The Metamorphosis: Lenoir's Narrative on Biomedicine as an Information Science

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In his description of biomedicine's metamorphosis into an information science, Lenoir explores several concepts and informs us that biomedicine is now a data-bound science. His non-critical narrative of this transformation, however, may lead the reader to wonder if Lenoir has witnessed the emergence of a butterfly from its chrysalis or a Kafkaesque metamorphosis that leaves the protagonist in the bedroom—dead.

Concepts

Lenoir introduces the reader to several concepts that support his claims. Key concepts include: *instrumentation*, *data-bound science*, and *unified theoretical science*.

Instrumentation

Scientists use instruments. The importance of instruments in shaping the behavior of scientists has been addressed by several commentators.[1] Lenoir, however, extends this concept by including the competencies that produced the instrumentation. He looks to the "role of [the] computational medium itself in shaping biology as an information science."[2] Lenoir goes so far as to imply that the competencies of the instrumentation create a crucial platform for extending biomedicine: "in non-mathematicized disciplines such as biology the language of the computer program would serve as the language of science."[3] Instrumentation then is not just a tool for finding truth but a surrogate mother for new scientific advances.

1 See Latour, B., and S. Woolgar. 1986. Laboratory life: The construction of scientific facts. 2d ed. Introd. by J. Salk. Princeton, New Jersey: Princeton University Press.

2 Lenoir, T. 1999. Shaping biomedicine as an information science. In Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems, eds M. E. Bowden, T. B. Hahn, and R. V. Williams. ASIS Monograph Series. Medford, New Jersey: Information Today, Inc. <http://www.stanford.edu/dept/HPS/TimLenoir/shapingbiomedicine.html>

3 Ibid

Data-Bound Science

Biomedical researchers no longer spend all day staring through microscopes at petri dishes. Some never study real objects at all. The combination of traditional research, computers, and archived data have changed biomedicine:

> "Along with this highly heterogeneous and hybrid form of computer-based experimentation and theorizing has come a different conception of theorizing itself: one based on models of information-processing"[4]

The new process of theorizing has turned biomedicine into a data-bound science that focuses on the structure of biomedical information rather than physical objects. Lenoir explains that scientists now make prediction "from sequence data alone. This... approach identifies the function and structure of unknown proteins by applying search algorithms to existing protein libraries in order to determine sequence similarity, percentage of matching residues, and the statistical significance of each database sequence."[5]

As a data-bound science, the microscope and petri dish have been replaced by a parallel computer running simulations. The computer's data is more important to the science than the physical phenomena that created it.

Unified Theoretical Science

Lenoir provides a reason for biomedicine's adoption of foreign technology and procedures: the quest for Big Biology:

4 Ibid
5 Ibid

> "I want to suggest that by introducing tools of information science biologists have sought to make biology a unified theoretical science with predictive powers analogous to other theoretical disciplines."[6]

By adopting computers and information science, the field of biomedicine is moving beyond the mundane world of the laboratory and into a realm of numbers and formulas. Rat guillotines and tissue assay samplers are traded for Bayesian algorithms and discriminant analysis. Only by abandoning the traditional setting of biological research can biomedicine attain the vaunted status and reputation of Big Physics: a Unified Theoretical Science.

Thesis

In telling the narrative of biomedicine's transformation, Lenoir provides a thesis:

> "Developments in technique and instrumentation launched biology onto the path of becoming a data-bound science, a "science" in which *all* the data of the domain—such as a genome—are available before the laws of the domain are understood."[7]

The thesis can be interpreted in two ways. An optimist could read Lenoir's commendation as an exaltation of modern science—a recommendation that we no longer need to understand the underlying laws to reap benefits from natural phenomena; The butterfly of modern biomedicine has emerged from the chrysalis of the biolab.

Alternatively, the thesis could be read as a warning that ignorance of underlying natural laws is dangerous and can result in unforeseen consequences; Ignorance will leave biomedecine dead in the

6 Ibid
7 Ibid

bedroom –looking like a monstrous beetle –with a rotting apple in its back.

Lenoir is neither optimist nor pessimist. He merely tells the story and leaves moral building to the reader. That information science has fundamentally changed biomedicine and is having a profound effect on science in general, however, is never in question. Although Lenoir never identifies this effect as either virtuous or insidious, he provides valuable insight into its manifestation.

Analysis

Lenoir provides a cogent tale. Upon review, however, three specters haunt his thesis. Before we can determine Lenoir's moral, each must be dealt with: *Cultural Stasis*, *Lengua Silica*, and *Private Perpitude*.

Cultural Stasis

In pursuit of Unified Theoretical Science, biomedicine has undergone extensive change. The nature of the researcher's work remains relatively unchanged. He [sic] is still an observer. Instead of observing natural objects, the researcher now makes observations from information:

> "...a paradigm shift has occurred in both the intellectual and institutional structures of biology. According to some of the central players in this transformation, at the core is biology's switch from having been an observational science, limited primarily by the ability to make observations, to being a data-bound science limited by its practitioner's ability to understand large amounts of information derived from observations."[8]

Lenoir claims that despite the fundamental changes in biomedicine, science will be conducted much as it always has been but that the apparatus and equipment will have changed:

8 Ibid

> "The actual biology will continue to be done as "small science"—depending on individual insight and inspiration to produce new knowledge— but the reagents that the scientist uses will include a knowledge of the primary sequence of the organism, together with a list of all previous deductions from that sequence."[9]

It seems that the institutional structure of biomedicine is changing even as researchers go about conducting research in much the same way as they always have. How, then, can researchers be cognizant of the threats posed by this new paradigm? How can they be aware that they are ignorant of the fundamental laws of the field?

They can't.

Biomedical researchers are unaware of their ignorance. Lenoir assumes, however, that fundamental laws actually exist for a domain of science. Ian Hacking[10] and others would fundamentally disagree and say that the laws of a field are a construct of training and environment. The laws that govern both the institution and practice of biomedicine are ephemeral.

The question now becomes: "Does ignorance of something that doesn't exist pose a threat to biomedicine?"

No.

By introducing the concept of a data-bound science in which all the data of the field are known Lenoir

9 Ibid

10 Hacking, I. 1992. The self-vindication of the laboratory sciences. In Science as practice and culture, ed. A. Pickering, 29-64. Chicago; London: University of Chicago Press.

implies that we are threatened by our ignorance of the fundamental law of practice. Fundamental laws do not exist. The point is moot.

Bring on the butterfly.

Lengua Silica

Fundamental laws may not exist for biology. The thought collective of biology does, however, have a set of practices and methods enshrined in the vademecum that could constitute proxy fundamentals just for the field of biology. The field of biology as remembered by Lenoir, however, has disappeared. It has been replaced by a new field with a new set of laws.

The adoption of a foreign technology brings with it an entirely new vocabulary. New concepts appear and are distributed throughout the field. Some concepts are given totemic significance. Lenoir, for example, talks mystically of Motifs:

> "Motifs are powerful tools for searching databases of known structure and function to determine the structure and function of an unknown gene or protein."[11]

Even Lenoir's description of the mundane elements of biomedicine as an information science uses exotic words: "perceptrons", "discriminant analysis", "neural networks", "Bayesian networks", "hidden Markov models", and "context free grammars." These words are as foreign to Lenoir's traditional biology as "tickety-boo" or "shampoo" is to the English language.

11 Lenoir, T. 1999. Shaping biomedicine as an information science. In Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems, eds M. E. Bowden, T. B. Hahn, and R. V. Williams. ASIS Monograph Series. Medford, New Jersey: Information Today, Inc. <http://www.stanford.edu/dept/HPS/TimLenoir/shapingbiomedicine.html>

By adopting this new vocabulary, biology has been irrevocably changed. In essence, the "language game"[12] that defines biology is constantly changing so the laws that define biology are constantly changing. Essentially, since biology is linguistically dynamic the fundamental laws that define it are constantly made and remade and temporally variable.

Lenoir tells us that a data-bound science has all the data before the laws are understood. The laws he refers to were for a practice that has been superseded and no longer exists. There is really little point in determining what those laws were.

Score two for the butterfly.

Private Perfidy

Fundamental laws of science or biology don't exist. Lenoir's account informs us that the National Institute of Health (NIH) knew this without having to turn to sociological or philosophical analysis. For biomedicine, NIH suspended its stated goal "to acquire new knowledge to help prevent, detect, diagnose, and treat disease and disability."[13]

Instead of addressing disease, the NIH BIONET initiative addressed only the equipment of biomedical research and made no mention of biomedical research:

> "[the primary goal of BIONET was] to provide a way for academic biologists to obtain access to computational tools to facilitate their nucleic acid... related research. A second goal was to provide a mechanism to facilitate research into improving such tools... a third goal of BIONET was to enhance scientific productivity through electronic communications."[14]

12 See Wittgenstein, L. 1958. Philosophical investigations. Trans. G. E. M. Anscombe. New York: Macmillan.
13 Downloaded on March 5, 2003 from http://www.nih.gov/about/Faqs.htm#NIH
14 Lenoir 1999.

NIH expresses no concern about the laws or sanctity of science. Instead, in the implementation of BIONET we learn that NIH resorted to outside contractors to run the enterprise as a for-profit initiative. If the laws of science don't exist, it appears that the Law of Capital does.

Although Lenoir never mentions ideology he informs us that control of data —the "reagents" of a data-bound science— was ruthlessly controlled through publishing mechanisms:

> "In order to doubly encourage molecular biologists to comply with the new procedure of submitting their data online, the major molecular biology journals agreed to require evidence that the data had been submitted before they would consider a manuscript for review."[15]

The NIH is the largest funder of biomedical research in the world.[16] The beneficence of an NIH grant can make or break a research lab. NIH expects that the results of the research it funds will be submitted publicly to online information sources. This requirement is enforced by the publishing agents. Since NIH places emphasis on publishing history when assessing grant applications, researchers are beholden to the publishers.

NIH wants to reduce researchers to the publications they produce. This situation is somehow reminiscent of Foucault's commentary in *Birth of the Clinic* that describes medical practice as reducing patients to merely a medical chart. The NIH, however, provides both a carrot and a stick in the form of enforced publishing control to ensure the compliance of researchers.

The role of the researcher has now been reduced to a flow of data for the NIH (albeit through privately

15 Ibid
16 See discussion in the Pew National Trust document: *Overview of National Funding for Biomedical Research*

controlled means). The NIH exerts extensive control over the production of this information (through privately controlled publishing), and *disciplines and punishes* researchers who fail to to conform with NIH expectations (by withholding capital).

Biomedicine may not actually exist as a science. It may be just an artifact created by the institution of Capital acting through the auspices of the NIH. As an artifact, the only law that exists is the law created by the institution. There are no external truths or underlying laws. Data and enforcement are all that ever existed.

And the winner is...

Conclusion

There are no underlying laws to biomedicine. Biomedicine is an institutional artifact that is in a state of constant change: new practices, new vocabulary, and new compliance mechanisms. Lenoir provides the story of an emerging science but leaves the moral to the reader.

My conclusion is this: ignorance of the laws of biomedicine poses no harm. The laws are nonexistent. The emergence of biomedicine as an information science is merely a new manifestation of the practices of the controlling institution.

The metamorphosis witnessed by Lenoir is that of a butterfly emerging from the its cocoon. The future is bright for biomedecine. As a data-bound science, researchers can use logic and computation to free man kind from all ills and ensure universal happiness. We have nothing to fear.

Unfortunately, this analysis seems too pat. I'm reminded of Nathaniel Hawthorne's warning: “Happiness is like a butterfly which, when pursued, is always beyond our grasp.” I won't forget about that big beetle just yet.