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Emerging truth and the defeat of scientific racism

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ABSTRACT: This paper looks at the attack on scientific racism in the 20th century by a group of social and biological scientists. I will utilize the apparatus of my model of emerging truth to show how even in complex socially conditioned argumentation the ultimate virtue is seeking the truth through increasingly powerful logical connections and deeply embedded warrants.

KEYWORDS: anthropology, argumentation, biology, evolution, genetics, racism, science, truth, warrant

1. INTRODUCTION

This paper is the next step in an agenda that has been at the focus of my efforts for more than two decades (Weinstein, 1990; 1994). In terms of the conference theme, my agenda is based on the following: Among the most significant virtues of argumentation is to know what you are talking about. Put in terms of informal logic it is: Evaluating arguments put forward whether in defense or attack essentially requires being able to give a comparative estimate of the strength of the warrants employed, whether tacit or overt (Weinstein, 2006). Seen in relation to critical thinking and undergraduate education it is: Developing the virtues of argumentation within their students is the task of the entire faculty (Weinstein, 1993).

My initial agenda was practical (Weinstein, 2012b). My recent agenda has been theoretical (Weinstein, 2009; 2012a) and included an exploration of an actual case, the development of the periodic table of elements (Weinstein, 2011). The core of the theoretical work is a metamathematical model of emerging truth (MET), which supports an account of warrant strength that can be grafted unto formal systems of adaptive logic (Weinstein, 2013). But whatever the technical elaborations, the thrust of the MET was to offer a metaphor of general utility in argument analysis and evaluation. The underlying focus was a shift from dialogue and dialectic towards epistemology. The concern was not with acceptability but with truth. The intuition was that the underlying structure of physical chemistry, seen as the paradigm of successful inquiry, had a logical structure, which a theory of emerging truth might elaborate. The structure that resulted, the MET, recast the notion of truth from simple correspondence and logical coherence applicable to propositions in isolation to field conditions defined on networks of warrants. A governing principle in my work was that the most important things to argue about were things about which

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the truth was unclear and yet possible to ascertain though successful inquiry. And that in such substantive arguments what was invariable at stake was the inferential structure of warranting generalizations.

The formalism of the MET (abbreviated in the technical appendix) attempted to capture three intuitive network principles exemplified by the history of physical chemistry: consilience, the increasing adequacy of empirical descriptions over time; breadth, the scope of theories as applied to a range of empirical descriptions and generalizations; and depth, a measure of levels of theoretic redefinitions each one of which results in increasing breadth and higher levels of consilience. A theory of truth that relies on the satisfaction of these three *desiderata* creates immediate problems if we are to accept standard logical relations. Among the most pressing within inquiry is the relation of a generalization and its consequences to counter examples. Without going into detail here, the model of truth supports a principled description of the relation of counter-examples to warranted claims that permits a comparative evaluation to be made rather than a forced rejection of one or the other as in the standard account (technical appendix, Part II). Such a radical departure from standard logic requires strong support and although my theory of truth offers a theoretic framework, without clear empirical models my views are easily overlooked as fanciful. But even if we accept the MET as a model for truth in the physical sciences, and physical science as paradigmatically truth-seeking, a broader range of application for my approach is needed if it is to be of interest to argumentation theorists.

In this paper I will look at arguments in anthropology and biology that, although scientific, are far removed from physical science. The focus is the response to racism by scientists who attempted to challenge the scientific support for racism. Scientific racist theories reflected the centrality of racial differentiation as manifested, first, in the wide spread enslavement of the native peoples of the new world, and then, as their enslavement matured into their disappearance, the importation of Africans as slaves. Despite the entrenched religious, cultural, social and economic reasoning that justified the enslavement of Africans by Europeans, the attempt to furnish a scientific justification in terms of some inherent biological difference between blacks and whites reflected the thrust of countervailing reasons, mainly religious and ethical. If blacks could be seen as a distinct biological category, then given the pervasive hierarchical models within biology starting with Linnaeus, differentiated moral treatment could be justified on grounds similar to the differentiated treatment of animals (Jordan, 1968).

The scientific arguments went through a period of elaboration in the 20th century, moving beyond blacks and whites to a concern with human differences, seen as deficiencies, generalized to include other races and social classes (Barkan, 1992). A major concern was the justification of eugenic policies in the United States and Great Britain. Eugenic science, based on social Darwinism, was an acceptable and even essential aspect of inquiry resulting in policies on immigration and education and the brutal invasion of the rights of individuals deemed socially undesirable (Tschauser, 2009). The importation of eugenics into Germany between the wars (Graves, 2008), coupled with the toxic cocktail of native prejudices and conceits resulted in the defeat of eugenics as collateral damage after WW2. But the scientific arguments, based on psychometric testing (Gould, 1981), resurfaced in 1994 with the publication of the *Bell Curve.* And recent work in genetics and paleoanthropology (Wade, 2006) have resulted in a renewed interest in human differences that extended from the application for race-specific medical patents to the commercial availability of genetic assays that could determine, with some approximation, at least some of the likely geographic history of a person's ancestors (Krimsky & Sloan, 2011).

The initial resistance to scientific racism had two sources: anthropology and biology (Barkan, 1992). Both of these scientific enterprises create problems for the MET. Anthropology, especially as practiced by Boas and his followers could be seen as a paradigmatically ideographic science. Biology reflecting the synthesis of evolutionary theory with genetics includes a concern with time absent in chemistry. And the application of genetics to populations is essentially statistical as is psychometrics. The task then is to sketch out how the basic set theoretic apparatus in terms of which consilience, breadth and depth are cashed out in the MET can be applied in making sense of the arguments against scientific racism.

2. ANTHROPOLOGY AND RACE

The efforts of Franz Boas and his followers to reject the racism endemic after WW1 are well documented (Barkan, 1992). It had both scientific and political dimensions that reflected the complex professional issues in the newly developing field of anthropology in the United States and Great Britain. What is salient for the discussion here is the commitment by Boas and his followers to historical particularism (Harris, 2001, pp. 250ff). This concern with the specific details of culture, based on both the interpretation of informants (emics) and close observations of their behavior (etics), became the basis of the landmark achievements of Boas' students, most notably Ruth Benedict and Margaret Mead. The studies of various cultures resulted in a deep cultural appreciation of human difference that played a significant role in the cultural rejection of racism. But this raises deep problems for the perspective that that MET affords, for the MET is based on a clearly nomothetic science, physical chemistry, and the notion of warrant strength that is at the core of its application to argumentation requires just what an ideographic approach to anthropology eschews.

But as Harris and others have indicated, although the focus is on rich descriptions of cultural practices, such descriptions are not immune to a theoretic overlay. Although Boas focused on culture as the major determinant of human understanding and behavior those that followed offered theoretic overlays that included Freudianism (Benedict and Mead), functionalism (Malinowski), structuralism (Levi-Strauss) and materialism (Harris). Each of these adds support to anti-racism by identifying commonalities across cultures that unify rather than differentiate groups in terms of explanatory theories. It is such theoretic accounts that support the relevance of the rich descriptions that Boas' approach requires. With over-arching theoretic constructs in terms of which the description can be understood the wealth of data sets the standards for the adequacy of theoretic accounts, challenging the theory as increasing detail is brought forward. This is captured by the initial insight that the MET affords, that theory must is supported by a sequence of models that satisfy the theory or are increasingly adequate to what the theory implies (MET, 1.2).

If a field study is to yield reliable information the details must be coherent. This is fundamental to recent disputes, for example, challenges to the conclusions found in classic study of the Yanomamo by Napoleon Chagnon (Ferguson, 1995). The original notion of the Yanomano as a culturally fierce and warlike tribe has been questioned as additional information on the impact of civilization on the ecology of the area prompted a reevaluation of how fundamental the warlike behaviors are to the culture. The fierce practices of the Yanomamo could be seen as an artifact of more recent and contingent impositions on that culture from outside. And so the richness of the ethnographic data is an initial guide to prima facie adequacy, but can only be sustained by further advance. Although as Boas saw the rush to generalize from limited data reflects the sort of cultural bias that characterized social Darwinists such as Herbert Spenser, who could be seen to have distorted Darwin's views in the name of a cultural agenda (Harris, 2001, pp. 122ff).

Distinguishing generalities that are imposed on incomplete data from generalities that are supported by increasing bodies of evidence is what the notion of model chain progressive attempts to capture (MET 1.3). It is not enough that a warrant is supported by evidence. The evidence must be be increasingly adequate to the warrant (MET, 1.2) and increasingly many chains of increasingly adequate evidence point to the epistemological power of the warrant and its logical force in supporting inference (MET 1.3). It is not surprising that the focus on rich and sympathetic description of cultures that reflect both the behavior and self-understanding of those within it is open to various interpretations, but if such interpretations are not to be seen as open to the vagaries of literary analysis (Eagleton, 1983) an over-arching explanatory theory must be formulated. Relying on the naturalness of the interpretation, an appeal to the ideographic description that make sense in terms of the intuitive ability to understand human beings, opens the door to the cultural bias that a theorist brings to the task. And given the pervasive history of racism, it is no wonder that early anthropologists found ample historical and cultural evidence to support their racist biases (Barkan, 1992, pp. 66ff). It is just such biases that the perspective of Boas and his students attempted to counter by offering rich descriptions based on in-depth exploration reinforced by the experience of the anthropologist living for an extended time in the cultural context to be studied.

It is the perspective of the MET that such rich descriptions, however essential in the understanding of human culture, are preliminary and that the adequacy of anthropological understanding requires that generalizations by put forward and tested by their ability to warrant increasingly adequate descriptions of the phenomena. Such generalizations determine competing theoretic perspectives. The MET attempts to offer an indication as to how such competing perspectives may be evaluated. The view put forward is that generalizations take their strength from the breadth and depth with which they connect networks of explanatory structures. This is evident by the large explanatory frameworks, for example, structuralism and materialism that are put forward as an overlay on the accepted generalizations in a field (Harris, 2001, pp. 634ff). The account of reduction in the MET (2 through 2.4) is an attempt to show what the logic of such a framework requires. It is not surprising that such large frameworks are the subjects of debate within anthropology, but if we are not to succumb to relativism and to be incapable of having scientific arguments to defeat racism, the logical appraisal of such reductive frameworks is essential. This will be clearer as we mover from anthropology to biology.

3. BIOLOGY AND RACE

The original biological arguments for distinguishing races reflected both the taxonomical model that would prove a mainstay of biology and a crude mixture of physical and cultural attributes that signaled the complexity of the attempt to make sense of human diversity. Linnaeus distinguishes Europeans as "White, sanguine, brawny. Hair abundantly flowing. Eyes blue. Gentle acute inventive. Covered with close vestments. Governed by customs,' from Africans who he sees as "Black, phlegmatic, relaxed. Hair black, frizzled. Skin silky… Crafty, indolent, negligent, anoints himself with grease. Governed by caprice (Jordan, 1968, pp. 220-221).

As the classification morphed into a hierarchical "chain of being," analogies were sought with the physical appearance and behavior of animals, especially supposedly man-like apes (ibid., pp. 228-234). But the fundamental distinction based on skin color remained essential (ibid., pp. 239ff) although it was expanded in later race theorists to include physical measures of the ratio of body parts that supposedly signal both aesthetic and functional superiority (Gould, 1981, pp. 127ff). The main focus of continuing research was the measurement of skulls as an indicator of both innate intelligence and evolutionary status (Gould, 1981, pp. 73ff). The underlying theory was that of polygeny, a proto-biblical doctrine of the separate creation of the various races championed by Louis Agassiz and reflected in the work of Samuel Morton (ibid., pp. 42ff) . Morton's work and the work of Paul Broca have been criticized by Gould, who identified both the empirical and theoretical failing of the work (Gould, op. cit.) but even if Gould's work is challenged as to the details the findings based on measuring skulls suffer from clear lack of theoretic connection to intelligence (Graves, p. 47). The MET points to the underlying problem. Even if we accept Morton's measurements, whatever their accuracy, it did not result in a continuing and increasingly effective research programs in craniometry. That is, it did not result in a progressive model chain (MET, 1.2), the minimum condition on a warrant if it is to be taken seriously. Moreover it does not have progressive model chains (MET, 1.3) that is, additional chains of models elaborating the relationship of craniometry to aspects of psychological functioning (the hope of phrenologists). The work of Broca attempting to extend craniometry to, for example, hierarchies of occupational status and social class resulted in a dead-end (Gould, 1981, pp. 82ff).

Craniometry was based on the connection between skulls, brains and cognitive function. This led to the next iteration, psychometrics as the scientific warrant for maintaining and engineering racial and social difference, the basis for eugenics and social policies that gave scientific support for segregated schools, sterilization and ultimately genocide. The basic apparatus for the psychometric support of eugenics was the availability of intelligence tests beginning with the work of Alfred Binet (Gould, 1981, pp. 146ff). The results of intelligence testing was related to Mendelian genetics by H. H. Goddard, which supported the program in eugenics to inhibit the reproduction of mental defectives (ibid., pp. 163ff) and given additional social relevance by Lewis Terman and especially by R. M. Yerkes in his testing of army recruits during World War I. Gould sees Terman to have recanted seeing that "mean differences are too small to provide any predictive information for individuals" (ibid., p. 192) and sees Yerkes to have made fundamental methodological and statistical errors (ibid., pp. 199ff) and to have disregarded the plausible interpretations of his findings as evidence of the radically different social and educational environment that characterized the individuals tested (ibid., pp. 217-222). All of which can be seen as a failure of the psychometricians to develop progressive model chains. But there is a deeper criticism that Gould employs in challenging the basic genetic interpretation of the results of testing. Gould asks, "Could the plethora of causes and phenomena grouped under the rubric of mental deficiency possibly be ordered usefully on a single scale?" (ibid., p. 159). His answer is that it could not, seeing "mental retardation, specific learning disabilities caused by neurological damage, environmental disadvantages, cultural differences" as all plausible contributors to the score on an intelligence test and so making the hypothesis of a single genetic cause unreasonable (ibid., pp. 159-160). In terms of the MET, the genetic interpretation of the testing data is not a useful explanatory model for the phenomena. Cyril Burt and his followers would beg to differ.

Burt, Charles Spearman, Arthur Jensen and the authors of the *Bell Curve*, now armed with an array of tests that indicate various aspects of cognitive competence rely on the statistical technique of factor analysis to argue for a univocal notion of intelligence, *g*, which reduces the correlations among the various tests to one major component, and thus accounts for the apparent variety of abilities in terms of one unifying, possible genetic, underlying cause. The argument is complex and relies on technical discussions of factor analysis and the openness of the technique to alternative constructions (ibid., pp. 214-215) but the deep issue is the reification of factors. Does the statistical fact, whatever it is, have ontological consequences? This is the problem of reification: are statistical artifacts real properties of the existent things that they measure? (ibid., pp. 238-239, pp. 250-252; pp. 268-269). The MET offers a perspective on that issue. The MET gives an account of ontological commitment internal to a scientific theory (Weinstein, 2002). Without going into the technical details, the upshot is that we commit ourselves to an ontology in terms of the domain of the intended model of our most successful theories, where that commitment is captured by the Quinean aphorism, to be is to be the value of a variable. Thus, factor analysis can tell us what our theories must account for, that is, even if *g* is supported by the statistical evidence, an explanatory theory of what *g* is must be forthcoming. If, for example, we think human cognitive capacity is a function of the central nervous system the neurophysiological correlate for *g* must be discovered. If, in addition, we think the neurophysiological correlate is an essential characteristic of a group in the sense of an inherited biological trait the underlying genetic structure must be identified. Whether and to what extent the factor is related to measureable environmental factors complicates the statistics.

But whatever the results of factor analysis, not matter how reconstructed, they only have ontological significance when they are cashed out in a theory of increasing empirical adequacy (MET, 1.2) and breadth of application (MET, 1.3, 2.3). In the best case, resulting in a theory whose breadth enables it to incorporate and reinterpret the range of empirical models and explanatory theories in its own terms (MET, 2.4) (Weinstein, 2002).

The issue of polygeny mentioned earlier raises more recent concerns. If polygeny is correct, whether in its biblical version or in terms of an evolutionary tree, which differentiates the races in terms of distinct evolutionary histories, a biological theory of distinct races is possible, and possibly supportive of racist interpretations. But that requires that there is some scientific notion of race that is sufficiently similar to the socially constructed notion, now determined primarily by self-identification in terms of socially available categories. The MET shows why, if genetic theory of race is a scientific possibility, it would offer powerful support for a reconstructed notion of race, possibly accessible to renewed racist constructions Krimsky and Sloan, 2011).

The reinterpretation of sets of empirical data under an overarching theory, called "reduction" by philosophers of science (MET, 2 through 2.4) generates warrants of enormous power, for the confirmatory yield for the theory within which the warrant is sustained is potentially a function of the joint confirmation of all of the more empirical theories that it reduces. Seeing the chemistry of gases, the structure of crystals, the electro-chemical properties of substances, the dynamics of fluids, the tensile strength of solids and the bio-chemistry of living things as all interpretable in terms of the underlying structure of molecules and atoms is the basis for the priority of physical chemistry as a paradigm of truth. The improbability of such a grand unification of disparate sciences, each with their own history, methodology and evidence attests to its enormous epistemological power on both intuitive and Bayesian grounds. And so we cannot rule out the potential of an evolutionary version of polygeny based on genetics despite the failure of the initial research program in its name.

The resuscitation of a genetic account of human diversity reflects recent work in paleoanthropology (Wade, 2006). Whatever the theoretic interest of the work, issues of racism arise due to socially sensitive social applications of modern genetics to medicine and criminal justice (Krimsky & Sloan, 2011). Although recent applications of genetic theory in paleoanthropology do not support polygeny in the sense of special creation, tracing the genetic variation of human populations subsequent to the migration of homo sapiens from Africa to the rest of the inhabited world indicates that the geographic distribution of humans offer genetic support for distinguishing groups of people in a fashion that reflects, to some extent, the traditional division of humans into races. For example, the chromosomal tree based on the Y chromosome, passed from father to son, includes the mutation M173 that distinguishes populations in Europe from those that populate the Americas, who are characterized by M242, as distinguished from the inhabitants of West Eurasia with M170. These mutations are generally not found in the parent population in Africa characterized by M168. The geographical distribution of genetic lines as reflected in the distribution of mutations based on mitochondrial DNA passed along the female line includes distinct lineages as well, albeit distributed in more complex ways (Wade, 2006, pp. 56ff).

Warrants based on genetics are potentially powerful reducers, they are mirrored in evidence as diverse as the archeological discoveries of settlements that track genetically identifiable migrations, the development of tool making cultures, the dispersion of language families and patterns of resistance to disease (Wade, 2006). Moreover genetic theories sit in deep and broad reduction chains (Met 2.2, 2.3). Genetic claims are supported by chemical analysis and are consistent with know principles of biology and physiology and so fit within a detailed and comprehensive inquiry project that accommodates a wide range of explanatory structures independent of their application to the biology of race. And so modern genetics has a high probability of leading to emerging truth. But even if the science of genetics is strongly supported by the theories that surround it, the question still remains as to whether it is a strong reducing theory in respect of its application to explaining human differences relevant to notions of race.

Explanatory theories that reduce offer explanations that reinterpret the reduced warrants in their own terms, as opposed to warrants that are generalizations upon the concepts used to describe the phenomena to be explained (the formal distinction is in the nature of the functions that differentiate MET 1 from MET 2. See Weinstein, 2013, for the most elaborated statement). In terms of our issue the question is whether race as genetically defined explains race as socially constructed, based on self-attribution in light of traditional racial categories? The first thing to notice is that race is socially constructed in various ways, particularly in countries in the Western Hemisphere with a long history of racial mixing. People descended from two different racial classifications can be grouped in two ways, hypodescent, where the designated race has lower status, as when a bi-racial individual of African descent is designated as African-American or hyperdescent, which designates according to the higher status racial designation, common in Brazil (Krinsky and Sloan, 2011, pp. 246ff). This, in itself, makes it unreasonable to expect genetics based racial theory to fit the traditional categories of race. The social construction of race is not a coherent categorical system; it reflects different social histories and encompasses competing distinctions, including physical characteristics, language use, religion and ethnicity.

The MET based on physical chemistry is not readily structured to address such a case. Although reductions are often partial, the MET (2.1) requires successful reductions to encompass more over time. The history of the periodic table was one of increasing range as chemical processes were understood in more detail and with increasing experimental adequacy, and as important newly discovered substances and their chemical properties were added to the emerging picture the table provided. Given the social construction of race we should not expect genetic theory to square with the myriad of different conceptions of race available. But the core role of reductions is to reinterpret theories in terms of the entities and processes of the reducing theory. And so we may ask: what is the likelihood that genetic theories of race may enable us to develop a scientifically warranted surrogate for the social construction of race? Whether it supports racism is a crucial social and ethical issues, but first we must ask whether some analogue to the notion of race can be sustained on genetic grounds.

We have seen above, that human beings can be differentiated by mutations, tracing both male and female lines that have geographic distributions that reflect racial distinctions to some extent. But can they be used to determine race? An interesting test case is the recent attempt to assign racial categories by finding genetic patterns identifiable with a geographic area associated with a socially constructed racial group (ibid. pp. 99ff). Even if we accept that the results offer percentages so that racial identification is partial, there is a logical problem. As an example, the Y chromosome is passed from father to son and is used to track male antecedents. But although one's father is a culturally strong identifier, it is a small fragment of the inherited genetic information, for everyone has 2 parents, 4 grandparents, 8 great grandparents and so on. And so whatever the filial connection a person is much more than his father's son. In terms of the MET, genetics markers reduce only a small fraction of a person's racial identity, and one that is vanishingly small as the generations multiply.

This raises an interesting question in light of a recent attempt to patent a race-specific heart medication, BiDil (ibid, pp. 129ff). Although genetic markers capture only a fragment of the genetic inheritance, is there a useful role for racial markers as identifying sub-populations that are sufficiently coherent with socially constructed racial categories to serve various social purposes. Race-specific medications is one such category, another is the identification of genetic markers as a forensic tool in criminal investigations (ibid., pp. 116ff). The scientific questions can be addressed through the MET. BiDil was seen in clinical trials to be exceptionally effective with patients who self-designated as African-American. This may be a coincidence, or even reflect little more than marketing strategy (ibid, p. 144). But if it is a scientifically supported discovery, the MET requires that it is a harbinger of things to come. The MET gives a criteria, the claim is scientifically supported to the extent that the range of medications with identifiable genetic locations is increasing. That is, the chain of medically supported generalizations about the predominance of illnesses among groups can be seen, upon reinterpretation, to be the effect of genetic properties as opposed to, for example, shared social, economic or environmental factors. We know that many diseases cluster, although the clusters are racially and geographically complex (Graves, 2001, pp. 176ff), but if genetic theories are effective reducers the reduction of such clusters to genetic theory should increase over time (MET, 2.2). This raises a significant issue within argument theory. Although the arguments in support of BiDil can be evaluated at a time, the ultimate question eludes resolution; only time will tell.

This becomes even more telling with the second example, forensic markers that racially identify potential suspects. This returns our discussion to the heart of racism, for even if such a practice is scientifically supported it is susceptible to significant abuse, if only because DNA databases of criminals are racially skewed, given the statistics on incarceration for various racial groups, and searches are broad enough to identify family members, so the chance of innocent individuals being charged is high (ibid., p. 76). It is ultimately a policy decision whether to rely on racially relevant genetic markers as a clue to the identity of a perpetrator, but the reliability of genetic markers, in general, can only be determined by the reach of genetic theory. As genetic markers become useful in a range of new contexts (MET, 2.4) the reliance on them in particular contexts becomes more supportable and more capable of resisting social and moral complaints about their possible misuse. Policy is an unhappy negotiation between fact and value, but we do this at our peril unless we get the facts right.

4. CONCLUSION

The foregoing is no more than a sketch and an indication of a procedure. If the MET is to be generally applicable across the range of scientific arguments the logical structure presented in abbreviated form in the technical appendix that follows needs to be shown to be broadly applicable to both theoretically coherent scientific arguments such as those found in physical science and the more theoretically diffuse complexes that are represented by multi-theoretic scientific arguments that are relevant to the broad array of social concerns for which scientific theories yield insight. The problem of racism is one such. Concerns with the environment are an obvious example of social concerns for which scientific knowledge is essential, policies on medical treatment, on sustainable development, on the effective management of natural resources and of food production are all equally obvious examples for which complex multi-theoretic scientific understanding is necessary in order to critically evaluate arguments put forward.

My choice of the example of racism is to offer an issue far removed from the original context of the MET. Future exploration of the power of the MET is a project that reflects my call for a research agenda for critical thinking and informal logic (Weinstein, 1990). At that point my agenda has purely speculative and had little technical resource to support the possibility of the research project that I called for. Hopefully, with the MET now available, others will join with me to explore the possibilities that the technical apparatus provides and the salience of the deep foundational concepts that it exemplifies.

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TECHNICAL APPENDIX
The Model of Emerging Truth (MET)

Part I:

1. A scientific structure, TT = <T, FF, RR> (physical chemistry is the paradigmatic example) where T is a set of sentences that constitute the linguistic statement of TT closed under some appropriate consequence relation and where FF is a set of functions F, such that for each F in FF, there is a map f in F, such that f(T) = m, for some model or near model of T. And where RR is a field of sets of representing functions, R, such that for all R in RR and every r in R, there is some theory T* and r represents T in T*, in respect of some subset of T.

A scientific structure is first of all, a set of nomic generalizations, the theoretic commitments of the members of the field in respect of a given body of inquiry. We then include distinguishable sets of possible models (or appropriately approximate models) and a set of reducing theories (or near reducers). What we will be interested in is a realization of TT, that is to say a triple <T, F, R> where F and R represent choices from FF and RR, respectively. What we look at is the history of realizations, that is an ordered n-tuple: <<T,F1,R1>,...,<T,Fn,Rn>> ordered in time. The claim is that the adequacy of TT as a scientific structure is a complex function of the set of realizations.

1.1. Let T' be a subtheory of T in the sense that T' is the restriction of the relational symbols of T to some sub-set of these. Let f' be subset of some f in F, in some realization of TT. Let $<T'_1,...,T'_n>$ be an ordered n-tuple such that for each i,j (i<j,) T'_i reflects a subset of T modeled under some f' at some time earlier than T'_j. We say the T is *model progressive under* f' iff:
  a) T'k is identical to T for all indices k, or
  b) the ordered n-tuple $<T'_1,...,T'_n>$ is well ordered in time by the subset relation. That is to say, for each T'_i, T'_j in $<T'_1,\ldots T'_n>$ ($i<j\geq 2$), if T'_i is earlier in time than T'_j, T'i is a proper subset of T'_j.
    1. 2 We define a *model chain* C, for theory, T, as an ordered n-tuple $<m_1,...,m_n>$, such that for each mi in the chain $m_i = <d_i, f_i,>$ for some domain d_i, and assignment function f_i, and where for each d_i and d_j in any m_i, $d_i = d_j$; and where for each i and j (i<j), m_i is an earlier realization (in time) of T then m_j.
    Let M be an intended model of T, making sure that f(T) = M for some f in F (for some realization <T, F, R>) and T is model progressive under f. We then say that C is a *progressive model chain* iff:
      a) for every mi in C, m_i is isomorphic to M, or
      b) there is an ordering of models in C such that for most pairs m_i, m_j (j > i) in C, m_j is a nearer isomorph to M than m_i.
    This last condition is an idealization, as are all similar conditions that follow. We cannot assume that all theoretic advances are progressive. Frequently, theories

move backwards without being, thereby, rejected. We are looking for a preponderance of evidence or where possible, a statistic. Nor can we define this a priori. What counts as an advance is a judgment in respect of a particular enterprise over time best made pragmatically by members of the field. We are engaged in rational reconstruction where logically clarity trumps descriptive adequacy, in presentation, but where descriptive adequacy is still at the heart of the intuition.

1.3. Let $<C_1,...,C_n>$ be a well ordering of the progressive model chains of TT, such that for all i,j (i > j), C_i is a later model chain than C_j. TT is *model chain progressive* iff $<C_1,...,C_n>$ is well ordered in time by the subset relation. That is to say each later model includes and extends the models antecedent to it in time.

2. We now turn out attention to the members of some R in RR. The members of RR represent T in T* in respect of some subset of T, k(T). Let $<k_1(T),...,k_n(T)>$ be an n-tuple of representations of T over time, that is, if
   i > j, then $k_i(T)$ is a representation of T in T* at a time later that $k_j(T)$. We say that TT is *reduction progressive* iff,
   a) k(T) is identical to Con(T) for all indices, or
   b) the n-tuple is well ordered by the subset relation.
      2.1. We call an n-tuple of theories RC = $<T_1,...,T_n>$ a *reduction chain,* and $<T_1,...,T_n>$ a *deeper reduction chain* than j-tuple $<T'_1,...,T'_j>$, iff n>j and for all i,j there is a r_i in R_i such that r_i represents T_i in T_i+1 and similarly for T'_i and further for all T_k ($k \leq j$) T_k is identical in both chains Note, the index i must be different from the index j, since if i=j, there is no T_{i+1}.
      2.2. We call a theory *reduction chain progressive* iff T iff for an n-tuple of reduction chains $<RC_1,..., RC_n>$ and for each RC_i (i<n), RC_{i+1} is a deeper reduction chain than Rc_i.
      2.3. T is a *branching reducer* iff there is a pair (at least) T' and T* such that there is some r' and r* in R' and R*, respectively, such that r' represents T' in T and r* represents T* in T and neither T' is represented in T* nor conversely.
      2.3.1 B = $<TT_1,TT_2,...,TT_n> = < <T_1, F_1, R_1>, <T_2, F_2,R_2>,..., <T_n, F_n, R_n>>$ is a *reduction branch* of TT_1 iff T_1 is a branching reducer in respect of T_i, and T_j ($i \geq 2$; $j \geq 3$ for $i,j \leq n$)
      2.4. We say that a branching reducer , T is a *progressively branching reducer* iff the n-tuple of reduction branches $<B_1,...,B_n>$ is well ordered in time by the subset relation, that is, for each pair i,j (i>j) B_i is a later branch than B_j, that is, the number of branching reducers has been increasing in breadth as inquiry persists.

Part II:

The core construction is where a theory T is confronted with a counterexample, a specific model of a data set inconsistent with T. The interesting case is where T has prima facie credibility, that is, where T is at least model progressive, that is, is increasingly confirmed over time (Part I, 1).

A. The basic notion is that a model, cm, is a *confirming model* of theory T in TT, a model of data, of some experimental set-up or a set of systematic observations interpreted in light of the prevailing theory that warrants the data being used. And where
   1) cm. is either a model of T or
   2) cm is an approximation to a model of T and is the nth member of a sequence of models ordered in time and T is model progressive (1.1).

B. A model interpretable in T, but not a confirming model of T is an *anomalous model.*

The definitions of warrant strength from the previous section reflect a natural hierarchy of theoretic embeddedness: model progressive, (1.1), model chain progressive (1.3) reduction progressive (2), reduction chain progressive (2.2), branching reducers (2.3) and progressively branching reducers (2.4). A/O opposition varies with the strength of the theory. So, if T is merely model progressive, an anomalous model is type-1 anomalous, if in addition, model chain progressive, type-2 anomalous etc. up to type-6 anomalous for theories that are progressively branching reducers.

P1. The strength of the anomaly is inversely proportional to dialectical resistance, that is, counter-evidence afforded by an anomaly will be considered as a refutation of T as a function of strength of T

in relation to TT. In terms of dialectical obligation, a claimant is dialectically responsible to account for type 1 anomalies or reject T and less so as the type of the anomalies increases.
P2: Strength of an anomaly is directly proportional to dialectical advantage, that is, the anomalous evidence will be considered as refuting as a function of the power of the explanatory structure within which it sits.
P*: The dialectical use of refutation is rational to the extent that it is an additive function of P1 and P2