REVIEWS

Hine, Christine. 2008. *Systematics as Cyberscience*. 320 pp.

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This is a rich, dense book. Hines provides sensible analyses of the communications networks that unite systematics—the science devoted to understanding and standardizing descriptions of the relationships among living things—and systematists in the 21st century. This work will be useful for introducing graduate students to these aspects of modern systematics and to the sociology of this science.

Hines unpacks "cyberscience" as a ragtag collection of anything to do with computers. Multiple case studies of networks of participants, both individuals and institutions, in local and global contexts, allow Hines to examine many of these aspects of "cyberscience." She notes that the introduction of information and computing technologies (ICTs) to scientific endeavours is fraught with the rhetoric of technological determinism and progress. Hines cites previous studies to demonstrate that, while ICTs have often been credited with establishing new directions in science, detailed examinations of their impacts often fail to demonstrate influence, with results sometimes contradicting expectations (p. 20). She also looks at the influence of funding bodies in directing systematic research, suggesting that the "packaging" of projects as high-tech and unique has increased funding to some initiatives at the expense of other, perhaps more useful, projects using older technologies (pp. 25, 198). Hines discusses the tensions within the biological sciences regarding systematics as "service or science," that is, what its outputs should be, and whose interests it should serve (p. 214). She examines the "taxonomic impediment"—the ongoing problem of far more species and specimens than there are curators and other systematists to examine them—and its impact on prioritization of goals within systematic communities. She outlines the types of discussion groups and publications systematists use as sites of online communications, including the Taxacom listserv. Hines also discusses how systematists attempt to balance the quantity and quality of data they make available, and to whom, with the frequency of updates they provide. The material is well-researched and Hines clearly communicates the interests and issues at stake.

Given the range of meanings of "cyberscience" and the inclusive title of this work, it was not immediately obvious that Hines would focus her analysis of

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systematics almost exclusively on communications. While communication is very important, Hines could have made her arguments stronger by situating them more firmly in their historical context. For instance, though Hines mentions the importance for systematics of codified standards of nomenclature, formalized processes for the attribution of credit, and data acquired centuries ago, she seems surprised at the high level of awareness among systematists of the history of their own discipline (e.g. p. 230) The balance of mobilization of information with stability which Hines remarks upon (p. 244) is not new.[1] It would have been nice if she had explored in more depth the preadaptation of systematic communication to the computer age (though, admittedly, prior research in this area is sparse). As well, though problems of handling immense quantities of data have driven standardization and formalization of communications in many disciplines, Hines does not compare the situation in systematics to anything else. In fact, she often mentions concepts that have well-known names in other disciplines without using these names at all (e.g. "migration" of data, "union catalogue," "expert system," "undiscovered public knowledge" and even the systematic term "DNA barcoding"). Explicitly mentioning these familiar terms would have made the work more accessible to others who could benefit from her insights, particularly historians of science and information management professionals.

The greatest flaw in this work, however, is the lack of discussion of the workings of phylogenetic analysis algorithms. These algorithms have been a major source of debate in systematics since the middle of the 20th century, so the scant attention devoted to this topic (just 2 pages out of 261) is disappointing. Even though discussions of these issues among systematists tend to be highly polarized and rhetorical, the underlying scientific content is at the heart of this discipline. It should have been addressed, even if only by more references to existing literature. The concerns Hines mentions about the reification of faulty data as an ICT infrastructure problem would make more sense if they were explicitly discussed in the context of debates about character coding, homology, and the weighting of evidence. As things stand, Hines' arguments about why systematists choose one algorithm over another are not as robust as they should be.

Likewise her relatively uncritical use of hyperlink analysis to reveal "network structures" detracts from the quality of her other research. Although it can serve as a useful starting point, hyperlink analysis is a notoriously unreliable tool, to be used with caution.

The good points in this book, however, vastly outweigh its faults. Hines makes some of the most important points in this work in her discussion of

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[1] Müller-Wille, Staffan and Scharf, Sara. "Indexing Nature: Carl Linnaeus (1707-1778) and His Fact-Gathering Strategies." *Working paper in The Nature of Evidence: How Well Do 'Facts' Travel? London School of Economics and Political Science* (Submitted 2008).
(To appear on this page shortly: www.lse.ac.uk/collections/economicHistory/pdf/FACTSPDF/HowWellDoFactsTravelWP.htm)

miscommunications in systematics. She notes that systematists communicate among themselves quite well, making use of long-established formalities and "virtual colleges" based on common interests rather than geographical location (p. 42). "The virtual culture of systematics is," as Hines points out, "a relatively gentle reworking of old practices through new forms" (p. 146). Instead, the challenge for systematics is to find ways to make itself appealing to funding bodies not despite, but because of its long-term goals of assembling large quantities of high-quality, relatively stable information. Hines' descriptions of how systematics functions as a discipline should be of great interest to museums, governments, and other bodies that benefit from and fund systematic research. She emphasizes the disconnect between museum hiring practices, systematic output, funding, and what users want. She notes that what users want is often so poorly measured it is laughable (pp. 200-201, 240). A lack of incentives to use standardized data formats contributes to a waste of resources as different institutions focus on building their own information structures rather than integrating with the community at large (with some exceptions, primarily in the EU (p. 205)). Meanwhile, uncertain funding for long-term projects means that valuable specimens sit uncatalogued and legacy data goes unmigrated. Hines' work subtly suggests that, ultimately, an infrastructure is meaningless without contents. The way forward should be to invest in people rather than in faddish high-tech tools. After all, systematics does not get done without systematists.

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