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AOS, AOC	AOS: Philosophy of Science, Philosophy of Chemistry, History of Science, Science and Technology Studies AOC: Bioethics, Logic, Philosophy of Social Science, Philosophy of Medicine (esp. Psychiatry), Marx and Marxism
EDUCATION	2020: Ph.D. History and Philosophy of Science, University of Pittsburgh Dissertation: Science, labor, and scientific progress 2012: M. A. Philosophy, Tufts University 2007: Ph.D. Organic Chemistry, Harvard University. Dissertation: I. Carbinols from <i>N</i> -acylpyrroles. II. Studies towards the synthesis of spiro-procentrimine. 1999: B.S. with High Honors, Chemistry, University of California, Berkeley, California
EMPLOYMENT	(2016-2021) Instructor, University of Pittsburgh (2011-2013) Consultant, Nimbus Therapeutics (2010-2011) Consultant, Concert Pharmaceuticals (2007-2010) Scientist, Concert Pharmaceuticals (2003) Research Associate, Amgen Inc. (2000-2007) Research in synthetic organic chemistry, Harvard University (1998-2000) Research in synthetic organic chemistry, University of California, Berkeley
PUBLICATIONS	<p style="text-align: center;">PEER-REVIEWED HPS ARTICLES</p> (Forthcoming) Discoverer and Methodologist: Alfred O. C. Nier and the Instrumental Revolution in Geochemistry, 1935-1948. <i>Historical Studies in the Natural Sciences</i> (2023) Whose labor? Labor, Appropriation and the Very Idea of Full Automation. <i>Science & Society</i> , October. (2020) On “the Application of Science to Science Itself:” Chemistry, Instruments and the Scientific Labor Process. <i>Studies in History and Philosophy of Science</i> , 79, 41-56. https://doi.org/10.1016/j.shpsa.2019.05.008 . (2019) Discovery and instrumentation: how surplus knowledge contributes to progress in science. <i>Perspectives on Science</i> , 27(6), 861-890. <i>Project MUSE</i> muse.jhu.edu/article/743378 .

IN PREPARATION

(Under Review) What Makes the Historical Sciences Tick? Geochronology and the Ontology of Scientific Methods. *Philosophy of Science*.

(Proposal) *Instrumental Rationality in Science: On the Evolution of Scientific Techniques*. Monograph.

REVIEWS

(2019). Review of M. Mizrahi (Editor). (2018). *The Kuhnian Image of Science: Time for a Decisive Transformation? Philosophia*

SCIENTIFIC PUBLICATIONS

(2011) Effect of Counterion Structure on Rates and Diastereoselectivities in α,β -Unsaturated Iminium- Ion Diels-Alder Reactions Marcoux, D.; Bindschädler, P.; Speed, A. W. H.; Chiu, A.; Pero, J. E.; Borg, G. A.; Evans, D. A. *Org. Lett.* **2011**, *13*, 3758.

(2008) Evaluation of a Series of Naphthamides as Potent, Orally Active Vascular Endothelial Growth Factor Receptor-2 Tyrosine Kinases Weiss, M. M.; Harmange, J-C; Polverino, A. J.; Bauer, D.; Berry, L.; Borg, G. *et al. J. Med. Chem.* **2008**, *51*, 1668-1680.

(2008) Naphthamides as Novel and Potent Vascular Endothelial Growth Factor Receptor Tyrosine Kinase Inhibitors: Design, Synthesis and Evaluation Harmange, J-C; Weiss, M. M.; Germain, J.; Polverino, A. J.; Borg, G.; *et al. J. Med. Chem.* **2008**, *51*, 1649-1667.

(2002) Remarkably Stable Tetrahedral Intermediates: Carbinols from Nucleophilic Additions to *N*-Acylpyrroles Evans, D. A.; Borg, G.; Scheidt, K. A. *Angew. Chem. Int. Ed.* **2002**, *41*, 3188.

(2001) Asymmetric Synthesis of Pre-Protected α,α -Disubstituted Amino Acids from *tert*-Butanesulfinyl Ketimines Borg, G.; Chino, M.; Ellman, J. A. *Tetrahedron Lett.* **2001**, *42*, 1433.

(1999) One-Pot Asymmetric Synthesis of *tert*-Butanesulfinyl-Protected Amines from Ketones by the *in situ* Reduction of *tert*-Butanesulfinyl Ketimines Borg, G.; Cogan, D. A.; Ellman, J. A. *Tetrahedron Lett.* **1999**, *40*, 6709.

PRESENTATIONS	<p style="text-align: center;">PEER-REVIEWED</p> <p>(2023). Geochronology and the Ontology of Scientific Methods. &HPS9, Columbia, South Carolina.</p> <p>(2022) Discoverer and Methodologist: Alfred O. C. Nier and the Instrumental Revolution in Geochemistry, 1935-1948. Scientific Instrument Symposium, Athens, and History of Science Society, Chicago.</p> <p>(2020-21) Discovery and instrumentation: how surplus knowledge contributes to progress in science. Center for Philosophy, University of Lisbon and Canadian Society for the History and Philosophy of Science, University of Alberta, Edmonton.</p> <p>(2018) Science, labor and scientific progress. <i>Société de philosophie des sciences</i>, Nantes, France</p> <p>(2018) Accentuating the Positive: Observation and Measurement in Kepler’s Optics. <i>Measurement at the Crossroads</i>, Paris</p> <p>(2016) On the Application of Science to Science Itself: Chemistry, Instruments and the Scientific Labor Process. <i>Society for Philosophy of Science in Practice</i>, Rowan, NJ</p> <p>(2000). Asymmetric Synthesis of Amines and α,α-Disubstituted Amino Acids from tert-Butanesulfinyl Ketimines. Poster, American Chemical Society, San Francisco</p>
	<p style="text-align: center;">NON-ACADEMIC</p> <p>(2022) Marx as a student of technology. Podcast interview. Pittsburgh Democratic Socialists of America.</p> <p>(2017) Questions éthiques sur la mort assistée. Présence Philosophique Le Puy, Le Puy-en-Velay, France</p> <p>(2016) Les origines, la nature et l’objet de la philosophie des sciences. Radio Chrétienne Francophone, France</p>
FUNDING	<p>(2021-2023) National Science Foundation Post-Doctoral Fellowship. \$138,000</p> <p>(2023) Science History Institute Short-Term Fellowship. \$6,000</p> <p>(2018) Wesley Salmon Fund Grant, University of Pittsburgh. \$450</p> <p>(2016) Wesley Salmon Fund Grant, University of Pittsburgh. \$832</p> <p>(2010-2012) Tufts University tuition scholarship. \$24,700</p>
HONORS	<p>(1999) Elected member of the Phi Beta Kappa Society (prestigious honor society in USA)</p> <p>(1999) Departmental Citation in Chemistry, University of California, Berkeley</p> <p>(1999) Commencement Chemistry Student Speaker, University of California, Berkeley</p> <p>(1997-1999) Honors received, University of California, Berkeley, California</p>

	(1996-1997) Dean's Honors List, University of California, Riverside, California
TEACHING	<p>University of Pittsburgh Philosophy of Psychiatry (independent instructor, 3 terms, 2021) Ancient Myth and Science (independent instructor, 2 terms, 2020) History and Philosophy of the Scientific Revolution (independent instructor, 3 terms, 2019-2021) Morality and Medicine (independent instructor, 7 terms, 2017-2021) History of Philosophy of Science (independent instructor, 1 term, 2016) Einstein for Everyone (teaching assistant, 1 term, 2015) Morality and Medicine (teaching assistant, 1 term, 2014)</p> <p>Tufts University History of Early Modern Philosophy (teaching assistant, 1 term, 2012)</p> <p>Harvard University Organic Chemistry of Life (teaching assistant, 2001) Organic Chemistry of Life, Part II (teaching assistant, 2002)</p>
GRADUATE COURSEWORK	<p style="text-align: center;">University of Pittsburgh</p> <p>Philosophical Philosophy of Science, Batterman, Fall 2013 Theory of Knowledge, Humphreys, Fall 2016 Explanations, Causes and Mechanisms, Bogen & Machamer, Fall 2013 Laws of Nature, Mitchell, Spring 2014 Epistemology of Experimental Practices, Mitchell & Chirimuuta, Spring 2017 Experiment and Scientific Practice, Chirimuuta, Spring 2015 Models and Modeling in Science, Mitchell & Woodward, Spring 2016 Topics in Philosophy of Physics, Norton, Fall 2013 Philosophical Issues in High-Energy Physics, Perovic, Spring 2014 Game Theory, Seidenfeld, Spring 2014 Philosophy of Economics, Zollman, Fall 2015 Marx, Thompson, Fall 2019</p> <p>Historical Aristotle's Philosophy of Science, Lennox, Fall 2013 History of the Life Sciences, Olby, Spring 2014 Darwin: Some of the Origins of the <i>Origin</i>, Lennox, Fall 2014 History of the Physical Sciences, Palmieri, Spring 2015 Scholasticism, Palmieri, Fall 2015 Descartes Scientist, Manders, Fall 2015 The Ocular Revolution, Baker, Spring 2016 Einstein, Norton, 2015</p>

	Tufts University
	<p>Philosophy of Social Science, Epstein, 2010 Metaphysics, Epstein, 2010 Logic, Smith, 2011 History of Modern Philosophy, Olfert, 2011 Science Before Newton (audit), Smith, 2011 Newton’s Principia (audit), Smith, 2012 Ethical Theory, Baz, 2010 Feminist Philosophy, Bauer, 2010 Merleau-Ponty’s Phenomenology, Baz, 2010 Voltaire & Rousseau, Hakim, 2012 Philosophy of Law, Kelly, 2010</p>
PROFESSIONAL SERVICE	<p>(2022-present) Penn Anti-Coercion Campaign (2020-2021) Organizer, University of Pittsburgh Faculty Organizing Committee (2016-2020) HPS graduate student liaison with Graduate Student Organizing Committee-United Steelworkers. (2016) Co-organizer of the 18th Annual Pitt/CMU Graduate Student Philosophy Conference, April 8th-10th. (2016-2017) Graduate Student Office Manager, Department of History and Philosophy of Science, University of Pittsburgh.</p>
AFFILIATIONS	American Philosophical Association, American Chemical Society, Society for Philosophy of Science in Practice, History of Science Society
LANGUAGES	English, French (bilingual) German (can read with a dictionary)

**DISSERTATION
ABSTRACT**

My dissertation introduces a new materialist theory of scientific progress built on a novel characterization of scientific work and an analysis of progress appropriate to it. Philosophers of science have long been interested in scientific change, but they have been mainly focused on how cognitive objects—theory, experiment, evidence, etc.—change. My dissertation argues that this focus is insufficient to answer two crucial questions for understanding scientific progress:

Why is it possible for scientists at a given time to have more epistemic abilities than scientists at an earlier time?

How can knowledge acquired in the past be used in on-going or future research?

I argue that these questions are best answered by analyzing science as a form of labor. The elements of the labor process, involving both intellectual and material means, provide a starting-point for the systematic study of how scientific abilities evolve.

Using this approach, I develop a novel model of scientific change that, I argue, is better at explaining the growth of scientific abilities than classical models like Thomas Kuhn's (among others), because it, unlike the classical models, incorporates changes in instrumentation and systems of labor. In virtue of its focus on the instrumental contribution to scientific research, my model explains how knowledge acquired in the past can be applied in on-going research: it brings out distinctive properties of instruments, largely ignored in the classical models, that allow prior knowledge to be brought to bear.

As a unit of analysis, the labor process exposes features of the dynamics of knowledge accumulation that traditional analyses do not. I analyze historical cases from chemistry and the Scientific Revolution, attending carefully to how scientific work is conducted and conceived.

First, the evolution of scientific abilities depends on ambient ideological conditions: Social attitudes towards different kinds of work are critical, as are scientists' own notions about the proper object of science and the value of technology. I demonstrate these effects of ideological conditions through a historically-driven analysis of the emergence of the scientific method in Europe's early modern period.

Second, I argue that scientific progress consists not just in the growth of theoretical or empirical knowledge, as in traditional philosophy of science, but also in the growth of abilities. The tools of science play a crucial role in determining the abilities scientists can and must have to do science. Tools also determine how scientists' abilities change over time, by enabling, but also constraining, the incorporation of knowledge into the labor process. I bring a new perspective to the idea that science is furthered by instrumentation. They do not just enhance our senses, which is the standard view. To it, I add that they initiate a positive feedback loop between the production of new knowledge and instrument construction. This process requires the integration, and transformation into material form, of different kinds of knowledge. As the process is repeated over the long term, scientific work is transformed because it becomes less dependent on native human epistemic abilities.

This view refreshes the topic of scientific discovery, which has traditionally been treated as a one-way avenue leading from the scientific method to novelty. In contrast, my view is of a spiraling process, in which discoveries are conceived as a surplus, and hence as having potential uses that can be incorporated into scientific practice for further rounds of discovery.

I showcase these claims on a concrete historical case drawn from the history of 20th century chemistry that has not been much discussed in the philosophy of science. The

“Instrumental Revolution in Chemistry,” as it has been called, involved a revolution in the analytical methods of chemistry. On a traditional, theory-centric view, this episode would largely be a story about the development of quantum mechanical theory and its application in chemistry. On my view, this has to be understood as a transformation of labor. It is true that each new method was based on a physical phenomenon, most often quantum-mechanical. But the initial phenomenon was generally inapplicable for other than specialist use until the instrument used to detect it, and the techniques for its use, were transformed in order to adapt them to the chemical context. Conversely, the adoption of the instruments entailed a transformation of analytical work in chemistry. Thus viewed, I argue that the Instrumental Revolution appears as one instance of a recurring pattern of scientific revolution caused by radical changes in the means of scientific work.

The question of dynamics may be put in broader perspective by considering the well-known fact that starting roughly in the 1980s, the history and philosophy of science took what has been called the “turn to practice.” This turn involved a shift in research focus from the finished products of science—theories and facts, for pre-turn historians and philosophers—to the nature of scientific practice. Though my work is clearly inscribed within the practice turn tradition, it combines that tradition with an older concern for the nature and causes of scientific progress. This older tradition, however, tended to view progress as either incremental or discontinuous. Incrementalists emphasized the gradual incorporation of past achievements into present theories. Discontinuists, on the other hand, emphasized revolutionary episodes in which theories are overthrown and replaced by superior competitors. My view is that science is constantly transforming itself by incorporating prior knowledge into its own practices. There is indeed a revolutionary aspect. But there is also an incrementalist aspect, in that the transformation occurs by the integration of prior knowledge into present practices. The conception of a discovery as a surplus, and hence as having a potentially transformative role in the reproduction of scientific practice, is important for appreciating these dynamics.