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10

Qualities, Universals, Kinds, and the New Riddle of Induction

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In *Fact, Fiction, and Forecast* (1954), Nelson Goodman presented his "new riddle of induction," illustrated by the famous *grue* predicate. The traditional problem of induction, viewed as a problem of *justifying* induction, may be disposed of easily enough, Goodman asserts, by noting that induction is no more justifiable without recourse to inductive arguments than deduction is justifiable without recourse to deduction itself. The justification in either case is circular, and we need not look for anything better; that is, we should not require what is not possible. Whether we accept this dissolution of the traditional justification problem or not, there is still a problem with induction, not to justify it once and for all but to formulate reliable principles that allow us to distinguish good and bad inductive inferences. Extant theories of inductive generalization and confirmation are apparently not adequate in this regard.

Goodman presents his *grue* example to demonstrate this problem. The *grue* predicate applies to any blue thing not observed before a certain fixed time *and* to anything examined before that time and found to be green. If the given time is, say, January 1, 2000, then our current observations of a thousand (so far unobserved) emeralds would disconfirm the generalization that emeralds are *grue*, whereas observations of those same thousand emeralds prior to that date would have confirmed the claim that emeralds are *grue* as much as that they are green. Thus inductive generalizations at different times could lead us to opposite results. How can we decide when this is or is not happening in particular stages of an inquiry?

An understandable first reaction to this example is that the *grue* predicate is simply too strange to warrant serious concern. We need not be bothered by such arbitrary and artificial predicates. The example may even be thought to have some force against Goodman's own nominalism because of its obvious nonsensical results. It may be more to the purposes of sci-

ence to presume that continuity, projectability, and other such "generals" have a kind of reality as much as do individual emeralds. But this kind of reaction moves us in the wrong direction (for the present essay anyway). Goodman's example does apparently illustrate an interesting logical problem. The *grue* predicate is odd because its time dependence is unusual when applied to things like emeralds. But how can we be sure that the sciences and our commonsense beliefs are not peppered with more subtle *grue*-like predicates? The predicates *whale*, *fish*, and *mammal* were misconstrued (ill-defined, insufficiently specified) for some time by many who believed on the basis of selected evidence that whales are fish. The problem in this case is not time dependent but is due to reliance on a too-limited range of observable features of things. The idea of restricting and not restricting observations to a given set of features can play much the same role here that observing before and after a given time plays in the *grue* example. Similarly, in medieval astronomy, evidence garnered, examined, and analyzed over a long period confirmed a system of generalizations involving odd predicates like *celestial sphere* and *epicycle*. Again the problem is not time dependent but involves hypothesis formation that goes way beyond what is directly observable. If we rule out the use of telescopes and other new observational technologies, or if such technologies had not emerged on the scene when they did, there might not be any reliable way to dispel a medieval cosmology. Again, the notion of observing the heavens with and without telescopes plays a similar role that observing before and after a given time plays in the *grue* example.

Could a more carefully formulated theory of confirmation serve to identify such mistakes in a reliable way? How and when do we decide such matters? What are the principles by which we distinguish acceptable from unacceptable predicates that are constitutive of hypotheses confirmed by our experience? How do we deal with potential restrictions on sources of evidence or methods of observation if we have no grounds for realizing that such restrictions are now coloring our view of the world? Is it just a matter of luck and happenstance?

This essay will not address these larger questions to any great extent. Rather, the limited aim here is to explain what Dewey might say in particular about the formulation of the *grue* example. Goodman's problem of distinguishing good and bad inductive inferences (and their constituent predicates) is an important one, but the *grue* example misconstrues this complex problem for certain technical reasons, due to ambiguities that contemporary logical theory has not yet come to terms with.

Goodman's problem is a problem for the theory of induction and thus for logical theory in general. We may safely assume that behind the whole

discussion of these issues over the last five decades is a certain view of logic hammered out by Russell, Carnap, Tarski, Quine, and many others. Goodman's nominalism hinges in essential ways on a certain view of formal logic with an extensional quantification theory at its core. This raises any number of issues, but the one issue most germane to the present discussion is the conception of predicates ensconced in this view of logic. The problem here is the implicit assumption that there is just one type of first-order predicate. Predicate symbols stand for properties and relations that hold for given individuals. The ontological status of these properties and relations, as general terms, is problematic, raising questions such as whether we need to be able to quantify over such things and thus acknowledge them as higher-order individuals in themselves. Several such problems could occupy us here. But underlying all of them is an unquestioned assumption that properties and relations constitute one logical category (symbolized by some indexed collection of capital letters, say, in a recursive first-order grammar). Questioning this assumption is essential, Dewey would say, to dissolving if not solving many of these problems. Before we get locked into any particular formalism like first-order or higher-order quantification theory, and putting aside for now the whole nominalism/realism issue, we first need to acknowledge several distinct types of properties and relations (and respective predicates). Goodman's *grue* example seems confusing just because we have not done this. The force of the argument based on such examples rides on an unfortunate ambiguity in how we regard properties and relations of things.

Dewey casts logic broadly as a theory of inquiry. It is not just a study of formal languages even if this is an integral part of its subject matter. Dewey's notion that inquiry is a clarification and transformation of some concrete problematic situation (1938, chap. 6) is well known. This pattern of inquiry is essentially the basic pattern of experience—a redirection of life activities against disturbances or imbalances (1916, chap. 11; 1925, chap. 1; 1930; 1934, chap. 3)—except that it also involves deliberate observation and experimentation guided by theoretical reflection. In short, inquiry is a type of concrete experience that involves experimentally applied thinking. Of special interest here is the notion that inquiry involves the correlative development and manipulation of both existential and ideational contents:

> Inquiry is progressive and cumulative. Propositions are the instruments by which provisional conclusions of preparatory inquiries are summed up, recorded, and retained for subsequent uses. In this way they function as effective means, material and procedural, in the conduct of inquiry, till the latter

> institutes subject-matter so unified in significance as to be warrantably assertible. It follows (1) that there is no such thing as an isolated proposition; or, positively stated, that propositions stand in ordered relations to one another; and (2) that there are two main types of such order, one referring to the factual or existential material which determines the final subject of judgment, the other referring to the ideational material, the conceptual meanings, which determine the predicate of final judgment. In the words of ordinary use, there are the propositions having the relation which constitutes *inference*, and the propositions having the serial relation which constitutes reasoning or *discourse*. (LW12:310; also see Dewey 1942, LW15:37–38)

This passage ranges widely over matters we need not delve into here. Of particular importance, though, is the identification of two types of ordered relations among propositions, namely, existential and ideational. In his 1938 *Logic* (and in several papers written at roughly the same time: 1935, 1936a, 1936b, 1936c) this distinction serves as the basis for a rather elaborate scheme for classifying different sorts of propositions and their constituent terms. In particular, it supports acknowledgment of three distinct sorts of predicates.

In the first place, we use predicates like *green*, *blue*, *sweet*, or *soft* to denote *qualities* of things. Qualities are not limited to simple or atomic sense data, but they are the most immediate results of exploiting various operational capabilities and observational sensitivities. A so-called particular proposition is one in which a quality is attributed to some discernible *this* or *that*: This is green, that is soft. Things like voter preferences or salary levels as recorded by means of some properly administered survey instrument may just as well be regarded as qualities of individuals in a given population. Presumably there may be qualities of various arities, not just unary qualities. Hence, *this is between that and the other* may be as much a qualitative proposition as any color attribution. A spatial *between* quality may be seen to hold among three or more individuals as immediately as are the color qualities of those individuals. Generally speaking, observational results—data—are constituted by particular propositions in this sense.

Second, some predicates function in inquiry to denote abstract ideas, or what Dewey sometimes prefers to call *universals*. By themselves, universals and the abstract propositions they constitute are not directly subject to inductive methods. They are subject rather to standards of comprehensive systematic coherence. It must be said though that Dewey does not embrace any traditional notion of universals. Dewey identifies ideas as plans of action and thus espouses a kind of operationalism in which ideas designate

possible ways of acting, possible modes of being, abilities to act or be in specific ways, etc. (LW12:289, 350, 516): "Ideas are operational in that they instigate and direct further operations of observation; they are proposals and plans for acting upon existing conditions to bring new facts to light and to organize all the selected facts into a coherent whole" (LW12:116). As denoting possible modes of action, ideas are termed *universals* by Dewey in virtue of their abstract function in inquiry. Possible ways of acting or modes of being, as terms which are functionally universal, are rooted in basic animal abilities tempered by distinctly human cultural forces. Dewey's characterization of universals as abilities or possible modes of action is rooted in a natural history of biological and sociocultural developments. He discusses such genetic matters in the opening chapters of his 1938 *Logic* as necessary background for his logical theory. While genetic considerations are crucial to understanding the functional nature of universals in inquiry, our primary concern here is specifically with that function. Engrained abilities may function as universals insofar as they are possibly relevant and thus available for use in virtually any situation that comes about. Such abilities embody ideational aspects of inquiry insofar as a specimen inquirer has the capacity to consider different options regarding how to act under given conditions, rather than simply being driven mechanically by established habits. Existential conditions will support certain suggestions as to possible options, and these suggestions take on the status of "ideas" when developed symbolically in relation with other ideas (LW12:58, 113, 275, 300, 350). Reflection upon ideational aspects of a problem constitutes a significant portion of our abstract discourse in a given inquiry, including (but not limited to) mathematical discourse (1938, chap. 20). Of particular note here is Dewey's point that universal propositions, stating relations among universals, will be *definitional* in character, ideal, and very likely contrary to fact, as opposed to existentially descriptive (LW12:259–60, 270–71, 300–303, 404–5).

Third, we use predicates in inquiry to denote what Dewey refers to as *kinds*. Classifying an individual emerald as being of the kind *green* (a singular proposition) or subsuming a kind *emerald* under a kind *green* (a generic proposition) differs in important ways both from subsuming a universal *emerald* under a universal *green* and from attributing a quality *green* to some individual emerald. Nevertheless, a kind constitutes a systematic synthesis of such qualitative and universal contents, that is, an integration of existential and ideational contents. If anything is basic in Dewey's philosophy of logic, it is the claim that we cannot rectify an agent's grasp of things in the world except in terms of that agent's operational abilities and possible qualitative outcomes of exercising such abilities. Quality predicates and univer-

sal predicates serve to denote each of these aspects of human experience, respectively. But attunements to kinds, as well-behaved systematic associations of such abilities and the qualitative events to which these abilities provide access, are the primary means by which an inquirer finds structure and meaning in the world. Actual objects serve as actual or potential instantiations of kinds insofar as they are capable of evidencing an array of characteristic qualitative traits resulting from prescribed systematic activities. This sort of classification is obviously subject to inductive methods. Qualitative propositions express supporting (confirming or disconfirming) data for such classifications, while universal propositions should convey whatever systematicity there is in the activities that yield such data. This view of kinds incorporates and integrates operational and empirical meaningfulness into the basic fabric of inquiry, where the operational contents of kinds are directly relatable to ideational matters while the empirical contents of kinds are directly existential in nature.

To illustrate these three distinct sorts of predicates, consider the notion of temperature. (1) Our bodily sense of cold and warmth is a sense of heat-differential qualities. Temperatures, as degrees of heat, are rather what we determine primarily with thermometers. Thermometer readings indicate *qualities* attributable to objects to which thermometers are applied. (2) The *abstract idea* of temperature is grounded in such measurement capabilities, but these remain mere possibilities when the idea of temperature is employed abstractly in relation to other ideas, for instance, in the theory of ideal gases or in thermodynamics more generally. The idea of temperature is meaningful because of its grounding in operational measurement activities, though its full meaning is expanded greatly by explicating its relations to other ideas. Ideas which are not so simply grounded, such as the idea of *energy*, are rendered (more) meaningful by their abstract linkage with ideas like that of temperature. In turn, by virtue of such linkages, temperature qualities (e.g., of objects to which thermometers cannot be applied) may be determined indirectly by means other than thermometers (by registering colors, pressures, electrical potential differences, and so forth). (3) A temperature *kind* may be specified with respect to one or more classes of thermometers and methods for their use and is thus articulated in terms of specifications for the proper use of these instruments and the range of readings possible as results of their employment. *Temperature* as a kind term is inherently a general term applicable in certain existential conditions—integrating the *idea* of temperature (and its abstract links to other ideas) with a respective range of registrable temperature *qualities*. Another kind that we might call *water in a fluid state* would incorporate, among many things,

specifications referring to the kind *temperature* with allowable thermometer readings falling anywhere between zero and a hundred degrees centigrade, excluding readings outside of this range (in a simplest characterization anyway, applicable under usual terrestrial conditions). The point of this example is that we need to distinguish the abstract idea embodied in possible uses of thermometers, the potential readings we get from mercury levels or digital displays, and systematic pairings of these possible uses and their results. This distinguishes three sorts of temperature predicates—a universal, respective qualities, and one or more kinds—all of which function rather differently, though in an understandably coordinated way, in the language of physics. Failing to distinguish these predicates can easily lead to nonsense because predicates are not simply intersubstitutable as we move between existential and ideational considerations in physical inquiries.

So where does Goodman's *grue* example stand in this kind of framework? On one reading, one could essentially treat the *grue* example as an abstract construction, incorporating relevant universals like *green* and *blue*. It would also incorporate abstract conceptions of *time* and *observation*. There is nothing illegitimate here so long as we realize that we are dealing with a system of abstractions. An abstract notion of observation in such definitions must be handled with care, though, insofar as it is a notion employed generally in logical theory and cannot be constrained so easily by its use in specific cases like the *grue* definition. To define a universal *grue* that puts temporal limits on observation processes is not unlike defining *fish* in such a way that one is explicitly limited once and for all to considering only specific features of things to the exclusion of anything else that may later seem to gain relevance, and not unlike condoning only currently used instruments and methods of observation in astronomy to the exclusion of others as they arrive on the scene. Such restrictions may be legitimate for purposes of analytical simplicity (say) or for historical analysis, but it runs contrary to the sorts of concerns we should have when it comes to justifying inductive inferences about fish or planets in light of full-blown contemporary scientific methods. In general terms, proper applications of systems of abstract ideas in concrete inquiries are bound by principles whose incremental development and standing trumps any one abstract definition taken singularly. Over the centuries we have developed a body of guiding principles of good experimental design, of proper methods of testing and confirmation, and so forth. Any abstract predicate whose definition restricts the use of these principles requires that one should not use the techniques of induction properly. It is hardly surprising then that methods of induction are at best difficult to evaluate when considering such a predicate, be-

cause these methods are hamstrung from the start by the predicate's definition. One is inclined to say that the problem lies with the abstract predicate rather than with principles of induction.

On Dewey's account, abstract definitions in and of themselves are not immediately subject to inductive methods. Goodman is mistaken if he thinks that his *grue* predicate is already subject to inductive methods just because it speaks of observations at or before or after a given time. Applying the *grue* definition in concrete situations in such a way as to inductively distinguish grue things is not just an abstract procedure. On another reading of the *grue* example, one could treat it as a concretely applicable system of specifications for a certain kind of thing (as opposed to an abstract universal). Or we could construct such specifications for a certain kind of thing from the definition of a *grue* universal. In either case, one identifies certain appropriate methods of interaction applicable to candidate objects, along with a range of qualities that should result from applying these methods under which conditions. Because Goodman was not sensitive to the distinctions we are working with here, there are several ways to translate his definition into Dewey's terminology. The predicates *green* and *blue* may be taken to denote either qualities or kinds. Similarly, phrases like *after January 1, 2000* and *at or before January 1, 2000* may be regarded as denoting kinds or else as specifying intervals of temporal qualities in a wholesale fashion. The possible combinations of these options make for several ways to characterize the kind *grue*, though they all lead pretty much to the same conclusion here given the simplicity and straightforward correspondence of these particular kinds and respective qualities. Indeed, it is such simplicity and straightforward correspondence that makes it difficult not to run these logical categories together as if they were indistinguishable. The distinction is more salient with kinds like *fish* or *heavenly body*. But we are concerned now with the predicate *grue*. It is safe to read Goodman as if he were wanting to compare and contrast kinds like *green*, *blue*, and *grue*, ultimately to make a point about how their relations to each other and to kinds like *emerald* may be inductively ascertained. The role of the term *observation* here is also flexible, depending on whether we want to read it as a kind term in the language of gemology or as a more general term used in the language of (inductive) logic. One would think that Goodman intends to use this term in the latter sense, and that is how we will take it here. It is a meta-term widely employed in the specifications for any kind term where observational methods applied under certain conditions are linked with expected qualitative results.

On this reading one has to admit the oddity of the kind term *grue* in contrast with kind terms like *blue*, *green*, or *emerald*. Only a simplistic conception of inductive generalization would move us to say that observations of a thousand emeralds at or before January 1, 2000, support the claim that emeralds are *grue* as much as that they are green. This blatantly ignores too much else that is relevant to rational inductive inference. There is more at work here than laws of probability applied to a single sample of a thousand emeralds. If emeralds are grue, then one would predict from the specifications of the kind *grue* that emeralds examined only after the key date would be observed to be blue. Indeed, the very same thousand emeralds observed before the key date, if they had instead been hidden away from all observation until after the key date, would later have been observed to be blue. But why would one expect any such thing of emeralds? Is this a problem for induction, or just a matter of trying to run with an unusual and unreasonable predicate? We can define universals with few constraints other than systematic abstract coherence (which may seem to give Goodman's definition some initial credence), but kinds employed in conjunction with other kinds require systematic *existential* compatibility as well. A thousand observations of emerald colors carry some weight, but the specifications for the kind *emerald* (supported by centuries of observations at or before the key date) also strongly suggest that they do not change colors. Our thousand observations by themselves do not disconfirm their being grue, but everything else we believe about emeralds suggests that other emeralds observed only after the key date will not be blue (and hence that they are not grue). There is nothing particularly reasonable about such a possibility in light of other existential factors of which we are well aware, even if it may seem possible in the abstract. If the possibility of their being grue were to seem pertinent to us, then principles of good inductive method would suggest that we continue to observe new emeralds beyond the key date and to forego judgment until then—no other test is possible except to wait and see. On the other hand, if emeralds are in fact *grue* (relative to some unknown future key date), then we will eventually discover it. Until then, the claim that they are green is far more likely in light of current principles of induction than is the claim that they are grue.

This bit of plain and unsophisticated common sense may not solve the new riddle of induction, but it does bring into question whether the *grue* example is an appropriate illustration of the problem. Note that the unreasonableness of the *grue* predicate is not due to the time dependence in itself but only because this time dependence is imposed within a system of kinds where it is out of place and unmotivated by any sort of existential functionality. What should move us to give any weight to a merely abstract possibility? Instead, consider voter preferences, where timing is crucial. A large enough poll must be taken quickly to obtain a trustworthy snapshot of voter

preferences. Results may change within a short time, so mixing up results from polls taken at different times is not acceptable. That would be as bad as visually ascertaining the color of one emerald against some standard color scheme by applying the color scheme to a second emerald, or calling the flip of a fair coin on the basis of the result of a different independent flip. Suppose we are interested in classifying each of the fifty states as a Bush state or a Gore state, if there are such states at all. This classification would be based on polls taken at different times before and after the 2000 presidential election. Polls in a Bush state would consistently show a preference for Bush before and after the November 7 election. Similarly for a Gore state. For good reasons, we might also be interested in knowing which states are Gush and Bore states. Namely, the kind *Gush* applies to a state if polls there after the November 7 election consistently indicate a preference for Bush, while polls prior to the election consistently indicate a preference for Gore. A Bore state would be just the converse. This example has very much in common with the *grue* example except that timing and a key date are relevant to a meaningful classification scheme. Of course, a state may fall under none of these four predicates, and the idea that voter preferences may be hidden away and not observed until after the key date is feasible but not particularly relevant since voter preferences, fickle as they are, are commonly tied to specific times anyway. In any case, observations of preferences before and after the key date make all the difference, and identical results over any significant time span cannot generally be assumed on the basis of past experience. Before the election, a state may be showing signs (from a thousand different surveys) of being a Gore state, and hence a potential Gush state, but we are not inclined by any principles of good inductive inference to infer that the state is both. In fact, as levels of support for the one conclusion rise, levels of support for the other decline (though any such conclusion would have to be offered rather tentatively given what we know about voter preferences and the contingencies of election politics). The point is that in a domain like this where time dependence does make a meaningful difference, the principles of good inductive inference seem to function well enough with a grue-like predicate.

Of course, it does little good to counter a counterexample with an example. But the point here is to illustrate how the ideas employed in the *grue* example are applied in a domain where they have no obvious existential relevance. When applied to domains where they do have such relevance (such as with the *Gush* predicate), the alleged problems for inductive inference would seem to evaporate. Thus it is not clear that the *grue* example has any significance for the general problem of distinguishing better and worse inductive inferences.

Nevertheless, the new riddle of induction remains an important concern. In fact, one might argue that it will always be an important concern as new tools, methods, and principles of better and worse inquiry continue to emerge in the ongoing cumulative development of human experience. Such developments potentially bring results of past experience into question, including existing principles of logic itself. But this is and always has been *the* problem of logic in general as an open and unfinished science. It is hardly a new problem at all.

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