Making Worlds with Symbols

Paul Teller

prteller@ucdavis.edu

Abstract

I unpack the metaphor of “Making worlds with symbols” with the Kantian attitude that all our cognitive contact with the world, including perception, is representational. Using two ideas, Carnap’s frameworks and Stalnaker’s common ground that I take to illustrate the metaphor, I develop a broader conception of frameworks. I then develop and defend my main thesis, that all our framework bound access to the world is through frameworks that stand to be improved in accuracy, precision, and usually both. Such improvement is characterized in pragmatist terms.

 I take the idea of “making worlds with symbols” to be a metaphor. This paper will examine ways of unpacking the metaphor and repercussions for how to think about the human epistemological enterprise.

Part I

 **1. Unpacking the metaphor.** I start with the intuitive thinking that I take us generally unselfconsciously to deploy, that we open our eyes and passively see things just as they are – for which I will use the term “direct realism”[[1]](#footnote-1) I open my eyes and see the chair before me, just as it is. I am not aware of any intermediary. Visual perception – and direct realism – are “transparent”.

 But does vision give us “direct”, “transparent” access to objects of perception?

 Instruments give us no such access. In the first instance an instrument gives us concrete representations, no “direct access” to things “just as they are”.

 Can we do better with perception?[[2]](#footnote-2) Perceptions are the end product of complex causal chains. The end product has intentionality, in the sense of being about things. Perceptions have correctness conditions. Perceptions can count as misperceptions, and fairly so described we have misrepresentations. These are the marks of representation. On the grounds of these briefly stated reasons I will take all perceptions to be, or constitutively to involve, representation.[[3]](#footnote-3) Worldly access by perception is relevantly similar to access through instruments in that both work through representational access.[[4]](#footnote-4) We take there to be a world full of stones, people, planets, galaxies, microbes, atoms, quarks…. But we have no access to things independent of us except in terms of the representations that we form with instruments or that nature forms for us in our perceptual representations.

 A corollary: Evaluation of the accuracy of a representation can only be through comparison with other representations. There is, logically, no such thing as putting a representation right up against an object and seeing if the representation “fits”, apart from any representation of the object. For example, I represent the fire engine as (largely) red. Is that right? Well, it *looks* red. But this perception is just another representation. I put a color sample up against the fire engine to see if the colors match. But ultimately what I compare is my perception – a representation – of the color patch with my perception – a representation – of the fire engine.

 Let us work to reconcile the foregoing considerations with the ubiquitous “transparency” of visual perception. Most visual experience has a “transparent quality”.[[5]](#footnote-5) We are usually not aware of experiencing. Rather, one wants to say, it is the target of perception of which we are aware. It is the fire engine that I see, the fire engine in its redness.

 This expression of perceptual transparency is problematically factive. To say that in looking I perceive the fire engine and perceive its redness is to presuppose that there is a red fire engine there. Such factive expression of transparency is hard to square with the representation-bound nature of our experience of an independent world. Hallucination can have the same “transparent” quality. So let’s instead try saying that (usually) we experience experience as transparent. This works as long as we are careful not to hear this as saying that we have first a transparent experience and second a “higher order” experience of the first order experience as transparent. Instead to say that we experience experience *as* transparent is to be heard as shorthand for saying that visual experience, or most of it, has a quality or nature described with the word “transparency”, which quality is characterized by saying that we are not aware of having the experience but rather the experience is as of things independent of us. This statement is neutral with respect to the further claim that there is a specific target of the experience, such as the red fire engine.

 To get the statement of transparency right I had to use “experience as”. An older philosophy of science literature argued that all, or most, (visual) experience is experience *as* so that experience, as all representation, has an interpretive element at its core. One line of argument considerers the phenomenon of gestalt switches, where the interpretive element is what prompts or underlays a gestalt switch, and all (or most, visual) experience involves the sort of interpretation apparent in gestalt switches even when there is no switch available.

 It is most important to note that all the foregoing is consistent with representations being of things in, aspects of, perspectives on a world independent of us. In Chiramuuta’s phrase, experience, instruments, and theory all “put us *in touch with* a reality beyond observations, and sensory appearances” (2015a, MS p. 21), even if what we are put in touch with might not be external objects as we take ourselves to see them. We know that our representations generally address something independent of us because we have only the most fragmentary control over how most of our representations play out. What is called into question is any “transparent”, “direct” access to things “just as they are”. Indeed my central thesis will be that all our representations, perceptual and theoretical, are at best partial, perspectival, incomplete, and always refinable ways of understanding an independent reality that is incomprehensibly more complex than any of our humanly accessible representational powers can present.

 The foregoing considerations provide a way of understanding the metaphor. Exceptional cases aside, we don’t make things with symbols. But our only access to extra symbolic things is through things we do make, or to which nature gives rise within us – representations. So the content of (or one way of understanding) the metaphor is that in the first instance all we have in our knowledge of and any perceptual or conceptual interaction with the world is our representations. (Immediately there is a worry: is this a latter day, representational idealism? I will return to this at the end of the paper.) Because at least most visual experience is experienced as transparent, the relation between us, our representation of things through perception, and the world is something that we generally don’t notice. And with this relation obscured in the case of perception, it is also easily missed for theoretical knowledge.

 **2. Carnapian frameworks as an illustration of “making worlds with symbols”.** My objective is not Carnap exegesis. Rather I aim to set out an example of “making worlds with symbols”. Subtitles of Carnap exegesis are not here to the point.

 Carnap is concerned with what he takes to be the vacuity of traditional metaphysics. His first sentence in his (1956) is “Empiricists are in general rather suspicious with respect to any kind of abstract entities like properties, classes, relations, numbers, propositions… [and more broadly with traditional metaphysical issues].” (p. 205) For example, we take ourselves to perceive ordinary physical objects: stones, chairs…. But are these philosophers’ “material substances”, Berkeleian “ideas”, some kind of Kantian “empirical phenomena”? Carnap aims for a “rational reconstruction” that sidesteps all such issues.

 To exclude such metaphysical worries Carnap wants us to work with –or within - what he calls “frameworks”. Here is Carnap’s initial statement (As the next quote makes clear, what he here says about “new” kinds of entities goes in the same way for familiar ones):

If someone wishes to speak in his language about a new kind of entities, he has to introduce a system of new ways of speaking, subject to new rules; we shall call this procedure the construction of a linguistic *framework* for the new entities in question. And now we must distinguish two kinds of questions of existence: first, questions of the existence of certain entities of the new kind *within the framework*; we call them *internal questions*; and second, questions concerning the existence or reality *of the system of entities as a whole*, called *external questions*. Internal questions and possible answers to them are formulated with the help of the new forms of expressions. The answers may be found either by purely logical methods or by empirical methods, depending upon whether the framework is a logical or a factual one. An external question is of a problematic character which is in need of closer examination. (p. 206)

 For example, to discuss and study ordinary physical objects we set up, or endorse a previously familiar “material object framework”:

Let us consider as an example the simplest kind of entities dealt with in the everyday language: the spatio-temporally ordered system of observable things and events. Once we have accepted the thing language with its framework for things, we can raise and answer internal questions, e.g., "Is there a white piece of paper on my desk?" "Did King Arthur actually live?", "Are unicorns and centaurs real or merely imaginary?" and the like. These questions are to be answered by empirical investigations. Results of observations are evaluated according to certain rules as confirming or disconfirming evidence for possible answers. (pp 206-7)

Further in the article Carnap continues:

The thing language contains words like "red," "hard," "stone," "house," etc., which we used for describing what things are like. Now we may introduce new variables, say "*f*," "*g*," etc., for which those words are substitutable and furthermore the general term "property." New rules are laid down which admit sentences like "Red is a property," "Red is a color," "These two pieces of paper have at least one color in common" (i.e., "There is an *f* such that *f* is a color, and . . ."). The last sentence is an internal assertion. It is [sic] an empirical, factual nature. (pp. 211-12)

 I summarize the idea that I take Carnap to be developing in this way: A linguistic framework for ordinary physical objects begins with a language with constants and variables interpreted as referring to and ranging over what we call “physical objects” and similar language for properties and relations. The framework includes rules about how to use this language, how to move from one sentence of the language to another, including rules of evidence – conditions
(also described in the physical object language) under which a sentence is to be accepted, assigned a probability, or the like. I note that we learn to use these rules in the way that we learn a skill. In Carnap’s formulation:

Results of observations are evaluated according to certain rules as confirming or disconfirming evidence for possible answers. (This evaluation is usually carried out, of course, as a matter of habit rather than a deliberate, rational procedure. But it is possible, in a rational reconstruction, to lay down explicit rules for the evaluation…) (p. 207 )

We incorporate our distain for the metaphysicians’ “matter”, “abstract objects” and the like by simply not including any such terms in the language of the framework. Carnap gives further frameworks: a number framework, a framework for talk about meanings and propositions, etc.

 Within a framework, basic existence questions count as internal questions and can be trivial. For instance, within the number framework consider the statement,

’There are numbers’ or, more explicitly, ‘There is an *n* such that *n* is a number.’ This statement follows from the analytic statement ‘five is a number’ and is therefore itself analytic. (p. 209)

Within the physical object framework “There are physical objects” will follow from “Chairs are physical objects”, given by the language’s rules, together with “I am now perceiving a chair”, that, in the right circumstances will be endorsed by the acceptance rules of the framework.

 Carnap contrasts his internal questions with external questions:

From the internal questions we must clearly distinguish external questions, i.e., philosophical questions concerning the existence or reality of the total system of the new entities. (p. 214)

Carnap rejects external questions. With regard to the example of talk of properties, he writes:

[T]he external statement, the philosophical statement of the reality of properties … is devoid of cognitive content. (p.212)

 And generally,

An alleged statement of the reality of the system of entities is a pseudo-statement without cognitive content. (p. 214)

 How, then, are frameworks to be judged and selected? Carnap writes: When we have introduced a framework

[w]e may still speak (and have done so) of the "acceptance of the new entities" since this form of speech is customary; but one must keep in mind that this phrase does not mean for us anything more than acceptance of the new framework,… To be sure, we have to face at this point an important question; but it is a practical, not a theoretical question; it is the question of whether or not to accept the new linguistic forms. The acceptance cannot be judged as being either true or false because it is not an assertion. It can only be judged as being more or less expedient, fruitful, conducive to the aim for which the language is intended. (p. 214)

In Carnap’s system the only basis for choosing a framework are pragmatic considerations. My only basis for choosing a framework is that it works well enough for me for the subjects to which it applies. If it no longer works well enough I will modify the framework or look for an alternative. What will count will be a framework’s practical efficiency, the balance, judged intuitively, not by any rules, between the results achieved and the amount and complexity of the effort required.

 I suggest that Carnap’s system of frameworks provides a nice example that fits the metaphor of “making worlds with symbols”. While working with or “within” (Carnap’s term in the quotation from page 206 above) a framework one generally applies it without question. For the most part Carnap uses “acceptance” with reference to accepting a framework, but he also comments that

The acceptance of the thing language leads on the basis of observations made, also to the acceptance, belief, and assertion of certain statements. (p 209)

such as answers to questions like "Is there a white piece of paper on my desk?" and "Did King Arthur actually live?", (pp. 206-7) Likewise, within a framework for mathematics we use referential language, without questioning its appropriateness, in statements such as “5 is a prime” and 5 is larger than 3”. (Below I will further develop such activity in terms of the idea of using “the tools of reference”.)

 It is at least a natural gloss of Carnap on his frameworks to say that, like perception, working within a framework has a kind of “transparency” about it. Carnap does not say anything like this explicitly, but it fits his examples and is, in any case, a natural way to take his frameworks.[[6]](#footnote-6) By working within a framework we are using symbolic tools to build up a perspective on the way things are. I submit this as an example of unpacking the metaphor of “making worlds with symbols”.

 In preparation for material below I need to say a little about the epistemology implicit in Carnap’s system. Carnap’s treatment of internal vs. external questions cuts short any regress of justification in epistemology. The rules for applying the sentences of a framework are part of the framework. Of course the rules of a framework themselves may include guidelines for changing rules of justification that are not basic within the framework. But any such framework will have basic epistemological rules that can only be changed by changing what counts as the framework; which, again, for Carnap, can only be based on pragmatic considerations for which there are no rules. The whole framework is rejected or accepted as a package deal on the basis of intuitively evaluated practical considerations, not on the basis of any rational procedure that, objectively, is either correct or incorrect.

 For these reasons Carnap’s method of frameworks counts as anti-foundationalist in epistemology. By epistemological anti-foundationalism I understand the view that within any specific situation one must work, at least tacitly, from some bottom level epistemological principles or methods. But these admit of no absolute justification or status in the sense that there are no rationally privileged epistemological principles, privileged for all projects and all frameworks.[[7]](#footnote-7) There may also be various epistemological frameworks designed to give epistemological advice for or work within other frameworks: A system of statistical methods, or philosophical theories such as empiricism, reliablism, coherentism, virtue epistemology, or epistemological naturalism. I would think that Carnap should be happy to consider any such as an epistemological framework that one might decide to use. What Carnap would reject, as an external question, would be any question of which such framework might be uniquely correct.

 Because Carnap's target was traditional metaphysics, for Carnap the issues of external questions vs. frameworks and their internal questions are inseparable. However, for other problematics the issues might come apart, as we will see in the next suggestion for fleshing out our metaphor.

 **3. Common ground and personal platforms**. Carnap’s frameworks has affinities with the more recent idea of “common ground”. I stress that common ground and Carnapian frameworks share some features but diverge on others. The differences themselves will be of interest.

 Stalnaker[[8]](#footnote-8) notes that for a conversation to go smoothly there must be a body of assumptions on which the participants agree. If not, the conversation could never get started. The agreement is usually tacit; and whether tacitly or explicitly, each interlocutor assumes that all in the conversational circle share the assumptions. Stalnaker refers to these background assumptions both as the conversation’s “presuppositions” and the conversation’s “common ground”.

 The common ground is not fixed in stone. A interlocutor may always ask that a background assumption be reevaluated or rejected. And each individual participant need not actually believe all the assumptions in the common ground. A participant may privately believe that some assumptions are not quite right or even very wrong. But if the participant is confident that the error in question will not compromise the objectives of the conversation, s/he will be happy to treat it as true. “True” here is understood as “just plain true”, no questions asked, while “treated as true” is understood as, “no questions asked, at least for present purposes”. I add to Stalnaker’s explicit analysis: To treat a statement as “just plain true” is also to treat it as if it were in no way vague. For example, conversationalists may all agree that John is short. Suppose that what is at issue is Mary’s identifying John when she picks him up at the airport. And we all agree that John is short enough so that Mary will unhesitatingly classifying him as short. Then, for purposes at hand, when we tell Mary that John is short we are treating “short” just as we would if the term were not vague.

 The phenomenon of common ground is actually very widespread. We see another example of the same kind of idea in Kuhn’s notion of a paradigm, what he later called a disciplinary matrix, in normal science.[[9]](#footnote-9) A scientist cannot always be reexamining first principles or methods that have already been found to work satisfactorily for the kind of question at issue. As apprentices, science students absorb the elements of a disciplinary matrix, and in the normal course of things use these elements without question, both in their own work and in communicating with others in their discipline. More broadly, in our very day life there is an enormous amount that we usually take for granted and that we take for granted that others take for granted. That the coins in my pocket will be taken as legal tender, the reliability of a common street map, and so on. Common ground can be culture wide. It can also be localized in an individual. In getting around in the world each one of us individually takes an enormous amount for granted. Without such personal common ground – what I call a “personal platform” - everyday activities would not be possible.

 I submit this expanded notion of common ground as a second example illustrating the idea behind the metaphor of making worlds with symbols. When working within a common ground, competing ways of thinking get put aside. To a greater or lesser extent the body of thought constituting a common ground will be unselfconsciously taken for granted. Of course an interlocutor can be very self-conscious about what is treated as true for the purposes at hand. But often the opposite. I would think that this will vary greatly from person to person and case to case. Quite likely there will also be cultural variation. But efficiency of communication and deliberation put a premium on letting drop out of self-consciousness the possible limitations on what is assumed “for present purposes”, even when those presuppositions might be quickly questioned in other contexts.

 In sum, on the whole a common ground will have, to lesser but often greater extent, the kind of quality that I have been calling “transparency”. For present purposes we take what we are presently saying and thinking as just the way the world is, as a perspective on how things are, which we can express metaphorically as a way of “making a world with symbols.”

 **4. Comparing and extending the ideas of frameworks and common ground.** In a central respect, common ground and personal platforms have much in common with Carnap’s frameworks. While working within a Carnapian framework the basic assumptions and rules are accepted without question, accepted as a basis for answering internal questions, which is just to treat them as common ground in the expanded sense that I have suggested. So Carnap’s frameworks and Stalnaker’s common ground, qualitatively, share the feature that makes each of them an illustration of how one might think of “making worlds with symbols”.

 But in other respects there are important differences. Most prominently, for Carnap, there is no stepping outside a framework and judging its truth or accuracy, while for Stalnaker’s common ground, as well as my extension, this makes perfectly good sense and is something we do all the time.

 I have already extended Stalnaker’s notion of common ground. A parallel extension of Carnap’s system of frameworks brings the two extended systems more closely together. As Carnap presents frameworks they function as islands. There is no stepping outside of any one of them for objective (as opposed to pragmatic) evaluation. But preserving much of Carnap’s attitude we can elaborate, taking individual frameworks to be subsumed by larger ones from the point of view of which the one included might be evaluated. We can take frameworks to overlap, for material in one to be used in others, and so on.

 So far my elaboration of Carnap’s system of frameworks is completely at odds with the original in the following way. I have relativized the internal/external question distinction. For Carnap the distinction was binary. In my elaboration, relativized external questions will make perfectly good sense where Carnap asserted his absolute external questions to be “pseudo-questions without cognitive content”.( p. 214) But Carnap gives no argument or rationale for this claim![[10]](#footnote-10)

 I have extended Carnap’s thinking, as I think we must, by allowing frameworks within frameworks. Indeed, if, as Carnap allows, we are free to set up what frameworks we like, we can set up nested and overlapping framworks.[[11]](#footnote-11) This admits an option that Carnap does not consider, of a master framework, one framework that encompasses all others. (We wave the worry that thinking in terms of just one master framework is so hopelessly idealized that it need not be considered in the project of understanding the nature of human knowledge.) Such an option would then raise the further question: Are there alternative choices for a master framework, all being equally rational to chose?[[12]](#footnote-12) Or is there only one, uniquely correct or uniquely rational framework? On the first option choices of a master framework would be made on exactly Carnap’s sort of pragmatic grounds. So the option is relativist, but precisely in the way and to the extent that Carnap’s is. There are no principled grounds on which to choose a (master) framework. But “the world” is always going to sensor unfortunate choices. Ones that don’t work will quickly be abandoned in favor of others. So these are no “anything goes” sorts of relativism.

 The second option, of only one, uniquely correct or uniquely rational framework, is also one that many of Stalnaker’s readers might tacitly presuppose. In Stalnaker’s original formulation he considered only the common ground of a localized conversation, where interlocutors might well privately disagree with assumptions made for the purposes of the conversation. Easy to step outside of a conversation and ask of any of its presuppositions, is it *really* correct. Presumably, such questions not only make perfectly good sense, but when the right justificatory conditions are satisfied (and what we assert is in fact true) such conversation independent renderings are just what counts as knowledge.

 I have two reasons for rejecting this option. I reject the epistemological foundationalism that is there supposed. I have elsewhere argued this at length (2011a) and will not comment on it further here. Second, the consideration that I develop in this paper, I think that one fixed overarching framework (again, supposing one wants to consider this at all) is ruled out by the circumstance that things are too complicated for us ever to get anything exactly right. Below I will explain more carefully what I intend by this claim, and the balance of the paper will be devoted to arguing for it.

 Collecting these considerations, we see a lot in common between my extensions of both Carnap’s system of frameworks and Stalnaker’s characterization of conversational common ground. The position is stronger than either in that I have greatly extended both. In one respect the position is weaker than Carnap’s original because metaphysics is no longer cast as “without cognitive content”. I feel this weakening is needed because of the absence of any sharp distinction between the “empirical” and other rule governed statements. But, given the rejection of foundationalism, the position is still close to Carnap’s spirit in that, at best, metaphysics can offer systems of thought that one is rationally free to embrace or reject.[[13]](#footnote-13)

 One more consideration on how I want to think of the idea of frameworks as I have developed it. I cited Kuhn’s notion of a paradigm or disciplinary matrix as an example. It is easy to read Kuhn in (1962) as thinking of paradigms as well defined packages with clear boundaries, and then offer a superficial objection that systems of thought in science are anything but. Instead one has to read Kuhn as advancing the idea of a paradigm as an simplification, as an idealization, as an ideal type. The type is exemplified nowhere in its ideal form. But thinking in terms of the ideal type allows us to see important things about the structure of scientific inquiry that would otherwise be obscure. When it comes to frameworks more broadly, as I mentioned above, in the real world things get very complicated. The idea of a framework in my extended formulation should also be thought of as an ideal type.

 A lesson learned from Stalnaker’s original formulation, absent from Carnap’s, is that often we do just fine with assumptions that are not perfectly precise and/or not perfectly accurate. This can be because, though we are capable of greater precision and accuracy, present purposes don’t require them and we are better off with a simpler framework. Or, though we don’t have full precision and accuracy, what we do have will suffice for what is to hand. When such circumstances obtain, thinking in terms of frameworks is an excellent way to organize our thinking about how we navigate with one or another imperfect symbolic map of how we take things to be. Because there is always room for improvement, organizing in terms of frameworks is always called for. In Part II I will argue that, with one small exception, all human knowledge has such limitations; and I will illustrate ways in which thinking in terms of frameworks functions well in managing our always limited and refinable cognitive contact with the world. Having developed my own idea of frameworks, taking inspiration from both Carnap and Stalnaker and noting similarities and differences all the way around, I will henceforth speak in terms of frameworks as I have developed the idea.

Part II

 **5. My thesis: All human knowledge is inexact.** I need a distinction between two kinds of limitations on any specific instance of knowledge: inaccuracy and imprecision. A statement is inaccurate to the extent that it misdescribes. A statement is imprecise to the extent that it is not specific about what it says about the world. I am using “precise” and “imprecise” differently from the usage in the sciences. As I will understand it, imprecision either is, or is a broadened species of vagueness. This is in agreement with usage in the vagueness literature. For example, throughout his (1994) Williamson uses “precise” as the antonym of “vague”. And I will use “exact” for “both accurate and precise”, “inexact” for “either inaccurate, imprecise (or both)”

 I take inaccuracy and imprecision to be “two sides of the same coin.” One can tradeoff one for the other. For any not completely precise statement, if one makes it more and more precise eventually it will become in some way not completely accurate. And given an inaccurate statement one can sweep the inaccuracy under the rug by making it suitably imprecise. For example, suppose that John is 179cm tall. Then “John is 180cm on the nose” is false. But “John is close to 180cm” and “John is tall” are true.[[14]](#footnote-14) This duality of (in)accuracy and (im)precision will be illustrated below, but the arguments of this paper will not depend on it.

 Now the thesis: Henceforth I will take it for granted that one is always working within one or another framework. I will argue that all framework-bound knowledge is inexact in the following sense: Given the claims made in a first framework one can expect there to be a second framework that improves on the first by broadly pragmatic standards. That is, treating the second framework’s authorized claims as true will succeed at least as well as the authorized claims of the first framework, for a wide range of practical concerns. And also, by the same pragmatic standards, in some respects the second framework succeeds better than did the first framework. This relation is further secured when, from the point of view of the second framework, one can explain the successes and failures of the first framework’s degrees of precision and accuracy.[[15]](#footnote-15)

 I have two qualifications of this very broad claim. First, the claim plausibly fails for combinatorial facts, logic, broadly finite mathematics. But as soon as mathematics becomes rich enough to support the incompleteness results we have the specter of “unintended interpretations” that bear at least strong analogies to the kinds of problems that I will detail below. The systematic exception of finite mathematics will henceforth be understood.

 The second, and much more important qualification: The world is changing so fast, none of us can have a good idea of what the distant future may bring. I take my task as an interpreter of human knowledge to understand it as it now exists and will exist as long as it is subject to anything like the limitations now in play. With this caution in mind, and with the exception of finite mathematics, my thesis is that all human knowledge is, and within any present intellectual horizon will be, inexact.

 The following sections argue for this thesis very broadly.

 **6. Inexactness of theoretical knowledge I: Scientific knowledge ubiquitously fails of complete accuracy and/or complete precision.** In this section I will not contest the scientific realists claim that we succeed in referring to “unobservable” entities such as electrons, nuclei, and larger ones such as chromosomes and mitochondria. Even accepting this realists’ claim “for the sake of argument”, all theoretical knowledge is inexact: There are, first of all, failures of accuracy. All hands agree that a great deal of theoretical knowledge involves idealization, where I understand “idealization” extremely broadly to cover inaccuracy of any sort. Even what many say is the most accurate of our physical theories, quantum field theory and general relativity, are highly idealized.[[16]](#footnote-16) There are apparent exceptions: Conservation laws. Constancy of speed of light. On closer examination it turns out in all such cases that the claimed law *is* true – but only within an idealized theory. Conservation laws reflect symmetries in nature - but exact symmetries are always idealizations. The speed of light is constant – but only in a perfect vacuum and there are no perfect vacua.[[17]](#footnote-17) A system of such idealizations nicely illustrates the idea of a framework. Such generalizations are taken as true because they are true (would be true) in worlds (if the world were one) in which the idealizations hold. But usually we put it aside that we are working within a framework that simplifies the world with the idealizations in question.

 There are also failures of precision. It would appear that a great many of our theoretical claims are true without qualification. Consider, for example the claim that water is H20. Most will accept this as true without qualification. But it is true only by dint of taking both “water” and “H2O” as imprecise terms. As soon as both are made more precise the claim fails in face of the complexities of water chemistry.[[18]](#footnote-18) This example illustrates the tradeoff between imprecision and inaccuracy. If “Water is H20” is understood sufficiently imprecisely, the imprecise statement counts as true. But clean up some of the imprecision and the statement quickly fails.

 I know of no exceptions. All scientific knowledge is inexact, that is not completely accurate, not completely precise, and very often both.

 **7. Inexactness of theoretical knowledge II: Failure of referential realism.** Scientific realists agree with the conclusions of the last section, agreeing, in their terminology, that even mature theories are at best “approximately true”. Wherein, then, the realism? The realism rests in the claim that we have successfully identified theoretical entities, such as nuclei, electrons, electric charge…. Realists agree that our knowledge of such is idealized and so not completely accurate, which is enough to agree with the last section’s conclusion. In this section I will problematize the residual realists’ claim of successful identification of theoretical entities.

 For the exposition I need to set out a compact way of speaking about some very familiar ideas . Assumptions expressed with these ideas usually operate “in the background” without being made explicit. (More unnoticed components of frameworks!) Making these assumptions explicit will be crucial in setting out difficulties that are otherwise not apparent precisely because one does not appreciate the role of what we generally presuppose.

 Our perceptual rendering of an independent world yields experience of a world as populated with independent physical objects: stones, chairs, trees, (bodies of) people…. In most situations we take there to be facts of the matter concerning questions of identity. Is this the same stone as the one on which I stubbed my toe yesterday? Is the chair you have delivered the same one that I purchased in your showroom? Is the diamond in my ring the same one that I left with you yesterday for cleaning?

 In logic and philosophy we have regimented such concerns with what I will refer to as “the tools of reference”, referring terms as having specific referents and predicates as having specific extensions (or extensions at a time). For a given predicate it is assumed that there is, for each object, a fact of the matter whether or not that object is in the predicate’s extension. These tools of reference are then elaborated with the methods of quantification.

 Crucial for the tools of reference is the inclusion of strict, also called numerical, identity. For two referring terms, ‘*a*’, and ‘*b*’, supposed both to have referents, it is assumed that there is always a fact of the matter whether or not *a* = *b*, that is, whether the referent of ‘*a*’ is the very same, numerically identical thing as the referent of ‘*b*’. Quine: “No entity without identity!” (1957-8, p. 20) As mentioned, I take the tools of reference to have their source in our everyday thinking about ordinary physical objects. They then get applied in taking about “unobservable objects”.

 I will appeal to the tools of reference in a restatement of conventional scientific realism. The familiar statement is, for example, that

To be a realist about atoms just to say that there are atoms, or that atoms exist.

I will recast this statement using Carnap’s distinction between material and formal mode statements of the same claim.[[19]](#footnote-19) Given any statement one conveys the same content by asserting the correct application of the terms used to make the statement. My application: We can restate the claim that there are atoms as the claim that “atom” has a non-empty extension. Generalizing on the last example,

Referential realism: To say that x’s exist to say that ⌜x⌝ has a non empty extension.

Referential realism captures the intent of what most intend by “scientific realism”.

 Much of the argument will appeal to problems with quantum mechanics. First a very general point: All interpretations of quantum mechanics are controversial. So adopting an interpretation is already, at a very general level, to be working within a framework. Let me illustrate with the one class of interpretations to which my arguments below do not apply. One can declare at the outset that we will take quantum mechanics to have classical, discrete, and identity bearing objects for its subject matter, things to which the tools of reference apply. Then one does ones best to tailor the theory to fit with this framework assumption. A great deal of work has been done on such an enterprise, what is known as “Bohmian mechanics”. Of course, Bohmians believe that an elaboration of work so far accomplished will develop the “one uniquely right” account. Bohmians are a long, long way from this accomplishment. Within any present intellectual horizon, to take the tools of reference to apply within a Bohmian interpretation is to adopt a highly imperfect framework, one that cannot be conclusively argued on general grounds, and insofar the tools of reference apply only within a framework a choice that is a matter of intellectual taste.

 Given that all interpretations of quantum mechanics are controversial, the kind of framework relativity illustrated by Bohmian mechanics applies very general. In addition, on other interpretations, as I will now argue, the tools of reference do not apply. This is of importance insofar as we do use the tools of reference for matter at a larger than quantum scale. In this way the interpretive situation illustrates an important way in which we use the tools of reference only within frameworks that work excellently for what they are intended but which are clearly inexact, not exactly correct. These limitations apply, as I will argue further down, for almost all human knowledge at the larger than quantum scale.[[20]](#footnote-20)

 On two interconnected and widely accepted interpretive constraints scientific realism, interpreted as referential realism, fails. To speak neutrally, let us talk about “quantum phenomena” and then ask whether quantum phenomena can be understood in terms of referential realism. The first interpretive stance to which I appeal takes any ontology for quantum mechanics to, somehow, recognize both object-like and wave-like characteristics. The particle like characteristics show up in the circumstance that observed quantum events must be localized in extremely small spatial volumes. The wave-like characteristics show up in the circumstance that a great many individual quantum phenomena can only be understood in terms of superposition.[[21]](#footnote-21)

 The second interpretive stance rules that, insofar as a quantum ontology involves particle-like features at all, these have to be understood not as classical particles or objects but as what I call quanta.[[22]](#footnote-22) The conception of quanta contrasts with that of particles understood classically. Classically, particles can be the referents of terms and treated with the tools of reference. In particular, if some classical particle is the referent of ‘*a*’, some particle the referent of ‘*b*’, then there is always a fact of the matter whether *a* = *b* or not. Furthermore, if *a* ≠ *b*, then for any property, P, the circumstance that Pa & ~Pb is a distinct possible case from ~P*a* & P*b*. As a specific example consider a case in which there are five objects in a box. Then there is a fact of the matter, which one did you put in first, which second… I will speak of the “cardinality” of a collection of objects for which there is the illustrated factual distinctness between the individual objects.

 In contrast to classical particles, quanta are an ontology that admits only of discreet amounts: 1 quantum, 2 quanta, 3 quanta…, which cannot be understood as a number of objects in the cardinality sense. In the case of five quanta in a box. there is no fact of the matter, which one was put in first, which second… So I will speak of the “amount” of quanta as opposed to the “cardinality” of classical objects. The tools of reference require the kinds of conditions that do not apply to quantum phenomena, so the tools of reference do not apply for quanta, in particular, individual quanta cannot be the referents of referring terms, and there is no distinction between one quantum being P and some other quantum being ~P, and the reverse.[[23]](#footnote-23)

 Here, now, is the argument against referential realism. Referential realism requires that kind terms such as “electron” and “nucleus” have non-empty extensions. But that presupposes the applicability of the tools of reference. Extensions have cardinality, in the sense indicated above. For any non-empty extension there are always facts of the matter such as that it is *a* that is in the extension, not *b*, or the other way around.

 In addition superimposed quanta can’t be members of an extension. We speak of “two particles” being superimposed, or of “two particles in” the superposition. But, on the quantal interpretation there is no fact of the matter whether it is *a* that is in the superposition, not *c,* or the other way around. Waves can have amounts of things (energy, quanta) but there is no such things as “two sub-waves” in a superimposed state. One and the same wave can be analyzed as having different components, for example, when analyzed in different bases.

 Realists might respond as follows: Agreed that the subject matter covered by terms such as “electron” does not involve classical-like particles, Agreed that quantum phenomena must be seen as a kind of “stuff” of an unfamiliar sort, that is seen in terms of quantized amounts, not numbers in the cardinality sense. None the less, the defense runs, referential realism succeeds in as much as we have successfully attached the term “electron” to this “electron-stuff”, and similarly for other terms attaching to materials as treated by quantum mechanics.

 The proposal under consideration has dropped the realism of natural kinds as collections of individuatable, identity bearing discrete entities that fall within a sharply delimited class. I ask: How is so doing relevantly different from taking “the luminiferous ether” to refer to the space-time of general relativity, “caloric” to refer to thermal kinetic energy or “phlogiston” to refer to absence of oxygen? If the claim is that *this time* we’ve got it right we have to remember that *all* of this works within a highly idealized theory which, from the point of view of quantum field theory, characterizes the subject matter in yet more abstract ways and that itself is still highly idealized.

 In other words, the defense is to adopt the new way of talking and asserting that, referentially, this time we have it right. The examples of the last paragraph show that this move is always available when a prior, partially successful way of talking is replaced by a new way of talking that supports (in some respects!) greater success in the descriptive enterprise.

 My response would appear to be an application of the “pessimistic induction”. It is more than that. Realists’ response to the pessimistic induction is to argue that in the progression of theory there comes a point at which it is reasonable to suppose that at least we have succeeded in the referential component of the enterprise. But the circumstances that I have sketched show that, except on a Bohmian style interpretation, the move to quantum mechanics throws over the very tools of reference as we know them. We haven’t finally gotten the referential component right, we have abandoned the tools of reference in any familiar form.

 My response is also not an induction on past failures. We need no induction to tell us that present theory is highly idealized. In particular it has overthrown the familiar tools of reference in favor of another scheme that we do not know how to connected in a unified framework with subject matters for which we do continue to use the familiar tools of reference - roughly, this is the infamous “measurement problem. Better to talk of the subject matter addressed with terms such as “electron”, “nuclei” and other terms from quantum theories as an imperfect view of a yet much more complicated reality, with the way we think of our referential vocabulary continuing to shift as we get a sharper and sharper image of this independent reality.

 My response does involve this much of a “pessimistic induction”: Both past failures and the specter of always increasing complexity supports the expectation that we have no realistic prospect, within any current intellectual horizon, of getting things exactly right. My quarrel with the realism interpretable as referential realism is with the claim that at least, in some cases, we have finally gotten the referential part of the progression right.[[24]](#footnote-24)

 My rejection of referential realism applies not only to the subject matter of quantum mechanics, but broadly across the theoretical spectrum; to the alleged referents of terms from biology: “cell”, “mitochondria”, “ion channel”, etc.; ….; for terms in material science with the form of referring to microscopic features of surfaces, microscopic imperfections in crystals, nanowires, etc.; terms from theories such as thermodynamics and statistical mechanics for example “temperature”, “entropy”, and “free energy”; and so on.

 All of these are cases of general terms. The difficulties arise in two ways. First for theoretical terms from some theory. I will illustrate with thermodynamics and statistical mechanics. The problem is that the theories are idealized with the idealizations infecting the way the terms are set up. Thermodynamics simply postulates quantities such as temperature and entropy, characterizing them in terms of the theory’s idealized laws. One wants to say, sure the laws are idealized, but these laws apply to quantities that we have identified and can hope to characterize more and more accurately – we have exactly the situation discussed above where realists acknowledge that our knowledge of, say, atoms is only approximately true, but claim that we have successfully identified a kind of objects, atoms. In the current example it is physical quantities that are in question.

 To find out, for example, what temperature is we turn to statistical mechanics that is supposed to specify temperature as mean translational kinetic energy. But how many molecules (that inherit all the difficulties discussed above in the context of quantum mechanics) must there be in a collection for that collection to count as having a temperature? And it isn’t just translational energy that is in question. One must look at all the separate degrees of freedom, where “degrees of freedom” itself isn’t a completely clear-cut notion. Generally notions in statistical mechanics are characterized only in the “thermodynamic limit” which takes the number of particles and the volume they occupy to the infinite limit holding the density constant.[[25]](#footnote-25)

 Much more accurate, I submit, to think of both thermodynamics and statistical mechanics as theoretical frameworks that simplify a more complex reality and where no part of the framework, including the quantities in terms of which it operates, correspond exactly to anything in the much more complicated world. Similar things will go for other super-quantum mechanical theories

 The second kind of problem concerns what we think of as “natural kind terms”, such as “cell”, “gold” and “water”. There is, in the real world, no such thing as “pure water”. Then how much impurity is allowed before a sample no longer counts as water? We already noted problems with the generalization that “water is H2O”: All the complexities of water chemistry in question there apply to compromise the idea that there is one, simple natural kind, water. As for gold, how big a sample must we have for the sample to count as a sample of gold? If single atoms, there are samples of gold with almost none of the properties usually taken to be intrinsic to the kind. Again there is the headache of just how much impurity should be allowed. “Cell”, as well as a great many other terms in biology and other theories characterize not natural kinds but functional concepts, where the function in question is relative to our ever shifting theoretical framework.

 All of these tangles submit to the strategy of taking natural kinds such as water, gold, and cells as ideal types with the intricacies then arising in the question of how well the ideal type fits a messy real case. This fits framework thinking exactly. The ideal types are elements of more complex frameworks where the framework as a whole will fit a case more or less well, but never perfectly.

 Another way to look at the referential realism issue for super-quantum mechanical but still theoretical cases is the question of whether there are individual entities that would appropriately get classified as a cell, a sample of gold, or a sample of water. Let us suppose that natural kinds have the status of ideal types, but still, it will be claimed, there are individual objects that appropriately get classified as instances of the type: That object we are looking at through the microscope is a cell. It exists. This also falls under referential realism. Stated in the formal mode, we have used a referring term, “That object we are looking at through the microscope”. The question of realism about the individual object is the question of whether that referring term has a referent.

 In section 9 we will look at the same question for terms purportedly having ordinary physical objects of perception as their referents. At the level of perception we will once again find that treating such cases with the tools of reference provides an effective, but not exactly correct simplification of a much more complicated world. All the problems we will see for those cases will apply to the present case of individual referring terms for objects at the level of theory.

 Thinking in terms of frameworks also comes into play with the issue of whether ultimately, all things are composed of what is in principle treated by quantum mechanics. We take everyday objects to have parts, which have parts… until we get down to the domain that we discuss with terms such as “atom”, “nucleus”, electron”…. For many quantum phenomena we must use great care in using classical terminology, if we use it at all. Yet for sufficiently large objects and for very nearly all phenomena concerning these we unproblematicaly use the tools of reference.[[26]](#footnote-26) Thinking in terms of frameworks enables us to make sense of this situation. For macroscopic objects we use frameworks incorporating the tools of reference. For many quantal phenomena we must use alternative frameworks involving “quanta” not “classical particles”. None of these frameworks are exactly correct. Where we apply the tools of reference we have idealized away the mysteries of quantum phenomena. Non-relativistic quantum mechanics and current quantum field theory are themselves highly idealized, the ontology of which we can expect eventually to be superseded by quantum strings or one of many other candidates for incorporating current quantum frameworks in some “more fundamental” system.[[27]](#footnote-27)

 **8. Doesn’t thinking of scientific theories as inexact frameworks amount to instrumentalism?** Broadly, instrumental accounts of theories reject the claim that theories are true or approximately true. All hands agree that at best we have approximate truth. What instrumentalists seem to find problematic is the referential realism for the unobservable.[[28]](#footnote-28) Approximate truth about the unobservable is rejected because the unobservable ontology is rejected. What instrumentalists offer instead is that the results of science are to be understood as tools for making predictions, facilitating manipulations, and the like for the observable. Since I have rejected referential realism for the unobservable, it would seem that I must be committed to instrumentalism.

 Instrumentalists are committed to referential realism for the observable, that is, to referential realism for things like stones, chairs, (bodies of) people…. Obviously, instrumentalists are presupposing that statements about the observable are free from the problems they allege for the unobservable - instrumentalists must be so committed, for otherwise they would be faced with exactly the claimed difficulties for the unobservable that they claim to resolve.

 However, as I will argue in the next section, referential realism fails just as thoroughly for the observable as the unobservable. In as much as instrumentalism is the view that referential realism for the observable will fill in for its claimed failure for the unobservable, my position is no sort of instrumentalism. Instead I will urge that, just as we must expect from the failure of any observational/unobservational distinction, the two – the theoretical and the observable or perceptual - are on a continuum, with the present problems applying and in the same kind of way all up and down this continuum. I will urge that also for the perceptual, we most usually use the tools of reference as parts of various frameworks that give us what is always not exactly correct knowledge of the world.

 **9. Perceptual knowledge, no less than theoretical knowledge, is ubiquitously inexact.** By perceptual knowledge I will understand knowledge obtained with unaided sense perception. Worries about no context independent observational theoretical distinction are here not relevant. There is a perfectly good distinction that works, person by person and in a context dependent way, between what a specific person can learn with unaided perception and what not. I have unaided perceptual access to colors that a color blind person does not. Many people have unaided perceptual access to small ants for which I require reading glasses.

 On our usual initial, naïve conception of perceptual knowledge, using our senses we detect the presence of external objects - stones, trees, chairs, (bodies of) people…, and our senses enable us to detect various properties of the detected external objects - colors, shapes, textures, weightiness…. Together these provide us with perceptual knowledge of facts such as that the brick I am holding in my hand is red, that the surface of the brick is rough, that the brick has considerable weight….

 The conception crumbles under examination. To begin with the well known example of color: Naively we take ourselves to perceptually detect colors as intrinsic properties of things such as the redness of the brick. Already in the early modern period natural philosophers knew, arguing from phenomena such as illusion, that this is incorrect for so-called secondary properties. We know from current color science that color perception is a complex process involving properties of the perceived object, characteristics of the perceiver, and complex environmental conditions.[[29]](#footnote-29) It is a vast simplification of a much more complex circumstances to think, as we generally do in our everyday affairs, of color instances apprehended through sight as intrinsic properties of external objects. But for virtually everything that goes on in our every day affairs, this simplification serves with complete adequacy. A more detailed, more nearly correct characterization would just get in the way of practical concerns.

 No need to delve into the details of perceptual processing in the brain to know that this sort of thing will hold very generally. Perception is nothing like the taking of a photograph. Information obtained at the “sensory periphery” (the retina, the skin…) is registered in complex ways, the parts of which then provide the material for complex processing in various segments of the perceptual system in ways that also use both innate information and information obtained in other ways.

 Some comments and caveats: Perceptually accessed knowledge with the senses of touch, taste, smell, and sound need a more nuanced examination. But in all these respect the perceptual information processing of our cognitive systems constructs for us a perceptual way of experiencing a world independent of us. The world-as-we-experience-it is a great simplification of something incomprehensibly more complex. This is constructivism in a Kantian spirit, not anything like “social constructivism”. Overall, our perceptual rendering of an independent world strikes a compromise among the demands of accuracy and efficiency, getting us a balance for experiencing the world that will be effective in our practical endeavors. Being responsive to our needs, this rendering involves much that is subjective, but is at bottom objective in the sense that there is, quite independent of our inclinations, a better and worse for how our experience of the world will function for us.

 A second way in which our experience of the world simplifies a much more complex reality: Our perceptual rendering of an independent world yields experience as of a world as populated with independent physical objects - stones, chairs, trees, (bodies of) people…. As noted above, in logic and philosophy we have regimented our referential discourse about such things with what I described as “the tools of reference”. What will be crucial here is the applicability of strict identity. To review, the tools of reference presuppose that for two referring terms, ‘*a*’, and ‘*b*’, both of which in fact have referents. there is always a fact of the matter whether or not *a* = *b*, that is, whether the referent of “*a*” is the very same, numerically identical thing as the referent of “*b*”.

 The applicability of the strict identity incorporated by the tools of reference falters broadly at the level of perception. First there are problems with temporal boundaries. Consider the case of an apple on my apple tree. A blossom progresses to a hard mass, developing into an apple, eventually falling and gradually disintegrating into a mealy mass. The question: At what time did the apple come into existence? At what time did it cease to exist? Obviously there are no answers to such questions. Rather, in making decisions we use varying practical criteria to provide answers in service of varying practical needs

 There are analogous problems with spatial boundaries. In this scenario I pick the apple and begin to eat it. How many bites do I need to take after which the apple no longer exists? Again, there are, at best varying practical answers to such questions. The problem here is distinct from that of temporal boundaries. I gave the example in a temporally extended way to dramatize the worry about just how much can be taken away from the apple without the apple ceasing to exist. But the point at issue here is atemporal. Just how big a bite can I take without the apple ceasing to exist?

 Such problem arise for all physical objects. Questions about strict identity have no absolute, context, and interest independent answers. In all these examples the point is that using the tools of reference involves a simplification of a much more complex situation.[[30]](#footnote-30)

 Some comments on two failed attempts to reconcile these circumstances with the applicability of the tools of reference. Four-dimensionalism attempts to address the problems with identity over time while presupposing that an acceptable solution must be framed in terms of the tools of reference. Four dimentionalism postulates “time slices” where an object over time is composed of (generally temporally and spatially continuous) sequences of these time slices. This approach makes no progress with the problem. Specifying just which time slices will compose the object is subject to all the shortcomings illustrated in the first scenario of the apple while specifying just how spatially large the time slices need to be is subject to all the shortcomings illustrated in the second scenario.

 One might seek to deal with the problems using supervaluationism. Lewis asks, who would be fool enough to say just where the city ends and the outback begins? (Lewis, 1986, p 212.) Lewis considers the 1001 cats that Tibbels might be, depending on just how many hairs get included. (Lewis,1999) Lewis’s solution: While acknowledging that “the outback” and “Tibbels” do not, strictly speaking, have referents we sidestep the problem by counting as true any statement using “the outback” or “Tibbels” just in case the statement comes out true no matter where we draw the line between the city and the outback, no matter how many of Tibbels’ hairs we include. In general, on a supervaluationist account, a statement using an indeterminate referring term is true just in case all its “precisifications” are true.

 Supervaluationism fails in this application. To begin with, Lewis assumes that there is a collection of things that count as Tibbels hairs.[[31]](#footnote-31) But just what is to be included? How much above the skin must a hair poke? And for that matter, just where is the boundary between the skin and what is above it? Very sorry, in this case the hairs that I am splitting are very much an instance of the problem! For the outback, Lewis assumes that there are precise lines to be drawn between what one might want to count as the city and the outback. This presupposes both the precise lines and the potential referents, the bodies of land on either side of each one of these lines. Problems similar to the ones I have been drawing arise for both.

 A second kind of problem: Even assuming a specific collection of things that will count Tibbels’ hairs , there is more – little bits of skin for example – that might or might not be included.[[32]](#footnote-32) Just what of all of this is to be included when we say, for each way of taking the referent of “Tibbels”, the statement in question will come out true? Similarly for ways of drawing a line between the city and the outback. We have to say, for all “appropriate” ways of drawing the line the statement in questions comes out true. Generally, “all precisifications” has to be understood as all “*appropriate* precisifications”. We have made no progress in the problem illustrated with the problem of saying, just which collection of parts will count as the apple.[[33]](#footnote-33)

 **10. Two challenges.** I began with the metaphor of making worlds with symbols. My way of unpacking the metaphor was through the Kantian idea that we have no access to things independent of us except in terms of the representations that we form; with repercussions especially salient in the corollary that we can only compare a representation with other representations, not directly with what we take these representations to be representations of. This line of thinking has had many incarnations. My distinctive twist has been to explore the repercussions of the circumstance that our representational access to the world is always inexact.

 The first challenge: If representations can only be compared with other representations, what content is to be given to either the ideas of being inaccurate or of being imprecise? I propose a pragmatist solution to this problem. A representation counts as inaccurate or imprecise to the extent that it can be refined in either respect, with “refined” unpacked in terms of working better us for a sufficiently broad range of applications .This was exactly the characterization of “inexact”, third paragraph of section 5.[[34]](#footnote-34)

 The second challenge: The threat of a representational idealism.[[35]](#footnote-35) Idealists claimed that all we access is our ideas (percepts and constructs therefrom, innate ideas…) and concluded that it is not reasonable to suppose anything beyond these, things the ideas are supposed to be ideas of. The current position appears susceptible to an analogous difficulty. If all we have access to are our representations, or, more carefully in the case of perception, if our perceptions *are* representations of a supposed “external reality”, why should we think that there should be anything these representations are representations of? This is exactly the threat that immerged in section 1.

 Our experiences, collectively, are not at all like a picture book, not at all like a collection of photos of how things seem to look. In particular, our experience of physical objects is shot through with reliable regularities.[[36]](#footnote-36) When we have the experience of seeing a physical object, the experience is not of part of one side of the exterior of an object. It – the experience itself at the moment - includes a tacit awareness of how the object would (or at least how it would appear to) look if we looked from another side, usually how it would feel if we exercised the volition of taking the action of feeling its surface, and similarly, the sensations resulting from pushing or lifting the object. So in addition to the “picture book like” aspect of our percepts, what we experience is shot through with complex law-like regularities, what further experiences would occur if we…. These are part of, intrinsic to, the experience itself. There is additionally an enormous amount of complex interpersonal regularity in these experiences and expectations.

 How is all this regularity to be understood? Sense data theorists postulated external physical objects as the explanatory “principle”. I have argued that, due to the ubiquitous refinability of all our perceptions and expectations, this can’t be exactly right. We know that there is something beyond our personal volitions and experiences. By taking (what we experience as) actions we prompt new experiences. There is much about these new experiences that we cannot control. In particular, some of these will be what we expected or wanted, many are not. Thus there is something beyond us that affects our experiences, “something” that has an enormous amount of regularity about it.[[37]](#footnote-37)

 But what is this “something”? Our only access to it is, in principle, through the frameworks of our experiences and the frameworks of our intellectual constructs such as our theories that are channeled though our experiences. The understanding that results is the only understanding that, logically, is possible, and it is the only understanding we need.

 A variety of frameworks gives us a panoply of perspectives. Nature has provided us with a framework of objects of experience. While working *within* this framework we think and act in terms of perceived external objects. Analogous remarks apply to talk of theoretical objects and their characterizations. We can also step outside of the objects of perception framework into one of the theory of perception and cognition, philosophical interpretation, or some combination of these. Within such an interpretive framework we reinterpret our experiences, and the framework within which they occur, as imperfect access to something incomprehensibly more complex. But, with respect to things that we care about, working within familiar frameworks gets things right enough for us to succeed in most of our endeavors.[[38]](#footnote-38)

 **11. But what is there REALLY??** I submit that we should reject this question. For Kantian reasons our only access to what is independent of us is through symbols, broadly interpreted to include our percepts. In many circumstances these provide excellent guides to what we care about. Because of the contingent circumstance of the complexity of things, these guides are always ones that could be refined. The foregoing provides a robust sense in which these (imperfect) guides, these (refinable) symbols, are guides to and symbols of what there is in the world.

 **Appendix A: Problems of superposition.** Quantum mechanics describes objects with quantum states that, at the very least, describe observable characteristics that may be observed with measurements. But a quantum state generally gives only statistical information about what characteristics will be observed. For example, if a quantum state specifies that a (relatively)[[39]](#footnote-39) precise position for a particle will be found on a position measurement then it can give only statistics for a very wide range of momenta that might be found in a momentum measurement. No quantum state can give precise values for both position and momentum – the famous Heisenberg uncertainty principle. The quantum description of the relation of position and momentum involves superposition of quantum states, with superposition in turn understood as the adding together of (descriptions of) things described as waves. If two waves meet with peaks coinciding the peaks will add, and similarly for two troughs. But if a peak meets a trough, they will cancel. Precise position and precise momentum states are related by superposition: A precise position state is a superposition of different precise momentum states, and a precise momentum state is a superposition of precise position states.

 Distinct quanta can also be entangled in superpositions. Suppose that in combined state 1 there are exactly two particles that will on measurement exhibit property P. State 2 is similar, but with ~P instead of P. In the superposition of state 1 with state 2, you will find on measurement for sure two instances of P or two instances of ~P. But the superposition does not tell us which it will be.

 What one wants to say about the foregoing two particle case is that before measurement both particles are in P or both in ~P. But it turns out to be *very* hard to maintain this. “Collapse” interpretations say that whatever one might say about the superposition before measurement, on measurement the superposition “collapses” either into both particles P or into both ~P. But what counts as a measurement? Exactly when does it take place? Most pressingly, how does measurement result in collapse? Many world interpretations say that on measurement the universe “splits” into two new universes, one with two P particles, the other with two ~P particles. These and other interpretations each have attractive features and each has many difficulties.

 Many take themselves to be looking for the uniquely correct interpretation. But what we are interpreting, quantum mechanics, or for that matter quantum field theory, are highly idealized and far from any exactly correct theory. For this reason (among others) we are best off thinking of quantum theory as a framework, one that gives us a very good grip, on prediction and on explanation of a wide but far from exhaustive range of phenomena. The quantum mechanical framework as a theory-in-use can be embellished with one or another interpretation, each with attractive features and drawbacks. But at the present state of knowledge, it’s a reach to think that we can get the theory, let alone its interpretation, exactly right. The very fact of the interpretive impasse provides additional reason to suppose that quantum accounts give a partial view of a much more complex reality.

 **Appendix B: Quanta and the problem. of quantum statistics**.[[40]](#footnote-40) Suppose we have a box with a right (R) and a left (L) half and two – we’ll call them particles for the moment - both of the same kind. Classically we would give one particle one name, say particle “1” the other its own name, ”2”. We arrange a situation in which first one, then the second particle is put in one side or the other with equal probabilities. The particles do not attract or repel each other. Then we expect four equiprobable possibilities: 1R2R, 1L2L, 1R2L, and,2R1L, each with a probability of ¼. But that’s not what we find for quantum particles. For particles called bosons we get a probability of 1/3, 1/3, 1/3 for the cases two in R, two in L and one in each of R and L. That is, there are not four but three equiprobable cases. Quantum mechanics represents this by making no distinction between this particle on the left, that one on the right, or the reverse. For particles called fermions there is only one possible case: one particle on each side. Two particles of the same kind on just one side is ruled out.[[41]](#footnote-41) And, just as for bosons, no distinction is recognized between two different ways in which one on the left, one on the right, could occur

 How is this situation to be conceptualized? For ferminions, no two ferminions of the same kind can be in the same state. Any number of bosons of the same kind can be in the same state. For both bosons and fermions, when it comes to the “counterfactually switched” cases, 1L2R and 2L1R, no such distinction is recognized. In particular, for bosons, if the distinction were recognized, since the particles were each put on one side or the other with equal probability, we would get a probability of ½ for one on one side, one on the other, instead of the observed 1/3. For fermions it would be consistent to recognized 1L2R and 2L1R as distinct cases. But quantum theory makes no theoretical use of such a distinction. So a parsimony argument rejects any such distinction for fermions also.[[42]](#footnote-42) I conclude that we should stop using the misleading term “particle” and instead talk in terms of “quanta” as explained in what follows in the text.

References

Burge, Tyler (2010) O*rigins of Objectivity*. Oxford University Press. Oxford

Carnap, Rudof (1937) *The Logical Syntax of Language*, New York : Humanities,

Carnap, Rudolf (1956) “Empiricism, Semantics, and Ontology” Supplement to *Meaning and Necessity: A study in Semantics and Modal Logic,* enlarged edition. Chicago University Press. Chicago. 205-221

Cartwright, Nancy (1991) *The Dappled World*. Cambridge University Press. Cambridge.

Chirimuuta, Mazviitta (2015a). “Vision, Perspectivalism, and Haptic Realism. *Philosophy of Science*,

Chirimuuta, Mazviitta (2015b) *Outside Color: Perceptual Science and the Puzzle of Color in Philosophy*, MIT Press: Cambridge.

French, Steven (2015) “Identity and Individuality in Quantum Theory” *Stanford Encyclopedia of Philosophy.*

Giere, Ronald (2006) Scientific Perspectivis University of Chicago Press: Chicago.

Hanson, Norwood Russell (1958*) Patterns of Discovery*. Cambridge University Press: Cambridge

Kind, Amy (2010) “Transparency and Representationalist Theories of Consciousness” *Philosophy Compass,* 902-913.

Kuhn, Thomas S. (1962). *Structure of Scientific Revolutions.* University of Chicago Press. Chicago.

Lewis, David (1999) “Many, but almost one” in *Papers in metaphysics and epistemology*, Cambridge University Press: Cambridge. 164-182.

Lewis, David (1986) On the Plurality of Worlds. Blackwell: Oxford.

Quine, Willard Van Orman(1957-8) “Speaking of Objects”. Proceedings and Addresses of the American Philosophical Association. Volume 31,

Stalnaker (2002). “Common Ground”. Linguistics and Philosophy, 25, 701–772.

Teller, Paul (1991a) (With Michael Redhead) "Particles, Particle Labels, and Quanta: The Toll of Unacknowledged Metaphysics", Foundations of Physics, Vol. 21, No. 1, 43-62.

Teller, Paul (1991b) "The Ins and Outs of Counterfactual Switching" Nous 35, pp. 365-393.

Paul Teller (1991c) "Substance, Relations, and Arguments About the Nature of Space‑Time", *The Philosophical Review*, Vol. C, No. 3, 363-397.

Teller, Paul and Redhead, Michael (1992) "Particle Labels and the Theory of Indistinguishable Particles in Quantum Mechanics", The British Journal for Philosophy of Science, Vol. 43: 201-218.

Teller, Paul (1994) “How We Dapple the World”. Philosophy of Science, 71: 425-447.

Teller, Paul (1995) An Interpretive Introduction to Quantum Field Theory, Princeton University Press: Princeton.

Teller, Paul (2011a) “Learning to Live with Voluntarism” Synthese: Special Issue, Stance and Rationality: A Perspective,” eds: Daniel Rowbottom and Otavio Bueno. 49-66.

Teller, Paul (2011b) “Two Models of Truth” Analysis Vol 71.

Teller, Paul (2001c) "Whither Constructive Empiricism?" Philosophical Studies 106, 123-150.

Teller, Paul (2004). “What is a Stance?” Philosophical Studies, 121, 159-170.

Teller, Paul (2016) “Modeling Truth” *Philosophia*. On line publication “Modeling Truth” *Philosophia*  On line publication 2016 DOI 10.1007/s11406-016-9739-2

Teller, Paul (to appear a) “Referential Realism as Idealized Access to a Complex World”.

Teller, Paul (to appear b) “Language and the Complexity of the World”.

Teller, Paul (to appear c) “Measurement accuracy Realism”.

Teller, Paul (to appear d) “Pan-Perspectival Realism Explained and Defended”.

Van Fraassen, Bas (2002) *The Empirical Stance*. Yale University Press, New Haven.

VandeWall, Holly (2007). "Why Water Is Not H2O, and Other Critiques of Essentialist Ontology from the Philosophy of Chemistry". *Philosophy of Science*, 906-919.

Williamson, Timothy (1994) *Vagueness*. Routledge. London and New York.

1. Chirimuuta (2015a) develops the idea that, broadly, scientific realists model all human knowledge on this way of thinking about visual perception. [↑](#footnote-ref-1)
2. By “perception” I will usually have visual perception in mind. Much of what I say should go for the other senses, but the others involve complications we need not consider. [↑](#footnote-ref-2)
3. Burge (2010, pp. 379-419) gives exhaustive arguments just summarized. [↑](#footnote-ref-3)
4. There is also an essential dissimilarity. We perceive the representations that our instruments produce. We do not (at least not without a concerted effort) perceive our own perceptions. Rather the event or act of perception is itself a representational event or act. To perceive *is* to represent. [↑](#footnote-ref-4)
5. With some latitude on just how “transparency” is to be taken, this claim seems uncontroversial. I don’t need the stronger claim that is sometimes made that *all* visual experience of *everyone* is experienced transparently. See Kind (2010) for a survey. [↑](#footnote-ref-5)
6. See material on Kuhn’s “normal science” below. [↑](#footnote-ref-6)
7. See my (2011a) pp 55 and section 2 passim, for a careful statement of (anti)-foundationalism and related concepts. There are different species of (anti)foundationalism corresponding to different kinds of values, epistemological, and others. This further complicates the landscape in ways that will not try to detail. [↑](#footnote-ref-7)
8. Stalnaker (2002), pp. 701 ff. Stalnaker is developing ideas from Grice, and especially Lewis’s discussion of “accommodation”. See Stalnaker (2002) for references. [↑](#footnote-ref-8)
9. For the immediate following see chapter 2 of Kuhn’s (1962), as well as much else in that book. [↑](#footnote-ref-9)
10. No argument in his (1956). No doubt Carnap is still thinking, no cogntivie content because complete isolation from empirical assertions. That reason won’t hold up today.
 [↑](#footnote-ref-10)
11. Indeed, nothing Carnap writes rules out metaphysicians introducing their own framework(s) for doing metaphysics, judging them on the pragmatic grounds of how well they satisfy their own intellectual preferences. Carnap might grimace, but his view would rule out only any claim to any such having absolute correctness or priority. [↑](#footnote-ref-11)
12. Readers familiar with van Fraassen’s (2002) notion of a stance will note obvious similarities. For van Fraassen the only constraint on rationality is consistency. See my (2004) [↑](#footnote-ref-12)
13. See note 7. Again, note connections with van Frasssen application of the idea of a stance. [↑](#footnote-ref-13)
14. For further details see my (2016) section 7, 8, and 9. [↑](#footnote-ref-14)
15. Again, for further details see my (2016) section 7, 8, and 9. [↑](#footnote-ref-15)
16. See my (1994) for detailed argument, as well as argument against thinking of our idealized theories as getting “closer and closer to the truth”. [↑](#footnote-ref-16)
17. Cartwright argues for this sort of conclusion throughout her (1991) and in many, many other places. [↑](#footnote-ref-17)
18. See VandeWall (2007). [↑](#footnote-ref-18)
19. See, e.g., Carnap (1937, 237-8)). Quine also refers to this as “semantic ascent”. (1960, p. 271) [↑](#footnote-ref-19)
20. Classical fields theories such as electrodynamics and general relativity might provide exceptions if one accepts substantivalism about space-time points or volumes. See my (1991c) for argument against substantivalism.

 [↑](#footnote-ref-20)
21. Readers not acquainted with quantum superposition will find a brief introduction in appendix A.
 [↑](#footnote-ref-21)
22. Readers will find a brief introduction to quanta in Appendix B. I introduce and defend quanta in my (1995), chapter 2; and readers will find further defense in my (1991a) and (1992). Survey and relevant arguments are to be found in my (2001b) and French (2015).
 [↑](#footnote-ref-22)
23. For more details *See my (1995) Chapter 2.* [↑](#footnote-ref-23)
24. See my (to appear d) passim. and especially my (to appear a) sections 5. and 6. for a sustained argument for why this should nonetheless count as a kind of realism. [↑](#footnote-ref-24)
25. There are many, many further problems. See my (to appear c) for extended treatment of basic quantities in physics such as time, distance, mass, velocity….

 [↑](#footnote-ref-25)
26. For *almost* all macroscopic phenomena. There are observable quantum phenomena at the macroscopic scale. [↑](#footnote-ref-26)
27. All of this bears some resemblance to Cartwright’s interpretation of quantum mechanics in her (1991), chapter 9. As I read her interpretation it is something like thinking of quantum mechanics as a framework for building models of experimental outcomes described, as Bohr would put it, in the language of classical physics. I present this summary as what I take away from Cartwright’s (1991), not as a summary that I think she would endorse.

 [↑](#footnote-ref-27)
28. It is widely agreed that there is no context independent observable/unobservable distinction that the instrumentalist would appear to need. (van Fraassen is an exception – who does not at all count as an instrumentalist. See my (2001c), p.127 for discussion and many references to van Fraassen.) I am here putting this problem to one side. [↑](#footnote-ref-28)
29. For an accessible survey of the science see Giere (2006), chapter 2. Chirimuuta (2015), chapter 4 gives a more detailed exposition. [↑](#footnote-ref-29)
30. The problems of temporal and spatial boundaries cover similar ground to those of matter and form in the problem of composition. While legions of philosophers struggle to find the uniquely correct answer to questions of composition (the statue and the clay, one object or two?) I urge that one can work from a variety of framework assumptions, tailored to various needs, the different characterizations, as always, getting at different relevant aspects of a more complex situation. [↑](#footnote-ref-30)
31. Obviously Lewis indulged in an expositional simplification. The problem is that the simplification can’t be completely undone, and it’s indefinite just what would count as success in eliminating the simplification. [↑](#footnote-ref-31)
32. The last footnote applies, in the same way, here. [↑](#footnote-ref-32)
33. A third way to attempt to address the problems is the approach to vague terms known as “epistemicism”. Space here allows me no more than a hint that I develop in my (to appear b). We are finite beings in an indefinitely complex world. This limits the discriminative powers, not only of our explicitly held knowledge, but our language mechanisms in drawing perfectly fine distinctions. [↑](#footnote-ref-33)
34. Readers will find more in my (2016) sections 8, 9, and 10, summarized last paragraph of section10 section. [↑](#footnote-ref-34)
35. van Fraassen (personal communication) has rubbed my nose very hard in this worry. [↑](#footnote-ref-35)
36. Note how in the rest of the paragraph I am using the tools of reference to talk about “a physical object”. This has to be understood as an exposition from within a physical object framework. In this case use of a physical object framework is an expository simplification. [↑](#footnote-ref-36)
37. One wonders if there may here be a thoroughgoing connection with Kant’s refutation of idealism that depends not just on our awareness of the temporal ordering of past experiences but on the causal laws from which observed regularity arise. I am not aware of any discussion of this suggestion in the literature and am not myself competent to elaborate or evaluate it. The attitudes proposed here also have obvious analogies to the Husserelian notion of the Lebenswelt, with strands also going back to Kant. Again, I am not competent to comment. [↑](#footnote-ref-37)
38. Substantially different presentations and arguments for the attitude developed in this section are presented in (to appear d), section 6. and (to appear a), sections 5. and 6. [↑](#footnote-ref-38)
39. Hence forth the “relatively” will be implicitly understood. [↑](#footnote-ref-39)
40. More extensive but still accessible exposition can be found in my (1991b). [↑](#footnote-ref-40)
41. See my (1991b), p. 381 for a little more detail. [↑](#footnote-ref-41)
42. The parsimony argument is spelled out in my (1991a) and my (1995), pp. 16-36. There is dispute about all these conclusions about quantum statistics and individuality for quanta. See my 2001 section 7 for the pros and cons and a survey of the issues in French (2015). More detailed arguments for the conclusions I have briefly argued here are presented in my (1991a), (1992) and (1995) chapter 2.

 [↑](#footnote-ref-42)