including T_1. Hume wishes to apply his principle to $C(-\infty, T_1)$, saying that if we can explain the state of the universe at each time T in terms of its state at some earlier time T', then in fact we have a complete explanation of $C(-\infty, T_1)$. But the close analogy between this case and the above-discussed case of the explanation of $C(T_0, T_1)$ for a finite T_0 suggests that Hume's argument is flawed even in the case in which he wishes to apply it. One may also note that we can find a one-to-one mapping of the collection of times T satisfying $-\infty < T \leq T_1$ onto the collection of times S satisfying $T_0 < S \leq T_1$.[14] Using this mapping we can argue that $C(-\infty, T_1)$ and $C(T_0, T_1)$ are isomorphic situations, so that if the Hume-Edwards Principle fails for the latter, it should also fail for the former. Thus, because of the isomorphism, any argument to show that the universe is completely explained in the Humean way by the collection of its past states would also lead to the absurd conclusion that our cannonball's flight was self-explaining.

3. The causal loop

While the examples given in the previous section were *actual* (after all, cannons have shot forth cannonballs, though perhaps not exactly at the times indicated), an interesting type of example suggested to me by Richard M. Gale is the *causal loop* which is merely logically possible.

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(*The autogenic Daphnia*) Consider a *Daphnia magna*, a small fresh water crustacean which under normal circumstances reproduces through parthenogenesis, with the offspring being exact genetic clones of the mother Daphnia. Suppose that on January 1, a mother Daphnia gives birth to a single offspring, and dies right after; in the surrounding environment, her body will be naturally recycled to provide nutrition for her offspring. Over the next ten days, the offspring matures. On January 10, the offspring herself becomes pregnant (parthenogenically) and is transported by a time machine back to January 1. It turns out that this offspring is in fact the very mother Daphnia with whose child-bearing our story had begun on January 1.

In this example, what is to be explained is the existence of the mother Daphnia on January 1 and of the one offspring Daphnia on January 1–10. The existence of the offspring is explained in terms of her mother. The existence of the mother is explained in terms of the offspring that has grown up to become that mother. By the Hume-Edwards Principle, having given an explanation of the mother and of the child, we have given an explanation of the mother-child aggregate. But in fact we have explained nothing, since none of our explanations tell us anything about where the mother Daphnia and/or her child have come from – we simply have a circularity in explanation. For a satisfactory causal explanation of the mother and child's existence to be given, it would be necessary to state some *outside* cause that has brought about the whole causal loop. Therefore, the Hume-Edwards Principle is false in this example, since it claims that the causal loop is self-explanatory. Since the Hume-Edwards Principle is to be taken as claiming to be a conceptual fact, and since the above example is logically possible, it follows that the Hume-Edwards Principle is false.

It may be objected that time machines are logically impossible. If that is so, then instead consider a possible world whose time-sequence is a ten day loop, with January 1 following January 10 (i.e., a universe with closed time). There is no logical contradiction in supposing such a universe and the above story of the Daphnia mothering herself is logically possible in such a world; hence, the same arguments as before establish the falsity of the Hume-Edwards Principle. An argument based on the Principle of the Identity of Indiscernibles and demonstrating the logical possibility of a closed-time universe has been given by Grünbaum[15] and will also be used in Section 4.2, below, in modified form.

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4. The chicken and the egg, and our universe as a whole

4.1 *Causal explanation of collections.* A reasonable sufficient condition for causal explanation of collections (or, perhaps preferably, aggregates) is that a collection B (causally) explains a collection A, if for every element a of A, there is an element b of B such that b (causally) explains a.

4.2 *Chickens and eggs.* Having seen the outlandish causal loop in which a normally parthenogenic Daphnia became *autogenic*, let us now come back to a somewhat saner possible world.

> (*Chickens and eggs*) Consider a possible world in which there is an infinite sequence of chickens (of both sexes) and eggs, stretching infinitely far back in time. The chickens lay eggs, and the eggs hatch into chickens.

The explanandum in this case consists of all the chickens and eggs. Now, each chicken is explained by the egg from which it had hatched, and each egg is explained in terms of the chicken which had laid it. Therefore, each individual element of the explanandum has been explained, and the Hume-Edwards Principle implies that we have explained the whole chickens-and-eggs sequence. However, in fact our explanations are just as circular as in the case of the causal loops in the previous section. For, let C be the collection of all the chickens that have ever existed, and let E be the collection of all the eggs that have ever existed. Then, every element c of C is explained by an element e of E, and conversely every element e of E is explained by an element c of C. By the sufficient condition given in Section 4.1 for causal explanation between collections, we thus have E explaining C, and C explaining E, and hence what we have is an explanatory circle once again. But an explanatory circle is not a satisfactory explanation of the whole phenomenon: to say that E explains C and C explains E does *not* explain the pair C and E. Therefore, the Hume-Edwards Principle, which claims that our explanatory circle does give an explanation of the pair C and E, must be false.

The argument in the previous paragraph, just as the one in Section 3, depends on the principle that a circle of explanations cannot possibly give a complete explanation. It may be objected that this principle only applies when we are going around a circle in explaining *individual entities* (as in the case of the autogenic Daphnia), whereas in the example at hand we have been explaining the *collections* C and E. However, these collections can likewise be considered as *aggregates*; at least from a reductionistic point of view which a staunch naturalist such as Hume cannot object very much to, C and E are not metaphysically very different from such aggregates as an elephant or a rock considered as temporally extended collections of elementary particles

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(the only difference is that the elementary particles in the elephant or in the rock are more closely packed together than those in C and E, and there is more temporal continuity in the elephant and in the rock). Thus, if we accept the principle that an explanatory circle is unsatisfactory for ordinary macroscopic objects, we should likewise accept this for such collections as C and E. Hence, indeed, the Hume-Edwards Principle fails for collections such as the collection of chickens and eggs.

Alternately, assuming the principle of identity of indiscernibles and a relational theory of time, we may argue for the inadmissibility of the Hume-Edwards explanation of the chickens and eggs as follows. Suppose that the world of chickens and eggs is approximately periodic, so that every year approximately the same kinds of lives of the chickens and eggs (and any other entities in the universe) repeat. Suppose that the Hume-Edwards Principle had been true in the original case of chickens and eggs (before we made the approximate periodicity assumption), so that the explanation of each chicken in terms of some egg from which it hatched and of each egg in terms of the chicken that laid it is a complete explanation. The introduction of approximate periodicity in the world should not destroy the completeness of the explanation *if* the Hume-Edwards Principle holds.[16] Now suppose that we make the approximate periodicity come even closer to perfect annual periodicity, so that in an appropriate limit, we do arrive at what seems to be perfect annual periodicity. If the Hume-Edwards Principle held in all the approximately periodic cases, one would expect that it would hold in the limiting case. But the limiting case in fact is *not* a universe with (open) linear time and perfect periodicity. For, given the principle of identity of indiscernibles and a relational theory of time, it is logically impossible for there to be a world in which everything exactly repeats with a one year period, because the events on a given date in one year could not be distinguished from those on the same date in any other year. Rather, under these assumptions, the limiting case will be a universe with a *closed cyclic time-sequence*, which resets itself to the 'beginning' at the 'end' of every year.[17] But an application of the Hume-Edwards Principle in such a universe with a circular time-sequence must give a correspondingly circular 'explanation' of the chickens and eggs and such an 'explanation' would not be satisfactory, as was already seen in Section 3. Therefore, the Hume-Edwards Principle fails in the limiting case, and hence it may be reasonably thought to fail in the other chickens-and-eggs cases. This argument shows that if the atheist is willing to accept an uncaused infinite chain of causes of the type of the chickens and eggs (and it seems difficult to see why he would deny this), then if he also accepts the identity of indiscernibles, he will be obliged to accept the possibility of an uncaused

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causal loop – and I claim that such a loop is contrary to the principle of sufficient reason, and indeed to all sound reason.[18]

4.3 *A generalization and a Cosmological Argument.* The chickens-and-eggs counterexample generalizes very widely. Suppose that we have *any* collection of S of entities (in the previous example this was the collection of chickens and eggs) such that no entity in S is a self-explainer, and such that every entity in S is explained by the causal efficacy of some other entity in S. This was in fact precisely the kind of case to which the Hume-Edwards Principle was originally applied in the criticism of the Cosmological Argument for the existence of God, since there the claim was made that explaining each entity in the universe by some other entity in this universe gives a sufficient explanation of the whole even if instead of there being a first cause or first causes, there is just an infinite causal sequence without a first element.

Assume for now that casual explanations is transitive: if c explains b and b explains a, then c explains a. Now, just as we had partitioned the collection of chickens and eggs into the collection of chickens and the collection of eggs, under the above assumptions so too can we partition S into disjoint collections C and E with the property that every element c of C is explained by some element e of E, and every element e of E is explained by some element c of C (this follows from Theorem 5.1 in the Appendix, which Theorem assumes the set-theoretic Axion of Choice[19]). The condition in Section 4.1 then again implies that C is explained by E and E is explained by C.

According to the Hume-Edwards Principle, S is sufficiently explained by the fact that each element of S is explained by another element of S. However, in fact, this mode of explanation once again leads to circular explanations: C being explained by E and E being explained by C. This circularity should alert us to the Hume-Edwards Principle failing to provide us with a complete explanation, and thus being once again falsified.

Because of this circularity, a complete explanation of S would either require a self-explainer in S or the positing of one or more entities outside S which give causal explanations of the entities in S. Indeed, it is not unreasonable to suppose the principle that *whenever we have a circular explanation without any self-explainers, a complete explanation of the whole circle requires some entities from outside the circle.* If one assumes that a complete explanation *does* always exist (this would be tantamount to assuming an appropriate Principle of Sufficient Reason), then one may conclude that such entities exist. But if S is the collection of *all* actual entities, then no such entities outside S can exist, and hence it follows that if an appropriate Principle of Sufficient Reason (PSR) holds, then the original conditions on S (namely that each element is explained in terms of another) could not be true. If one could

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argue that each existent[20] entity a has a causal explanation in terms of some existent entity b (perhaps now with b coinciding with a, in which case we would say a is a self-explainer or necessary being), then the above argument would show that the assumption that there are no self-explainers entails a contradiction to PSR. Hence PSR implies the existence of a self-explainer, *et hoc Samuel Clarke dicit deum.*[21]

I am indebted to Richard M. Gale[22] for noting that this argument can be criticized for presupposing the transitivity of explanation, which transitivity is in general questionable. As Gale observed, one way to respond to this criticism would be to rework the argument with the relation *is-causally-necessary-for* (defined by an appropriate counterfactual) instead of the relation *is-causally-explained-by*, since the *is-causally-necessary-for* relation is unproblematically transitive. This solution may run into problems with causal overdetermination issues, however. A preferable solution would be to insist that while explanation in general might not be transitive, still causal explanations of some appropriate type (Gale has suggested *per se* causal ordering) *are* transitive.

Finally, given a technical adjustment to the argument, one need not assume any transitivity. Let S be the collection of all entities in the universe, and suppose that each entity in S is explained by some other entity in S. Assume further that S has no explanatory loops.[23] Then, even if explanation is not transitive, it can still be proved (assuming the Axion of Choice and applying Theorem 5.3) that if each element in S is explained by another element in S, then S can be partitioned into disjoint sets C and E, such that C explains E and E explains C, contrary to the noncircularity of genuine explanation. Hence, just as before, assuming PSR, it follows it cannot be the case that each entity in S is explained by some *other* entity, and since each entity must have an explanation if PSR holds, it follows exactly as before that there must be a self-explainer.

5. Conclusions and Campbell's defense of Hume

All the examples given above have the property that every entity in the collection forming the explanandum is explained in terms of another entity in that collection, and in Section 4.3 I have indeed argued that in *all* such cases, the principle fails. The Hume-Edwards Principle is only plausible in cases in which there is a self-explainer in the collection or else when some entity in the collection forming the explanandum is explained in terms of something *outside* the collection, and the finite examples that Hume, Edwards and Campbell give are of the latter type (i.e., some entity is explained by a fact or entity *outside* the collection). If the Hume-Edwards Principle fails, then the

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Cosmological Argument continues to show that, assuming PSR, there must be at least one explainer unexplained by anything other than itself.

Recently, Campbell has defended Hume's criticisms of the Cosmological Argument, and in particular has tried to neutralize objections to that part of Hume's argument which is centered on the Hume-Edwards Principle.

Campbell in his paper gives two particularly interesting arguments: he claims that it suffices for the Hume-Edwards Principle to hold *sometimes*, and he defends the claim that the necessary being established by the Cosmological Argument could be the universe as a whole. For the remainder of the main body of the paper, I will consider these two objections.

5.1 *Campbell's first argument.* Campbell, on the basis of an example involving the explanation of three apples lying on a professor's desk which could but *need not* have a common explanation, says that to block the Cosmological Argument, one only needs what I will call the *weak Hume-Edwards Principle*:[24]

> for every given collection S of entities, if E is a set of explanations giving an explanation of each individual element of S, then it is the case that it is *possible* that E is an explanation of all of S.

Recall that the full Hume-Edwards Principle had stated the same thing less the modal clause 'that it is possible'. Note also the order of quantifiers and modal operators in this weak Hume-Edwards Principle: $\forall S \forall E[(E$ individually explains each element of $S) \Rightarrow \Diamond$ (E explains $S)]$. Moreover, the whole assertion is simply a conceptual statement about explanation, and as a whole needs to be taken as intended to be necessary.

The Cosmological Arguer, in order to conclude that there exists a self-explainer, must show that, assuming PSR, there *must* be an explanation for the universe over and beyond the collection of the individual explanations in which each existent entity is explained by another. The Cosmological Arguer needs to deny that there is even a *possibility* that citing an infinite causal chain could give a sufficient explanation of the universe, since once such a possibility is admitted, it no longer *necessarily* follows from the Cosmological Argument that there is a self-explainer. Thus Campbell's weakening of the Hume-Edwards Principle by inserting the possibility modal operator in the above-indicated place is a valuable contribution to the debate.

However, Campbell's weak Hume-Edwards Principle falls prey to the same counterexamples as I have already given. For, in each of them, I have provided a Hume-Edwards type of explanation for some collection. In the counterexamples, it was evident that the explanation did not satisfactorily explain the collection. And, if one considers the examples carefully, one will see that

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in each, the explanation not only *does not* satisfactorily explain the collection, but it *cannot* satisfactorily explain the collection, and hence the weak Hume-Edwards Principle fails. For instance, a causal loop *cannot* provide a satisfactory explanations, even though it satisfies the conditions of the (weak) Hume-Edwards Principle. Likewise, the movement of the cannonball *cannot* be explained by saying that the cannonball's movement is self-explainer. The argument in Section 4.3 can then be read as saying that the weak Hume-Edwards Principle fails in every case which satisfies the condition that each member of a collection is explained by another member.[25]

5.2 *Campbell's second argument.* Campbell's most interesting argument leads to a dilemma for the Cosmological Arguer: either (a) the universe is just the sum of its material parts, or (b) it is more than the sum of its material parts. In the former case, the (weak) Hume-Edwards Principle applies to the universe as a whole. In the latter case, the universe can itself be a necessary being.[26]

But in fact the Cosmological Arguer can embrace option (a), which Campbell calls the *mereological principle*. My counterexamples to the Hume-Edwards Principle did not depend on a denial of the mereological principle. The movement of the cannonball cannot be self-explanatory, whether the mereological principle is assumed or not. Likewise, a causal loop cannot be self-explanatory even if there is nothing more to the causal loop than the sum of the parts. And the circularity implicit in the infinite sequence of chickens and eggs is still vicious even if the collection of chickens and eggs has no reality over and above the sum of its parts. It is true that Gale's 'explanation is not agglomerative' criticism of the Hume-Edwards Principle (as well as possible criticisms based on non-extensionality of explanation) may depend on a denial of the mereological principle. But neither my examples depend on it, nor does the work of Rowe.

And even in case (b), Campbell's conclusion does not follow. First of all, if the universe is more than the sum of its parts, we can ask about the ontology of that 'more', and ask what explanatory relations there are between the 'more' and the parts. There are four possibilities.

First consider the case in which the parts explain the 'more' (the 'more' being as it were a mere epiphenomenon of the parts). In this case, if the universe is necessary, then in fact the most basic ontological constituent of the universe consists of the *parts*, and the presence of the 'more' (and whatever ontological status it has) simply follows from the existence of the parts. In that case, for the universe to be necessary, necessity will need to be proved in its parts. But the parts are contingent, and so the 'more' which depends on them will also be contingent. The 'more' in this case in no way helps Hume and Campbell to establish that the universe can be necessary – if the universe

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cannot be necessary given the mereological principle, then neither can it be necessary in this case.

Secondly, having considered the case where the parts explain the 'more', let us now consider the opposite case, where the 'more' explains the parts. In that case, the 'more' will be more basic than the parts. In effect, I claim, we will be able to identify this 'more' with God, at least in Campbell's weak sense of 'a transcendent being that is the cause of everything in the natural word'.[27] To explore the precise ramifications of this argument more fully, a deeper investigation of the ontology of the 'more' would be called for.

The third case is where the 'more' and the parts do not have a simple unidirectional explanatory relation. This can happen either if they are independent in the order of explanation, or if they are mutually explanatory. In the former case, the parts of the universe can be considered in the order of explanation independently of the 'more', and hence we can argue against the necessity of the universe along the lines of the mereological principle – for the 'more' in this case (being independent of the parts as it is) should not enter into the discussion, just as in the first of our four cases it did not enter except as a kind of epiphenomenon. If on the other hand, the 'more' and the parts are reciprocally explanatory, then we seem to have an explanatory circle. This does not appear admissible without either (a) positing an explainer outside the circle (which would prove the theist's case), or else (b) positing a deep unity between the 'more' and the parts. Case (b) seems to have a Hegelian flavor: all is one in some sense, though there are parts. The only way I can think of for making *rational* sense of such a view is through explaining the mutual dependence between the 'more' and the parts in terms of the on-going interaction between them, with the 'more' at one time explaining the parts at a later, and the parts at the later time explaining the 'more' at a yet later. But this is exactly like my Chickens and Eggs example – still nothing is fully explained in the end.

Finally, someone could just deny that there are *any* parts in the universe. On this view, all really is One and this One is necessary. This is a Parmenidean/Buddhist view. How such a view can make sense of the evident multiplicity in phenomena (which, *as phenomena*, are real), I do not know.

In conclusion, the denial of the mereological principle leads to four possible views. Of these, the first view (that there is a 'more' which is explained by the parts) does not give Hume any ammunition against the claim that the universe is contingent. The second (that the 'more' explains the parts) in effect posits the existence of a God (at least in Campbell's wide sense). The third – mutual dependance between the 'more' and the parts – either cannot be made rational sense of or else is an example of a causal loop or Chickens

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and Eggs type case. The fourth posits that all is One but fails to explain the evident multiplicity in appearances.[28]

In closing, let me consider a rejoinder that could be made here. I have disputed Campbell's objections to the claim that the universe is contingent. Campbell can now ask: 'But does not such an argument for the contingency of the universe also prove that God, if he exists, is contingent?' However, I will answer that a central premiss of my argument was that the world has contingent parts. This premiss does not apply to God. God has no contingent parts.[29] Indeed, according to traditional Western theism, God has no proper parts at all, but is ontologically simple,[30] and the objection in this case falls apart completely.[31]

Appendix: Some theorems of sets equipped with relations without maximal elements

Suppose that $\prec$ is a binary relation on a set of U. We may then define a binary relation $\prec$ on 2^U by positing that $A \prec B$ for subsets A and B of U if and only if

$$\forall x \in A.\ \exists y \in B.\ (x \prec y).$$

We then have the following theorem.

THEOREM 5.1. *Suppose $\prec$ is a transitive relation on a set U, and suppose that $\prec$ is defined on 2^U as above. Assume further that for all $x \in U$, there is a $y \neq x$ in U with $x \prec y$ and $y \neq x$. Then, assuming the Axiom of Choice, there exist two disjoint sets A and B whose union is U and which have the property that $A \prec B$ and $B \prec A$.*

We also have the following result.

THEOREM 5.2. *Under the conditions of Theorem 5.1, if there is a sequence $a_1 \prec a_2 \prec \ldots$ of distinct elements of U with the property that for all $x \in U$ there is an $n \in \mathbb{Z}^+$ such that $x \prec a_n$, then the conclusion of Theorem 5.1 holds even without the assumption of the Axiom of Choice.*

Proof of Theorem 5.2. Let $A = \{a_{2n} : n \in \mathbb{Z}^+\}$ and let $B = U \setminus A$. Then, given $x \in A$, we have $x = a_{2n}$ for some n, and so $x \prec a_{2n+1} \in B$. Thus, $A \prec B$. We now prove the opposite inequality. Given $x \in B$, there exists $m \in \mathbb{Z}^+$ such that $x \prec a_m$. If m is even, then $a_m \in A$ as desired. If m is odd, then $x \prec a_m \prec a_{m+1}$ and $a_{m+1} \in A$ as desired. Hence $B \prec A$. □

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THEOREM 5.3. *Let $\prec$ be any binary relation on a set U with the following properties*:

(i) *for all x in U there exists a y in U with $x \prec y$ and $y \neq x$*

(ii) *there are no odd-width loops, i.e., there is no sequence $a_1, a_2, \ldots, a_n$ of distinct members of U such that $a_i \prec a_{i+1}$ for $a \leq i \leq n-1$ and $a_n \prec a_1$, with $n > 2$ being odd.*

Assuming the Axion of Choice, there exist two disjoint sets A and B whose union is U and which satisfy $A \prec B$ and $B \prec A$.

For the proof of Theorems 5.1 and 5.3, we need a Lemma. For a function f: $X \to X$, we write f^n for the nth iterate of f, i.e., $f^n(x) = f(f(\ldots f(x)\ldots))$ with n occurences of f, and $f^0(x) = x$ for all x.

LEMMA 5.1. *Let $f: X \to X$ be any function such that for all* odd $n \geq 1$ *and all $x \in X$ we have $f^n(x) \neq x$. Assuming the Axiom of Choice, there exist disjoint sets A and B whose union is X, such that $f[A] \subseteq B$ and $f[B] \subseteq A$.*

Proof of Lemma 5.1. I am grateful to Martin Goldstern and Herman Rubin for the ideas underlying this short proof as my original proof was much longer. Define the equivalence relation $\sim$ on X by setting $x \sim y$ if and only if there are natural numbers n and m such that $f^n(x) = f^m(y)$ (it is easy to check that $\sim$ an equivalence relation). This equivalence relation partitions X into equivalence classes $[x] = \{y \in X\colon\ y \sim x\}$ for x in X. Let α be a function which assigns to each $\sim$-equivalence class some element of this class (this function exists by the Axiom of Choice). Given x and y with $x \sim y$, suppose $f^n(x) = f^m(y)$ and let $d(x, y) = 0$ if $n - m$ is even, and put $d(x, y) = 1$ if $n - m$ is odd. Using the condition that for all $\xi \in X$ we have $f^k(\xi) \neq \xi$ for odd k, it is easy to check that $d(x, y)$ is well-defined. Let

$$A = \{x \in X\colon\ d(x, \alpha([x])) = 0\}$$

and

$$B = \{x \in X\colon\ d(x, \alpha([x])) = 1\}.$$

Using the definition of d and the fact that $\alpha([f(x)]) = \alpha([x])$ since $[f(x)] = [x]$ as $f(x) \sim x$ (for each x), it is easy to see that if x is in A then $f(x)$ is in B and if x is in B, then $f(x)$ is in A. (Note that this proof can be adapted so as to only use the Axiom of Choice for collections of two-element sets.) □

Proof of Theorem 5.3. Choose a function $f: X \to X$ such that $x \prec f(x)$ and $x \neq f(x)$ for all x. By the Axiom of Choice and (i), such a function exists. Applying the Lemma to this f (one needs to use (i) and (ii) to see that the Lemma applies) will complete the proof. □

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Proof of Theorem 5.1. Choose a function $f_0 : X \to X$ such that $x \prec f_0(x)$ and $x \neq f_0(x)$ for all x. Let

$$S = \{x: \exists n \geq 1.\ f_0^{2n+1}(x) = x\}.$$

Note that S splits under f_0 into a union of disjoint odd-width cycles, i.e., subsets $C = \{x_1, x_2, \ldots, x_{2n+1}\}$ such that $f_0(x_i) = x_{i+1}$ for $1 \leq i \leq 2n$ and $f_0(x_{2n+1}) = x_1$. Let S' contain exactly one element from each such cycle (the existence of S' needs the Axiom of Choice). Now, define $f(x) = f_0(x)$ for $x \notin S'$ and put $f(x) = f_0(f_0(x))$ for $x \in S'$. It is easy to verify that f satisfies the conditions of the Lemma (in effect, we have changed all odd-length cycles into shorter even-length ones). Moreover, it is still the case that $f(x) \neq x$ and $x \prec f(x)$ for all x in X (if x is in S', then this uses the fact that $x \prec f_0(x) \prec f_0(f_0(x))$ and the transitivity of $\prec$). Applying the Lemma to f will complete the proof. □

Notes

1. Samuel Clarke, *A Demonstration of the Being and Attributes of God* (1705).
2. David Hume, *Dialogue Concerning Natural Religion* (1779), Part IX.
3. Paul Edwards, 'The Cosmological Argument', in *Rationalist Annual for the Year 1959* (London: Pemberton), reprinted in Donald R. Burrill (ed.), *The Cosmological Arguments* (New York: Doubleday, 1967), pp. 113–114.
4. W. L. Rowe, 'Two criticisms of the Cosmological Argument', *The Monist* 54, No. 3 (1970); reprinted in W. L. Rowe and W. J. Wainwright (eds.), *Philosophy of Religion: Selected Readings*, 2nd edition (New York: Harcourt Brace Jovanovich, 1989), 142–156, p. 153.
5. Richard M. Gale, *On the Nature and Existence of God* (Cambridge: Cambridge University Press, 1991), pp. 254–255.
6. Note that while Gale's argument if successful does show that the Hume-Edwards Principle is not a conceptual truth, Gale does not take the argument to help the Cosmological Arguer, as Gale thinks that 'the common cause principle is not applicable to the universe, since there can be no appeal to frequencies [in that case]' (private communication, 1997).
7. Rowe (1989, p. 154).
8. Rowe's counterexample is the collection of all human beings (ibid). Now, if there was a first human being (or a set of first human beings) whose causal efficacy explains the existence of all other human beings, then Rowe's counterexample fails, since then the explanation of some human being's (i.e., the first human being's) existence will be given in terms other than of the causal efficacy of some other human being. On the other hand, if human beings have always existed on earth, then Rowe's counterexample is question-begging in requiring a further explanation of the collection of all human beings, since Hume and Edwards believe that it is precisely this kind of infinite series which does not require a further explanation. (My chickens-and-eggs counterexample in Section 4.2 will indeed show a way in which one could argue that Rowe's example is *not* question-begging, but Rowe himself has not done this.)
9. Joseph K. Campbell, 'Hume's refutation of the Cosmological Argument', *International Journal for Philosophy of Religion* 40 (1996), pp. 159–173.
10. And of course for mid-size macroscopic objects such as cannonballs moving through the air, these laws are valid. But if one is a stickler for absolute precision, one can even use

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relativistic or even quantum mechanical laws in the explanation. We can include the actual laws of physics as part of our explanation.

11. I am grateful to Richard M. Gale for noting this possibility. However, first of all it would be most unlikely that either Hume or Edwards would be willing to pay the price of saving their principle by supposing that Aristotelian physics is correct, and, secondly, even if Aristotelian physics is in fact true, still it is not logically necessary that it be true, and hence the Newtonian counterexample given is logically possible.
12. And in *juridical* contexts, it will also need to involve the agent who fired the cannon, who also would not be a part of the relevant explanation of C in the above Hume-Edwards Principle based argument. One can only speculate about the possibilities of sleazy defense attorneys explaining the movements of bullets without making any reference to guns and *a fortiori* to their clients who pulled the triggers.
13. This counterexample is quite similar to the example of an explosion in James Cain, 'The Hume-Edwards Principle', *Religious Studies* 31 (1995), 323–328, p. 325. However, there is a technical difference introduced by me for reasons of clarity. Transposing Cain's reasoning into the setting of the present paper would make C be the collection of cannon and cannonball states between 11:58 a.m. (the time of the cannon being fired), non-inclusive, and 12:00 noon, inclusive, where instead in the present paper the starting point for C was chosen to be one minute *after* the firing of the cannon, at 11:59 a.m. The firing of a cannon is not an instantaneous process, but a continuous one (albeit the explosion of the gunpowder takes place over a very short period of time), and so there are some technical difficulties in specifying exactly how C is to start right after the firing, without actually including the firing (or, in Cain's original case, the ignition of the explosion) in C. These difficulties (of which Cain himself has some awareness as on p. 325 he says that 'perhaps events do not take place over open-closed intervals of time') are not major ones because even if a portion of the firing were included in C, this still would not provide a complete explanation of the cannonball's flight, because the firing itself would not be explained (a more complete explanation would have to include either a gunner who fired the cannon or an explanation of why the gunpowder spontaneously ignited). For reasons of clarity, however, in the present paper the explanandum C is started a minute after the firing to ensure that none of the firing is included; this highlights more clearly the absurd nature of the Hume-Edwards conclusion that C is self-explained, since it shows that the flight of the cannonball can be explained with no reference at all to the cannon firing if the Hume-Edwards Principle holds.
14. To get such a mapping, e.g., let $S = T_0 + (T_1 - T_0)/(1 + T_1 - T)$.
15. Adolf Grünbaum, *Philosophical Problems of Space and Time* (New York: Knopf, 1963), pp. 197–203.
16. One might object that in fact approximate periodicity *itself* would require explanation. However, this objection is not available to Hume, since it would open up the way for a *teleological* argument for the existence of God on the basis of various other regularities in the world.
17. Cf. Grünbaum (1963, pp. 197–203).
18. Note also that this kind of argument can also be applied to Rowe's collection of all human beings (Rowe, 1989, p. 154) in the case that human beings have always existed.
19. In cases in which Theorem 5.2 applies, the Axiom of Choice will not be needed.
20. Of course, an existent entity need not exist now, but could have existed in the past, or might exist in the future, or might be outside of time.
21. The claim that each existent entity a has a causal explanation in terms of some existent entity b would appear to require an appropriate PSR together with a notion of *entity* which is wide enough so that entities which are explained by the cooperation of causes could be also said to be explained by the action of a single *entity* which is an aggregate of the cooperating causes.
22. Personal communication (1997).

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23. An *explanatory loop* is a list $a_1, a_2, \ldots, a_n$ of distinct entities (for $n > 1$) such that each entity is explained by the succeeding one, and a_n is explained by a_1. If there are any explanatory loops in S, then, assuming PSR, for each such loop there must be explanation of the whole loop lying outside the loop itself (cf. Section 3), and replacing the circular intra-loop explanations by the extra-loop explanation we have effectively removed the loop; we can do so for all such loops. Alternately, we can posit that any explanatory loop is a violation of PSR. (*Technical note*: As the statement of Theorem 5.3 shows, only explanatory loops with n being odd need to bother us at all.)
24. Campbell (1996, pp. 164–165).
25. Campbell (1996) also offers two specific criticism of Rowe's work in this area. Neither seems to hit the mark. Campbell's first counterexample (p. 166) fails since given Campbell's infinite sequence of sets, Rowe will take either the sequence as a whole or the union of the sets in the sequence as his explanandum, and in either case insist that Campbell's explanation of *this* explanandum in terms of the causal relations between members of the initial sequences is precisely the kind of explanation that Rowe's principles and PSR rule out. Campbell's second argument against Rowe is to use Rowe's claim that 'whenever a set is such that each member's existence is explained by the causal efficacy of some other member of *that set*, it will be ... false that we thereby have an explanation of why the set has any members at all' (quoted in Campbell, p. 166) to disprove the possibility of a self-explainer. For, Campbell invites us to consider the singleton set consisting of the necessary being which Rowe is trying to argue for the existence of, and says that Rowe's above-cited principle implies that 'in order to explain why there is a necessary being at all we must appeal to some other set of objects' (p. 166), contradicting the possibility of there being a necessary self-explainer. But Campbell's singleton set consisting of the necessary being evidently and explicitly fails Rowe's condition that 'each member's existence is explained by the causal efficacy of some *other* member' (my emphasis). In Campbell's singleton set, the necessary being is explained by *its own* causal efficacy and not by the causal efficacy of some *other* member of the set (since indeed the set has *no* other members), and so Campbell's singleton set fails to be a counterexample to Rowe's principle.
26. Campbell (1996, pp. 166–167).
27. Campbell (1996, p. 160).
28. Another argument that could be made aginst the necessity of the existence of the universe would be to say that if the universe were necessary, then there would be an ontological argument (perhaps beyond our capacity) for its existence. But then one could argue that, assuming PSR, unless the universe were a personal agent able to freely decide its future, it would follow that everything in the universe would be of necessity determined, and hence there would be no contingency any where. But few people other than Spinoza would agree with this conclusion.
29. And if *per impossibile* God did have such parts, then by a redefinition of the word 'God' we could simply consider the aggregate of God's *non-contingent* parts to be God.
30. This corresponds to the fourth possibility in the case of the universe after the denial of the mereological principle. While I believe it would be possible to do so, nonetheless in this paper I shall not try to argue why I think that even though it is absurd to believe that the universe is simple, nonetheless it is not absurd to believe that *God* is simple.
31. I am most grateful to Robert Clifton and Richard M. Gale for interesting discussions and useful comments.

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