A Modern Defense of Vienna Circle Unity of Science (Extended Abstract)

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Abstract

This paper argues that continued progress in 21st century science requires using the methods of Vienna Circle (VC) developed unified science. The method as expressed by Otto Neurath is explained and defended. It is shown that unifying formal and social sciences is a direct result of using VC style unity of science and physicalist empirical testing. After providing a possible explanation of why unified science is not more widely used, a number of problem areas in modern science are discussed to illustrate the advantages of VC unified science. Criticisms of string theory are discussed. The prevalence of researchers who abandon empirical science in situations involving extreme complexity is analyzed. Finally, the sociology of the formal sciences is discussed to show that lack of VC unified science empiricism is detrimental to improve theories of infinity.

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1. Introduction

During the second half of the 20th century, a large separation existed between the formal sciences and the social sciences. The formal sciences were considered superior because of the perceived success of the formalized "standard model" in physics and axiomatized structuralism in mathematics. Social sciences were considered inferior because formal axiomatization was impossible. A problem with this characterization of science is that it celebrated non empirical formal sciences for which empirical criticism was not possible because the theories formalized prior discoveries. Yet, it denigrated social sciences for which empirical testing was still important.

This separation did not exist during the development of as empirical science in the latter part of the 19th century. Instead, all science attempted to be empirical and to avoid metaphysics. The most significant impediment to late 19th century science involved replacing beliefs based on dogma such as religion, or tradition, or Kantian introspective metaphysics with empirical testing (Planck[1932]). Empiricism was not limited to formal sciences. For example, the debate between Ernst Mach and Albert Einstein over the role of sensory input used modern empirical testing that involved both experiments and theories. Sociological thinking was important in changing organizations to allow replacement of metaphysical beliefs with empirical science. The appointment of Max Planck as Professor of Natural Philosophy at the University of Humboldt was an important social step in the development of modern physics. This method was later called "the unity of science" by Otto Neurath. This paper argues that 21st century formal and social sciences would both benefit from returning to the unity of science method. It should be read as a post Lakatos-Feyerabend-Kuhn continuation of the 1958 Minnesota Studies paper "The Unity of Science as a Working Hypothesis" (Oppenheim[1958]).

2. Vienna Circle (Neurath) Unified Science

The main cornerstone of unified science is that all scientific problems are studied without metaphysical assumptions or axiomatic preconditions. Problems are seen as complex, multi-faceted, multiply interconnected and without boundaries (called Ballungen by Neurath). Demarcation between problems and even scientific areas is an empirical question that requires theories and experiments.

In the language of Neurath (Uebel[1991] particularly R. Haller's essay p. 117-129, also Neurath[1983]), theories should be called encyclopedias because a theory is more than just the axiomatized list of results but also may include experimental results, formulas, rules of thumb, computer codes, simulations, behavioral models and even observational statements. Encyclopedias are provisional and therefore can be split, combined or modified in any way that is consistent with empirical results. The testing process is called shaking because no methods of testing are a priori preferred. The term encyclopedia is particularly explanatory for modern science because of the current importance of computer data bases and models. The empirical method of unified science is called physicalism because it uses the reasoning methods of modern physics as

opposed to, for example, either the consciousness raising methods (critical possibilities) of the Frankfurt School (see below) or the formal proof rules of axiomatized mathematics. A property of unified science is that there is no distinction between formal science, social science, philosophy of science or even sociology of science. They all have encyclopedias that are tested using physicalism.

This paper uses the Vienna Circle (VC) language of Neurath, but the similar language of Lakatos' methodology of scientific research programmes (MSRP) could be used instead (Meyer[2008] extended abstract, also last slide that contains a table of corresponding terms). MSRP can be viewed as a reformulation of Vienna Circle unified science by a student of Karl Popper. As Lakatos (and Feyerabend and Kuhn) moved away from Popper's falsificationism they moved closed to VC unified science (Meyer[2004]). Popper wanted to eliminate social sciences from scientific study (particularly psychoanalysis and Marxism) and gave priority to negative experimental results (Popper[1959]). Unified science allows any empirical testing (called shaking). Choice of empirical methods is a provisional and testable property of a given encyclopedia. Using VC unified science, sociology of science is immediately reconciled with the philosophy of science.

3. Incorrect Frankfurt School Criticism of Vienna Circle Empiricism

One may ask why the method of unified science is not widely accepted especially in light of its close connection to Lakatos' methodology of scientific research programmes (MSRP). In my view, the main reason unified science became unfashionable is due to criticism from the Frankfurt School of Continental philosophy which completely mis-characterized Vienna Circle empiricism. Due to political events in Austria during the 1930s, there was no one to answer the Frankfurt school criticism.

Following H. Giroux's book (Giroux[1997], p. 39), Horkheimer claimed that VC logical empiricism:

presented a view of knowledge and science that stripped both of their critical possibilities. Knowledge was reduced to the exclusive province of science, and science itself was subsumed within a methodology that limited scientific activity to the description, classification and generalization of phenomena with no care to distinguish the unimportant from the essential. Accompanying this view is the notion that knowledge derives from sense experience and that the ideal it pursues takes place 'in the form of a mathematically formulated universe deducible from the smallest possible number of axioms, a system which assures the calculation of the probable occurrence of all events[quoting Horkheimer[1972], p. 183]'.

This characterization of unified science is completely wrong (Uebel[1991], Neurath[1983]). In fact VC unified science advocates methods exactly opposite to those attributed to it by Horkheimer. Now that unified science has been rediscovered and the main criticism has been shown to totally mis-characterize unified science, it is time to again start using the methods of VC style unified science.

4. Unified Science Critical for 21st Century Scientific Progress

Already in the 21th century, there is growing skepticism toward scientific knowledge that was considered proven knowledge during the late 20th century. The dominant pattern in the examples discussed below is related to the metaphysical (and in my view incorrect) assumption that sciences without axiomatized formal foundations are somehow inferior to empirical sciences. My argument is that large benefit would come from explicitly using methods from Vienna Circle unified science: encyclopedia development, universality of empirical testing, Neurath Principle and apply empirical testing as used by physical sciences (physicalism).

4.1 Problematic String Theory

In physics string theory is facing increasing criticism and doubt. See Smolin's book *The Trouble with Physics - The Rise of String Theory, the Fall of a Science, and What Comes Next* (Smolin[2006]). Not only does Smolin claim that string theory is failing empirical tests (the crucial Higgs Boson will probably not be found) but also criticizes string theory because it is formal theory (encyclopedia) deduced from axioms that does not provide testable predictions.

4.2 Abandonment of Empiricism when Complexity is High

From the other natural sciences, the view that many problems (encyclopedias) are so complex that they lie outside of science (nothing empirical can be stated) is becoming more prevalent. This view is expressed by some as chaos theory. It is expressed by others using the newly defined term 'emergent' phenomena. It is used to name problems considered to be so complex that observed properties emerge only from interactions. In this definition of emergent, it is not possible to learn anything by studying a problem's constituent elements (primitives).

Interestingly, physicists reject the complexity definition of emergent. They define emergent to mean properties that 'emerge' from material boundaries such as physical study of the ocean-atmosphere boundary or physical properties at the minimum Planck distance boundary. Physicists are applying unified science. They see complex, puzzling and unspecified problems as Ballungen that need empirical study. They construct provisional encyclopedias which can be split, combined or changed as study continues. It seems to me that unified science is much more likely to lead to progress than focusing on the metaphysical phenomenology of complexity.

4.3 Sociology of Formal Versus Empirical Sciences

Mathematics and to a lesser extent theoretical physics and computer science have benefited greatly from their social organization. Mathematics in the last half of the 20th century has been sociologically extremely successful and affluent. On the positive side, there are many difficult problems for young mathematicians to work on. There are contests such as the Mathematics Olympiad. There are prizes for mathematicians such as the Field Prize for which mathematical methods do not need to compete with empirical methods. Modern legal systems have even allowed mathematicians to profit by patenting their formulas. The value of the formulas often depends on fads created by advertising.

On the negative side, the sociological success of the formal sciences has led to

elimination of both any connection to empirical sciences and any testing of foundational encyclopedias. There may be a brief period of debate when some new foundational result is introduced, but just one method (definition of acceptable proof technique) is almost immediately agreed upon by convention. This conventionalism is not new and goes back at least to acceptance of Goedelian criticism of logical truth versus Finsler's around 1930 (Breger[1995).

The lack of empiricism let alone use of methods from VC unified science in formal sciences at best prevents progress in empirical testing and at worst is detrimental to scientific progress. See Smolin[2006], pp. 260-288 for a discussion of the sociological effect of lack of empirical testing of competing encyclopedias in theoretical physics.

4.4 Empirical Testing of New Concepts of Infinity

In physics, problems related to continuous mathematical models (discontinuities and infinite physical quantities resulting from the mathematics) have become increasingly prevalent (Smolin[2006], 5,6, 187-189, 278). One obvious application of unified science would be to develop new concepts of infinity (new provisional encyclopedias) that could be used to allow physical calculations that avoid use of uncountable infinity (one to one correspondence with real numbers). Mathematics is at best oblivious to helping solve such physical problems because it might require large changes in mathematical proof rules.

An obvious candidate for a new encyclopedia on infinity that also solves one of the most important open mathematics of computation problems (is P equal to NP) arises from exploring a new type of infinity which is the number of non deterministic Turing machines. Sociologically mathematics are not interested in trying to imagine new ways to count the infinite number of non deterministic Turing machines. Such a study in unified science would present a complex ill defined Ballungen that would require VC unified science style empirical testing.

Another related encyclopedia of infinity involves today's common implicit assumption that because computer are so fast, all problems can be treated as finite. In my ECAP-2008 talk (Meyer[2008] I argue that the main difficulty in understanding computational thought is the fallacy of finiteness. Mathematics avoidance of studying encyclopedias of this finitism does not directly hinder progress in empirical sciences, but it does hinder progress in encyclopedias involving foundational problems in the philosophy of mathematics. Study of encyclopedias of finitism is particularly important for progress in science because computer codes are now an important part of all science both formal and social.

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