**1: Introduction**

Over the past few years, research carried out at large-scale materials science facilities in the United States and elsewhere has undergone a phase transition that has affected its character and culture. In this talk, I’d like to briefly (1) describe this phase transition, (2) review the practical challenges it poses for historians, (3) review some potential digital tools that might respond to these challenges, and then (4) suggest some theoretical challenges posed by the emerging field of “database history.”

**2: The New Big Science**

What we might call the Old Big Science was born, starting after the Second World War, with the creation of national laboratories. The primary dynamic of the Old Big Science was that the scale of its premier high-energy physics projects—instruments, collaborations, and the time-scale that projects followed—increased rapidly. In the New Big Science, which started in the 1980’s and entailed, in part, a shift to materials science, instruments and collaborations do not get bigger and bigger; instead, the research ecosystem grows more complicated. That ecosystem involves more and more fields making use of national laboratories, a wider variety of instruments, more connections between seemingly disparate research programs, and a faster turnover of programs.

Research in the New Big Science differs from research in the Old Big Science in the *scope and complexity of its research networks*, which can simultaneously involve several national labs, several universities, and several industries. The *formation of knowledge* in this research culture is also different. Instead of research projects addressing single puzzles, materials scientists often work to pull together a mosaic of properties whose focus may change rapidly with the properties of the materials being produced.

**3: Challenges for the Historian of the New Big Science**

That description brings me to the focus of this paper: the challenges of telling the story of such a research ecosystem, and the opportunities that digital tools and methods offer for meeting such challenges.

Consider the traditional methods for investigating the research ecosystem at a science facility. The traditional tools that a historian can bring to such a research object are diverse, but narrow; confined to the length of a book or article, he must choose one or a few currents in the full ecosystem on which to focus. For example, he might choose to track a machine’s *operational history*, its *administrative history*, or its *functional history*. He could focus on the publications associated with each port or research program; the personnel associated with each port or research program; the instruments associated with each port or research program, and when they were built, rebuilt, or replaced; the funding, in the form of prizes, grants, and other funding sources, associated with work associated with each port or research program; the industries associated with each port or research program; the historical map of research programs at the NSLS, how long they lasted, and how they were funded; or the applications of research findings.

It is our argument, however, that narratives and lists of this kind are of little value unless they are connected with each other. So essential is interconnectedness to the New Big Science that traditional historical methods, which can follow only a few threads at a time, cannot adequately account for the functioning of this research ecosystem nor explain its achievements. This mode of practicing science can only be fully understood if connectivity and interdependence are placed in the foreground of the historian’s attention. Because of the singular dependence of any one factor on an entire ecologic environment, even very basic and traditional questions about the new era of materials science are difficult to answer: for example, what biological science is happening at materials science facilities, and how has this science evolved? More detailed questions are still harder: what are the connections between specific kinds of biological research and other fields like physics, chemistry, and engineering? How have these connections evolved over time, and how are they related to the evolution of broader social concerns about health, epidemics, and so forth? These are interesting and important questions—not just to science historians, but also to scientists, administrators, funding agencies, and policymakers.

As it happens, we, too, live at a moment characterized by transformation in our forms of knowledge production, defined, in part, by new tools that facilitate the rethinking of research objects in terms of connections and relationships. In particular, these tools include the relational database and a growing humanistic concern with database use, an orientation that new media scholars have begun to address as *database thinking*.

**4: Database Thinking and Historical Thinking**

The best way to introduce the specific challenges of database thinking is to summarize the goals of our current project, which takes as its basis the National Synchrotron Light Source (NSLS). The NSLS was a historic site for groundbreaking research in materials science from 1982-2014; during that time, it was one of the world’s most widely used scientific facilities. The NSLS is anchored in Brookhaven National Laboratory, and is managed on behalf of the US Department of Energy by Brookhaven Science Associates, of which our home institution of Stony Brook University is a partner. The machine spins electrons in a circle so that they give off light and then reaps the light through several dozen ports. At each port, instruments shape the light so that it can be put to a range of tasks, such as studying materials via electromagnetic radiation.

In terms of research, the NSLS is one of the most productive instruments ever built. The vast number of experiments that took place at the NSLS, and the vast amount of data that it produced during a history that encompassed many changing disciplines, make it nearly impossible to gain a comprehensive global view of the knowledge production that took place at this facility. Traditional historical methods and linear narratives fail to capture precisely the elements that demand new exploration. We are therefore collaborating to develop a new kind of digital tool to capture the history of this research. This project will comprise a digital archive to obtain a history of the NSLS, the main component of which will be a relational database that allows for a wide range of forms of query and analysis. It’s a traditional digital humanities project in the sense that the project aims to demonstrate that new kinds of digital tools can help with challenges of information overload by storing, integrating, and imaging the large amounts of information needed to answer the questions we may ask of a complex ecologic environment. The aim of the database will not be to present a block of answers to our own research questions, but rather to enable other historians to easily explore questions and historical narratives of their own. As we move forward, we intend to guide our progress with reference to models like Sein et al.’s Action Design Research, which offers a model for addressing design problems and theoretical problems as intertwined strands.[[1]](#footnote-1)

However, these tools also pose a new set of problems—historiographic problems that concern the relationship between the domain expertise of the historian and the design of a historical database. As the creation of historical databases becomes an increasingly common practice, we have a growing need to articulate principles for the design of digital tools that will support the kinds of analysis and discovery that we have traditionally valued as historians. For example, while one benefit of using databases is supposed to be freedom from the limitations of received ideas—a notion that *Wired* magazine memorably publicized by heralding big data as “the end of theory”—scholars such as Ted Underwood have reminded us that our digital research tools rely, however invisibly, on a range of preexisting narratives and assumptions.[[2]](#footnote-2) Moreover, as research objects in the digital humanities become more complex, we have a growing need to articulate principles for the design of digital infrastructures to support the management of new volumes and configurations of data relevant to humanists. Here, as with thick description, the deliberate negotiation of frameworks persists, albeit at layers sometimes invisible to the user. Call it deep *description*.

**5: The Challenges of Database History**

So for the closing three minutes, I would like to focus on a specific problem associated with the question of how to write a history of the New Big Science taking place at the NSLS. Specifically, we wish to focus on the question of “database history” as a genre. As Katherine Hayles discusses in her 2012 book, *How We Think: Digital Media and Contemporary Technogenesis*, as historians rely more and more on databases for the management and discovery of information, they must reckon in their methodology with the relationship between the architectures of narrative and database.[[3]](#footnote-3) As we have just outlined, the problem in historiography that the new archive is designed to address lies in the narrow and linear structure of most historical narratives. But databases carry historiographic problems of their own. While the structure of a database evades traditional narrative elements such as sequence and fixed order, a database designed by and for historians may still capitulate to “narrative” in the sense of the embedded logics of the discipline. Does the design of a database, whether in the configuration of the user interface, the selection of its contents, or the indexes that manage its workings, limit the stories that emerge from its contents in a way that would be problematic in the terms that Ted Underwood has described in his criticism of algorithmic research: the limitations are unseen to the people performing the search, who think that the search process has no limitations?

A related question is: would the involvement of human agents in managing this database limit or predetermine the uses that will be made of its contents? This question regards the database as an analog not to a book, but to a journal like *Annales*, *Representations*, or *Année Sociologique*, which not only curated scholarship, but also famously nurtured distinctive schools of practice. Because the field of history, and the schools that comprise it, are under the control of a professional community of historians, the information structure that grounds a historical database will reflect a necessarily partial (and perhaps even political) set of interests. In other words: can there be any kind of database other than a politicized database?

Early answers to these kinds of questions suggest: probably not. But since this feature is part of what makes a historical database, as an artifact, evaluable as a contribution to the discipline, we might start looking for ways to embrace and foreground this inevitability as an opportunity. If database thinking entails thinking in terms of classifications and relationships, then the integration of database thinking with historiographic thinking represents, not an end of theory, nor (in a term that was famously applied prematurely to our postmodern technological society) an end of history,[[4]](#footnote-4) but rather an extension of the historiographic tradition into the materially grounded, practice-based domain that Matt Ratto has called “critical making.”[[5]](#footnote-5)

1. Maung K. Sein et al., “Action Design Research,” Management Information Systems Quarterly 35, 1 (2001). [↑](#footnote-ref-1)
2. Chris Anderson, “The End of Theory: The Data Deluge Makes the Scientific Method Obsolete,” Wired Magazine (23 June 2008). Accessed online, 28 May 2016: <http://www.wired.com/2008/06/pb-theory/>. Ted Underwood, “Theorizing Research Practices We Forgot to Theorize Twenty Years Ago,” Representations 127, 1 (Summer 2014): 64-72. [↑](#footnote-ref-2)
3. N. Katherine Hayles, *How We Think: Digital Media and Contemporary Technogenesis* (Chicago: The University of Chicago Press, 2012). Hayles proposes that we think of narrative and database as “symbionts,” not opposites. [↑](#footnote-ref-3)
4. On this subject, see Alan Liu, *Local Transcendence: Essays on Postmodern Historicism and the Database* (Chicago: University of Chicago Press, 2008). [↑](#footnote-ref-4)
5. Matt Ratto, “Critical Making: Conceptual and Material Studies in Technology and Social Life” (2011). [↑](#footnote-ref-5)