Qualitative Identity and Uniformity

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I

In this paper I shall attempt to throw light on J.S. Mill's much debated principle of the uniformity of nature. Halfway to our destination we shall stop to examine the vast set of properties members of which share the characteristic of being too insubstantial to prevent numerically distinct particulars from being qualitatively identical. I believe the nature of these constitutes on its own a topic of considerable interest, however my main purpose here will be to obtain a clarified notion of these properties and make use of it in an explication of Mill's principle.

As we know, Mill asserted '. . what happens once, will, under a sufficient degree of similarity of circumstances, happen again.'[1] His principle implies that the regularities observed by nature are invariant with respect to location in space and time. The principle lends itself to a wide variety of interpretations. Many have understood it to convey a fundamental and indispensable truth about the universe without which science would be impossible. Thus the famous physicist E.P. Wigner says:

> It is . . . essential that, given the essential initial conditions, the result will be the same no matter where and when we realize these . . . If it were not so . . . it might have been impossible for us to discover laws of nature.[2]

Most scientists would wholeheartedly endorse Wigner's statement: if difference in date or position alone could make particulars unalike, then inductive reasoning, based on the belief that like things behave alike, would have no application.

Others look upon Mill's principle as a useful, basic assumption

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scientists do indeed make; however, it is an assumption that has often turned out to be false.

According to a more radical view the principle, though it may sound as if it were of momentous consequences, actually fails to make any assertion and is altogether vacuous.

II

Brian Skyrms, for instance, in his widely known *Choice and Chance*, claims that ". . nature is simply not uniform in all respects, the future does not resemble the past in all respects."[3] To illustrate his point, Skyrm cites Bertrand Russell's story concerning a chicken who argued inductively that hitherto the farmer fed her everyday, so he will continue to do so forever. The chicken complacently assumed nature's uniformity not suspecting that in a few hours she was going to end up on the farmer's dinner table.

Undeniably it is her cockeyed reasoning that led Russell's chicken to the fatally wrong conclusion; however, its error lies not in overestimating nature's uniformity, but just the opposite, by underestimating it! Solid inductive argument would take into account the much larger uniformity of which a single chicken's appointed lot is but a tiny part of a pattern that emerges from farmyard history. The relevant sample class clearly indicates that farmers almost invariably raise chicken for their eggs and finally for the pot. By focusing solely on her own halcyon days, the hen relied on a flawed sample class, the days before she reached final maturity. It would have been quite all right if she had restricted her generalization to what happens to unfledged fowl, but she extrapolated to her later stages of development of which she had no experience and was thus no longer comparing similar instances.

Other examples which may seem to show as if nature was not uniform in all respects, may be treated in similar fashion. About ten years before the invention of the aeroplane, the eminent physicist Lord Kelvin declared that heavier-than-air flying machines are impossible. His assessment was based on the long history of man's persistent failure at greatly varying attempts to build aerial vehicles. Does the subsequent success of the Wright brothers show nature's lack of unity, since while it is true that indefinitely many machines shaped and powered differently cannot as a rule take to the air, certain specially designed contraptions form an exception to this uniform rule? The answer of course is, no. Aerodynamics is ruled by perfectly uniform laws. The kind of heavy machines that could not fly before the twentieth century continue to be incapable of flying even now, and those which we see flying around nowadays would have been also able to take to the air any time in the past. Lord Kelvin was right insofar as he was referring to the type of machines he was acquainted with, but he happened to go beyond that and argue from a biased sample class.

III

Some philosophers have argued that Mill's principle is vacuous because of the problem that assuming, for example, the color of emeralds to be invariant with time, does not help us to decide whether they are and remain green or rather grue with the passage of time. I shall not deal here with this objection. Those who are still under the impression that the Goodman green/grue problem is a genuine one might want to read a most recent paper clearly explaining why that is not the case.[4]

To present a different way of attempting to demonstrate the vacuousness of the principle one might begin by asking: is there a single instance in the history of science where an inductively well established hypothesis was overturned by subsequent experience? On the surface it might appear that such examples exist: the generalization, 'All swans are white' was based on thousands of supporting observations, yet eventually black swans were sighted; a vast amount of evidence confirmed the long held belief in the immutability of matter, until the discovery of nuclear fission and fusion showed the convertibility of mass into energy, and Newtonian mechanics, which was based on a very wide variety of empirical support had to be replaced by relativistic mechanics, and so on.

On a closer look, however, we realize that such examples of hypotheses once firmly held and later abandoned, do not represent instances where experience violated the principles of inductive reasoning, but rather instances where these principles were improperly applied. For induction to work we must not compare unlike cases, that is to say, we must not make use of biased sample classes. Now, the swans which were all found white were of a different species and were discernible in more than one way from the swans living in Australia; failure of fusion and of fission occurred in the past under temperatures and pressures too low and provided no evidence for what might happen under much higher temperatures and pressures, and all the observations which seemed to support Newton's laws were confined to objects moving with velocities well below the velocity of light.

In fact, examining any of the seeming counter-examples to the principle of the uniformity of nature, will lead to the conclusion that in the past no violation of that principle had ever taken place and the appearance of violation can always be shown to have been the result of the wrong application of the inductive method where we did not argue from similar cases to similar cases. This naturally leads us to the question, as to whether it is even just conceivable that a properly conducted inductive reasoning should yield wrong results, or rather whether whenever we get wrong results it is not always possible to ascribe it to an improperly conducted inductive reasoning? After all, the members of any finite sample class have some feature in common which yet unobserved instances lack. Consequently, whenever we come across evidence falsifying an inductively established generalization, we can attribute this to the fact that some of the features characteristic of the sample class constituted a significant bias, from which no legitimate inference could be drawn.

Regardless of the nature of a generalization, inevitably all its confirming instances occurred on a planet (supposing it to refer to some regularity involving particulars on a planet) revolving around a sun containing less helium than the crucial amount it contains today, (and obviously future instances will lack this feature), or they occurred in a universe where the density of matter—which keeps decreasing all the time—was higher than the value to which it dropped today for the first time in its history, or on a planet the distance of which to the nearest quasar has grown to at least n light years, or they occurred in a universe where the distance between the two closest quasars is less than n light years. Thus the claim that under similar circumstances similar events will take place, is in principle invulnerable; inevitably, there are indefinitely many differences between occurrences at different times, their circumstances are never really similar.

Thus at this stage Mill's principle appears empirically vacuous. If we interpret it to be saying that under entirely similar conditions similar events happen, then it refers to no facts since as soon as they differ merely in time or in space, conditions are dissimilar in indefinitely many of their relational properties. On the other hand, if the principle is meant to convey that under substantially similar conditions (conditions that have no significant dissimilarities), similar events happen, then it is a circular, empty statement; 'substantially similar conditions' appears to mean conditions that do not produce different events.

IV

A defender of Mill might still insist that all this does not prevent his principle from serving as a fundamental methodological rule, saying something like: circumstances that exhibit no dissimilarities of which we have good grounds to believe that they make a difference, are to be assumed to produce similar effects. Given this rule it is conceivable to go even further and attempt to lend empirical status to Mill's principle. It is reasonable to claim that, whether a certain methodology will or will not work, depends on nature itself. It is a fact that scientists have been quite successful in employing the rule to regard sample classes as unbiased unless there is good reason to do otherwise; in spite of some failures, experience has shown that the way things are, lend themselves to be discovered through the methodology recommended by Mill. His principle has thus been empirically vindicated, as it is evident that the universe imposes restrictions on the variability of natural phenomena, since otherwise science could have made no headway at all. However, the substance conferred upon the principle by such a maneuver would be very tenuous. First, we are to be reminded that if our methodology's rate of failure had been twice, three times or five times greater than it actually was, we would still be working with the assumption that differences of which there are no positive reason for believing that they make a difference, are to be disregarded. This is the only rule that has a chance of working: its use leads us to maintain that the regularity observed among the members of the sample class is observed by instances yet to be observed. The alternative would yield nothing: if we were to use it, all we could say would be that in the future past regularities are not going to take place. We would only give up our assumption about uniformity if it always turned out to be false, in which case of course we would have to abandon the entire scientific enterprise. It follows therefore that a blank assertion that nature responds to a methodology based on Mill's principle, fails to indicate how smoothly or grudgingly it responds, it leaves open a vast range of possibilities and conveys little specific information about the kind of uniformity nature exhibited.

I propose to offer a modified version of Mill's principle, one that is by no means necessarily or trivially true, but happily enough nothing in our past experience disconfirms it. The principle states: the regularities governing numerically distinct particulars (or temporal stages of a particular) are invariant with respect to differences too insubstantial to prevent them from being qualitatively identical. In what follows I shall attempt to clarify the distinction between properties that are and those that are not of consequence. At this stage I shall state only that we regard two particulars X and Y to be

> *numerically distinct and qualitatively identical*, iff, X and Y, which occupy different temporal or spatial regions were to exchange loca-

tion, the universe would remain in an identical state.

As we shall see later, the notion of 'identical state' is in this context not to be understood in the strong sense, as the sharing of all properties, but in the weaker sense of sharing all *substantial* properties.

V

There exists a vast set of events and properties which are thought of as lacking in substance that are characteristic of those genuine properties which constitute the material for scientists to study. These have been referred to as 'Cambridge events' or 'Cambridge properties'. Peter Geach cited the examples of Socrates undergoing the change of becoming shorter than Theaetetus, owing to the latter's growth, to illustrate the notion of a Cambridge event.

The following are examples of Cambridge properties (C-properties, for short): being admired by Fred; being forgotten by Herb; being the widest river in Africa; being situated halfway between a large oak tree and a small pine tree; having parents who visited the Louvre during their honeymoon, and existing at a time when the average density of matter in the universe is higher than *d*.

Among the few authors who have dealt more than casually with the topic, we find Barry Miller, who offers some examples and a definition:

> For example the properties corresponding to the predicates '—is famous', '—is shorter than his brother', and '—is temporally prior to his nephew' are clearly not real but Cambridge, since even if these are true of X, his having the corresponding properties may not make the slightest difference to him.[5]

Miller's examples seem to be appropriate, but about his definition one may wonder whether a more precise one could not be found. After all, it does make a difference to X whether, for instance, he does or does not exemplify the property of being temporally prior to his nephew, for that determines whether or not X must have had either a sibling or been married, whether or not he is an uncle whose nephew succeeds him temporally, and simply, whether or not he has or lacks the property of being temporally prior to his nephew. True enough none of these amount to real differences, as all of these are merely differences in C-properties; but surely we do not wish to settle with a definition saying no more than 'having C-properties may make not the slightest difference except with respect to having C-properties'.

It might be suggested that C-properties of a particular X are those that do not manifest themselves in any way within the region occupied by X. Thus even a perfect observer whose observations are confined to that region only, would be unable to determine where X does or does not exemplify the property in question.

Some may prefer an alternative definition: suppose during the interval t_0-t_1, X actually undergoes changes with respect to any number of its C-properties but not with respect to any other. Consider a possible universe U which differs in no respect from the actual universe except that in U the temporal slice, X-at-t_0 and X-at-t_1, of an actual particular X were interchanged. Our universe will be perfectly identical with U. Or more briefly:

> A temporally extended individual X, has undergone changes solely in its C-properties during period t_0-t_1, iff, its temporal slices, X-at-t_0 and X-at-t_1, were interchanged, the resulting universe would remain perfectly indiscernible from the universe in which these slices remained in their temporal location.

VI

While C-properties in themselves constitute no substantial properties, they may be associated with the causing of full-fledged properties. Thus a massive body M situated halfway between two trees may be subject to gravitational forces, and in consequence of the stress undergo a change in shape. It is crucial to note however that the cause of the stress is being located in a continuous field of force stretching from the trees to M. If that field ceased to exist (e.g. the force of gravity was cancelled by an opposing force, or the law of gravity were suspended), M on its own would be in a state indiscernible when 'lying halfway between two oak trees' could truly be predicated of it, from when in a state in which it could not be predicated of it. The only difference between the two cases would be, that the statement 'M lies halfway between two oak trees' was true in the first and false in the second; but no particular would have acquired or lost any significant properties.

It is crucial to realize how radically different the universe would be from what it actually is if C-properties did assume substance: in such a universe, M, when placed midway between two oak trees, even in the absence of a gravitational field, acquires a genuine property i.e. it begins exemplifying the property of 'lying halfway etc.' and in consequence of what now counts as a substantial change, M, may undergo all sorts of other changes in its thermal, electric and other properties.

Another illustration: parents, owing to the lasting impact their honeymoon excursion to the Louvre has had on them, may treat their children somewhat differently than they would have otherwise. The slightest manifestation of this by their offspring will, of course, be a manifestation of a genuine property. We are to realize, however, that the immediate cause generating that property would be the treatment the children receive by their parents, a treatment which was influenced by the latters' experience at the museum. If the newlyweds' visit had absolutely no manifested effect upon their children, except to ensure that the statement about them 'These youngsters parents visited etc.' is true, then the laws of nature do not permit them to develop as a consequence any special, palpable properties. And, of course, visiting the Louvre during their honeymoon is a substantial property, but of the parents and not of their children.

VII

One philosopher who has paid a great deal of attention to the issue of C-properties is Sydney Shoemaker. He has dealt with the topic in detail in his ''Causality and Properties''[6] and more recently in a 1988 paper ''On What There Are''[7]. Among the Cambridge properties, which he also calls ''fishy'' properties he includes: (i) grue—the property that something has, just in case it is green and examined before 2000 AD, or it is blue if examined after; (ii) arbitrary disjunctions or ordinary properties, like being red or weighing thirty pounds; (iii) being 50 miles south of a burning barn; (iv) having once been touched by the drummer of a rock band. (p. 201)

It is hard to see why all these four characteristics should be placed in the same category. Admittedly, (iii) and (iv) lack substance, in that every atom in X may be in identical state with every corresponding atom in Y, even though X is 50 miles from a burning barn and Y is not and X was touched by a drummer while Y was not. But there is nothing insubstantial about (i). If X is green while Y is grue that makes a clearly visible difference to their appearance in year 2000. In addition X and Y will differ with respect to substantial properties at this very moment. An evergreen tree and a tree with leaves that will turn brown in the fall may look now exactly alike but given the law of causality we expect real differences in their structure already existing at present that will account for one of them having and the other of not having the disposition to change its color later.

Nor is there any place for (ii) among C-properties. X which is red or weighing 30 pounds is immediately and clearly distinguishable from Y, which is neither. What one might claim is that though (ii) is not similar to any C-property, it is different from standard properties in that it is a disjunction of two distinct properties and thus it does not constitute a characteristic quality exemplified by all members of any given natural kind. But even this is not so clear. Experts tell us, for instance, that in the case of a certain fish one has to watch whether they have a certain color or weight; a member of that species which lacks that property, i.e. it has neither the required color nor the required weight, is not likely to be fit for human consumption.

We should also note that the reason so many arguments have been put forward in the last few decades as to why we are not to ascribe grueness to certain objects has nothing to do with their lack of substance. 'Grue' has been used as an example of a predicate we are not prepared to apply to something (e.g. emeralds) on the basis of existing evidence (i.e. that they appear green). But there are circumstances under which the evidence clearly warrants it and we have no hesitation in ascribing grue-like properties to all the members of a certain kind. For example, there exists a species of plum trees whose fruit is green in the spring and early part of the summer, but during August it turns blue. It is also the case that there are differences in taste and texture between plums which exemplify the property of being green and examined before August, or blue and not so examined, and plums which fail to exemplify it.

VIII

As indicated earlier I propose to present Mill's principle to be saying (without claiming that this is what he actually had in mind) that the same laws of nature govern all numerically distinct but qualitatively identical particulars. Now if two individuals, or individual temporal slices, A and B, could not be regarded qualitatively identical unless they differed in nothing except in their temporal or spatial location, then not only would the principle remain vacuous, but so also would the entire concept of 'numerically distinct but qualitatively identical'. For if A occurred at a moment in which the whole universe was not precisely identical with itself at the moment in which B occurred, then A and B could not be identical in all their relational properties and would have to be deemed as distinct qualitatively as well. On the other hand, if the universe was in identical states on those two occasions, nothing would appear to keep A and B apart, and no longer would there be any reason to treat A and B as presenting quantitatively distinct entities. I am therefore proposing that a weaker notion of qualitative identity should apply to Mill's principle. Thus while according to *the* ***strong*** *notion of qualitative identity*: A and B are qualitatively distinct if they differ from one another in anything at all in addition to their spatio-temporal location;

according to

the ***weak*** *notion of qualitative identity*: A and B remain qualitatively identical even if they should differ in any number of properties beside temporal and spatial location, as long as they differ in C-properties only.

I shall use concrete examples to illustrate why on the present version, i.e. with the use of the weak notion of qualitative identity, the Principle of the Uniformity of Nature *could* be violated, and that such a violation would cause serious obstacles for the scientist, and thus why there is good reason to share Wigner's joy—in our good luck of finding ourselves in a universe where the principle is not known to have ever been violated.

Let us examine the suggestion referred to earlier that a change in the earth's C-property, such as it reaching a distance of *n* light years from the nearest quasar, might be associated with the breakdown of a certain generalization that held before. Suppose it is known that the melting point of all metals is considerably lowered on the surface of any planet whose distance from the quasar closest to it grows to or beyond *n* light years. Thus here on earth, where before time *t*, for instance, the generalization 'iron melts at 2800° F' held true, after *t*, when the quasar nearest to us, Q, which keeps receding from us, reaches the distance *n* light years from here, all samples of terrestrial irons melt at 1000° F.

We shall assume the principle of the spatio-temporal contiguity of causes and their effects. We can then envisage a situation in which (a) the lowering of the melting point of earthly metals is law-governed, (b) it cannot be explained as having its causal origin in Q, or indeed anywhere outside the earth, (c) it would constitute a violation of the new version of Mill's principle, since the change in melting point would have to be attributed to a change in one of the earth's C-properties, and (d) this would be the kind of phenomenon, Wigner thought might put a brake on the progress of science. Let me explain.

We could know (a) through induction, as mentioned earlier. We postulate that lowering the melting point of earthly metals fails to be accompanied by any changes in the region between Q and the earth, i.e. the space intervening between us has the same properties before and after *t*. Clearly, in that case (b) is true, for it is impossible to refer to the event just described as 'a drop in the melting point of metals being caused by some emanation from Q, affecting us when we reach distance *n* from it', since the purported "cause" is not being mediated throughout the space between its source and the recipient of its effect. We might however prevent this from presenting an instance where a causal influence failed to be propagated uninterrupted in space, by saying that the earth's acquisition of the C-property of 'being n light years away from the nearest quasar' amounts to the acquisition of a substantial property constituting a palpable enough occurrence to draw to itself the associated event of the plummeting of all metals' melting point. This, of course, implies (c), since we would have to concede that a mere change in the earth's C-property transforms it sufficiently to affect the melting point of earthly metals. It is also clear that (d), the universe just described is one which Wigner has bid scientists to be grateful for not inhabiting. In such a universe—which as we have seen is conceptually possible—we would not be dealing with a cause transmitted to us from elsewhere, but only with one residing in the earth itself, i.e. with the event of its acquiring the property of 'being n light years away from Q'. And since at time t, the earth—as indeed at any time, every particular—undergoes indefinitely many changes in its C-properties, we would be hard put to identify correctly the one responsible for the lowering of the melting point of metals.

We are to note that circumstances are conceivable under which (a) takes place as a result of us reaching a distance n from Q, without at the same time any of (b), (c), or (d) obtaining. We could imagine that when the intensity of some type of radiation arriving here from Q declines to an appropriate level that constitutes the cause for lowering the melting point of earthly metals. A clue to this would be comparatively easy to find as we could establish that the effect we receive has been propagated continuously through the intervening space, since any test-particle placed between us and Q is affected in some characteristic manner. In this case, of course, it would be still true to say that the lowering of melting points inevitably follows the acquisition of the C-property of 'reaching a distance n from Q'' but it would be referring merely to the *association* between the two events and not to the existence of a causal link between them; the actual cause of the former would be the absorption of a certain kind of radiation.

A second illustrative example may be provided through considering Fred, the offspring of the couple who visited the Louvre during their honeymoon. Let us assume that such an individual typically has some eccentricity e.g. a disposition to rush out and buy an expensive French painting right after his own wedding. We may then distinguish between two cases:

Case 1: The parents' visit to the museum is the original cause of Fred's postnuptial extravagance. Given the requirement that there be temporal contiguity between a cause and its effect, there are bound to be present during the entire interval between the two episodes some special occurrent properties to sustain Fred's dormant disposition. In other words, even as a baby, Fred was bound to exemplify some peculiarity that is nomically linked to the disposition which emerges only with the completion of the wedding ceremony.

In this case obviously there would be no violation of any version of the Principle of the Uniformity of Nature. We should note also that while our newly wed friend's odd behavior could have been predicted through our knowledge of his parents' honeymoon visit to the Louvre, it is not true that Fred's C-property of 'having parents who etc.' is what caused his behavior; it is only bound to accompany it. The actual cause is to be found in the special occurrent property Fred has been harboring all his life and which was transmitted to him by some peculiar property his parents have acquired in the course of their visit to the museum and continued to exemplify. There is thus no unfilled temporal gap between the original cause, which took place before Fred's birth and its effect taking place on his wedding day.

Case 2: Fred fails to exemplify any occurrent properties that could causally be conjoined with the disposition to be manifested after the wedding. We would then have to save the principle of the temporal contiguity of cause and effect by conferring substance upon the property of 'having parents who visited the Louvre during their honeymoon', which he does not fail to exemplify at any moment of his life. Clearly, in this case there would be a violation of our version of the Principle of the Uniformity of Nature since the mere acquisition of a C-property would prove capable of generating a substantial disposition. Clearly also, this would create the unwelcome state of affairs Wigner referred to, as it should be very difficult to trace the connection between two events with such a wide empty temporal gap separating them.

We have thus seen how it would be possible for nature to fail to be uniform, that is, how when A and B are qualitatively identical (in the weak sense, as they differed in spatio-temporal positions as well as in C-properties), they could nevertheless be governed by different laws. Our version of the Principle of the Uniformity of Nature gives us reassurance that we need not fear that this will ever be the case. It says that it will always be possible to find an explanation for the diverse behavior of A and B in some causes of universally acknowledged substance, which though they may be of remote location, their effects are mediated continuously through the intervening space and time.

References and Notes

[1]*A system of Logic*, (London, 1879), Book 3, Sec. 1.
[2]*Symmetries and Reflections*, (Bloomington, 1967) p. 4.
[3](Belmont, CA., 1966) p. 26.
[4]e.g. by S. Mulhall 'No Smoke Without Fire: The Meaning of Grue' *Philosophical Quarterly*, 1989, pp. 166-89.
[5]''Negative Existential Propositions'', *Analysis*, 1982, p. 185.
[6]In P. van Inwagen (ed.), *Time and Cause*, (Dordrecht, 1980)
[7]*Philosophical Topics*, 1988